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High sensitive voltametric nanosensors for determination of ascorbic acid in fruit and vegetable juice samples

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Abstract

Ascorbic acid or vitamin C is distributedwidely in both plant and animal kingdoms. In vegetable cells, it bound to protein as ascorbigen [1]. Among animal organs, the liver, leukocytes and anterior pituitary lobe show the highest concentrations of ascorbic acid. Vitamin C also is present in many other biological systems and multivitamin preparations, which are commonly used to supplement inadequate dietary intake [2]. In this work, production of NiO nanoparticles (NiO/NPs) by chemical precipitation is the approach utilized Nanopowders properties are identified by TG, FTIR, XRD, SEM, and TEM. The results obtained confirm the presence of nickel oxide nanopowders produced during chemical precipitation. In continuous, a novel NiO/NPs carbon paste electrode (NiO/NPs/CPE) had been fabricated. Electrochemical behavior of vitamin C at the NiO/NPs /CPE had been investigated in pH 7.0 phosphate buffer solution (PBS) by cyclic voltammetry (CV), chronoamperometry (CA) and differential pulse voltammetry (DPV). The experimental results suggested that the modified electrode exhibited an electrocatalytic activity toward the redox of vitamin C. Detection limit of vitamin C was found to be 0.05 µM. The proposed sensor was successfully applied for the determination of vitamin C in food samples.

Keywords: Food sample analysis, Voltammetry, Ascorbic acid

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Preparation and characterization of nickel oxide nanoparticels and its application to glucose and methanol sensing

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Abstract

Glucose detection is essential in clinical diagnostics, biotechnology and the food industry (1). Methanol, the simplest alcohol, has attracted considerable attention in the last decade due to its use in fuel cells (2). Even though enzymatic sensors show good sensitivity, such sensors suffer from the intrinsic nature of enzymes, which suffers from, long-term stability. To overcome this limitation, numerous non-enzymatic sensors based on metals and alloys were developed (3). On the way to maximize the anti-poisoning sensitivity of nonenzymatic electrochemical glucose and methanol sensor as well as achieve favorable selectivity, we propose here a porous interface fabricated by a facile but effective approach for glucose and methanol monitoring in alkaline media. In this study the porous Ni_xO film were successfully prepared by electrochemical deposition assisted with Cetyl trimethylammonium bromide (CTAB) as a soft template. Cyclic voltammetry and chronoamperometry were used to evaluate the catalytic activity of the nickel oxide nanoparticels modified electrode toward glucose and methanol detection. Cyclic voltammetric tests indicate that a diffusion-controlled glucose and methanol electro-oxidation reaction occurs at the modified electrode at around +0.5 V vs. Ag/AgCl in 0.3 M NaOH. As a matter of fact, we checked out the surface morphology of the Ni deposits after cyclic voltammetric treatments until stabilization of cyclic voltammetry curves in NaOH. Fig. 1 shows the surface morphology of the formed Ni deposits captured by SEM. It is visible that the catalyst is made of particels with nano size with large surface area. Under the optimal detection conditions the modified electrode exhibited good selectivity and sensitivity toward glucose and methanol. For glucose sensing, the electrode exhibited a linear relationship in the concentration range of 0.01-2.14 mM and a linear relationship in the concentration ranges of 1.50-38.57 mM

and 49.28-167.06 mM for methanol sensing. Moreover, the Cu- Ni_xO modified electrode was also relatively insensitive to commonly interfering species such as ascorbic acid, uric acid, and dopamine. Finally, the sensor was applied and checked in the glucose determination in blood serum samples. In summary, a cost-effective enzyme-free glucose and methanol sensor was successfully fabricated, which were based on a Ni_xO nanostructured system.

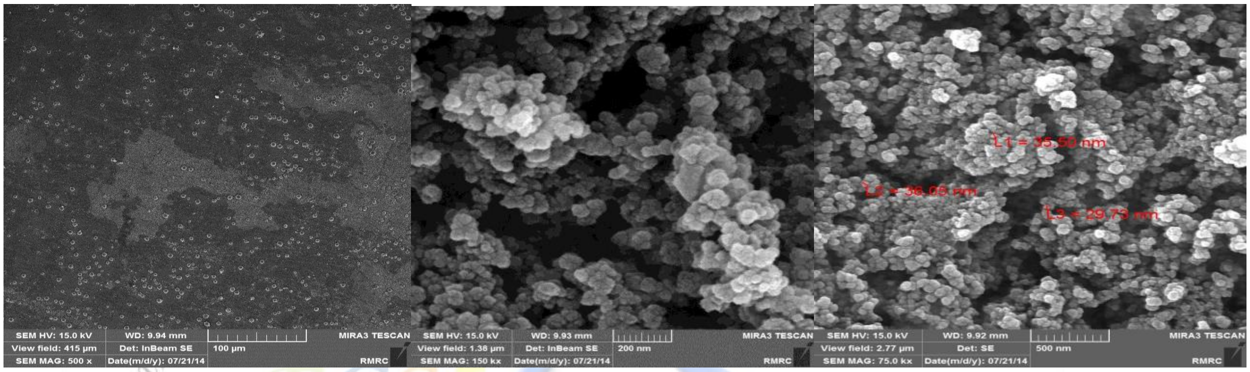

Fig 1. SEM images of Cu- Ni_xO modified electrode with different magnifications.

Keywords: Non-enzymatic sensor ,Glucose, Methanol, Ni_xO nanoparticels, Choronoamperometry, Cyclic voltammetry

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A Glucose And Methanol sensor Fabricated By Modified MWCNTs-paste Electrode With Nickel Nitroprusside And Then Nickel Oxide Nano Particles

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Abstract

Development of cheap, reliable, and fast sensors for glucose detection is important because it involved in many areas, including food industry, clinic diagnostics, and biotechnology (1). Electrochemical glucose sensors has been widely investigated for its simplicity, high reliability, sensitivity and low cost (2). Methanol is one of the most commonly used volatile organic solvents, especially in industry and laboratories. Developing a sensor that can evaluate the methanol concentration rapidly and reliably is necessary (3). In this paper, we report on a sensitive glucose and methanol sensor fabricated by MWCNTs-paste electrode modified with nano nickel nitroprusside and then nickel oxide nano particles. At first MWCNTs-paste electrode modified with nickel nitroprusside prepared by 10% of nano nickel nitroprusside powder, 90% MWCNTs and paraffin. Then the electrode was employed in a solution containing 0.6 M $NiSO_4$ And 0.02 M Cetyl trimethylammonium bromide (CTAB) as a soft template, then an electrodeposition process with a constant potential of –1 V was performed for 900 s. we tested the electrochemical behavior of the proposed electrode in alkaline media. Electrochemical experiments indicated that the modified MWCNTs-paste electrode with nickel nitroprusside and Ni_xO enhanced electron-transfer rate compared with only modified MWCNTs-paste electrode with Ni_xO. The determination of glucose concentration using the modified electrode was performed with chronoamperometry. Scanning electron microscopy (SEM) was utilized to observe the surface morphology of Ni_xO film. Fig. 1 shows the surface morphology of the Ni_xO film deposits captured by SEM. It is visible that porous structures is due to CTAB assistance in the solution. The sensor showed good selectivity to conventional intermediates such as Ascorbic acid, Uric acid and Dopamine and long term stability. Chronoamperometric results obtained under optimized conditions reveal that the proposed sensor exhibits desired poison resistance

ability in the presence of chloride ions and significant selectivity to glucose. The nonenzymatic glucose sensor based electrode was further used for the determination of glucose in human blood serum samples by chronoamperometry at the potential of 0.45 V. In summary, a new nonenzymatic glucose sensor based on MWCNTs/nano nickel nitroprusside-nano Ni_xO electrode was developed. The results of the experiments showed that the developed electrode displayed good reproducibility, high stability and satisfying accuracy for determining glucose and methanol.

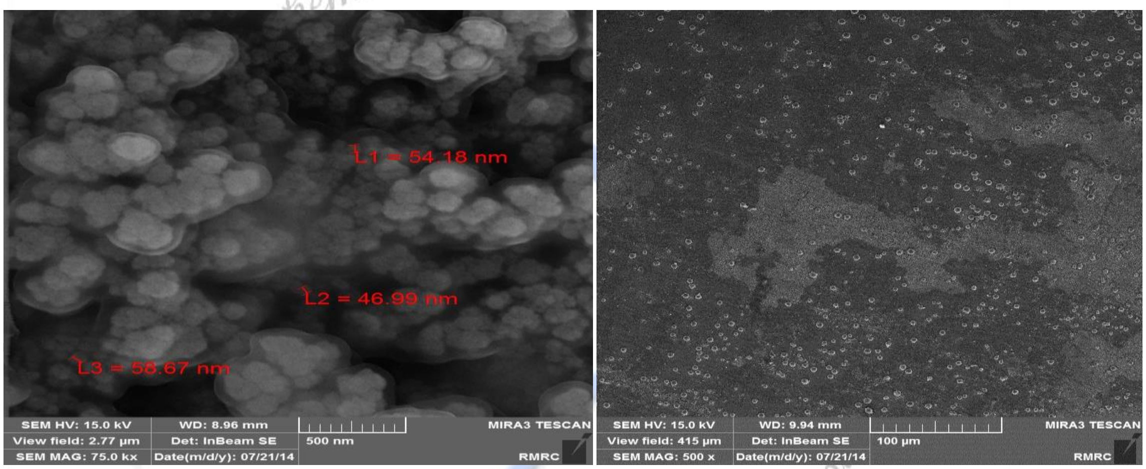

Fig. 1 SEM images with different magnifications of the modified MWCNTs-paste electrode with nickel nitroprusside and Ni_xO.

Keywords: Non-enzymatic sensor, MWCNTs , Nickel nitroprusside, Ni_xO *nanoparticels, Glucose, Methanol*

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Intraction of Furazolidone with DNA on a MVCNT-Ionic Liquid Modified Carbone Paste Electrode

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Abstract

In this study we describe the interaction of Furazolidone (Fu), an antimicrobial drug, with calf double-stranded DNA in solution on the multi-walled carbon nanotube and ionic liquid modified carbon paste electrode (MWCNT-IL-CPE) by using cyclic voltammetric. In the presence of DNA, the reduction peak current of Fu decreases and the peak potential shifts to a positive potential which indicates the interaction between Fu and DNA. The data confirmed that the interaction between Fu and DNA is intercalative mode. At the scan rate from 20-120 mV s^{-1}, the electrode process was controlled by adsorption. The electron transfer coefficient (α) and the heterogeneous rate constant (k_s) values were calculated according to Laviron's equation and the obtained values kept unchanged in the absence and presence of DNA. The binding constant K_a = 2.375×10^3 M^{-1} and Hill coefficient m=1.06 were obtained according to the cooperative Hill mode. This electrochemical method was applied to the determination of DNA. Under the optimum conditions, two linear calibration curves for DNA detection were obtained in the concentration ranges from 0.03-0.10 µg mL^{-1} and 0.30-4.00 µg mL^{-1} with the detection limit of 0.0272 µg mL^{-1}.The present method exhibited 95% recovery in calf blood serum. Therefore, the present method can be applicable for real sample analysis.

Keywords: "DNA","Furazolidone","IonicLiquid","MWCNT","CPE"

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A high sensitive biosensor based on using a ZnO/CNTs nanocomposite/catechol derivative modified electrode for simultaneous determination of glutathione and amoxicillin

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Abstract

Glutathione (as biological thiols), occur widely in living tissues. GSH is synthesized in two steps catalyzed by -glutamyl-cysteine (Glu-Cys) synthetase and GSH synthetase, and then degraded into cysteinyl-glycine (Cys-Gly) by -glutamyltranspeptidase [1]. Amoxicillin, D-α-amino-p-hydroxybenzylpenicillin trihydrate, is one of the most frequently used β-lactam antibiotics in the world and it is employed to treat humans and animals [2]. Amoxicillin or clavulanic acid and their combined administration effective on the biochemical liver parameters, reduced glutathione (GSH), and lipid peroxidation measured as hepatic malondialdehyde (MDA) levels. Therefore, simultaneous determination of these compounds is very important. In this study, we describe preparation of a modified electrode using novel catechol derivative and ZnO/CNTs nanocomposite as a sensor. The modified electrode exhibited a potent and persistent electron mediating behavior followed by well separated oxidation peaks of GSH and AMX. The peak currents were linearly dependent on GSH and AMX concentrations in the range of 0.002–720 and 1.0–950 μM, with detection limits of 0.0008 and 0.5 μM, respectively. The modified electrode was successfully used for the determination of the analytes in real samples with satisfactory results.

Keywords: Glutathione, Amoxicillin, Modified electrode,Voltammetry

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Sulfamethazine–DNA Interaction and Its Study by UV–Visible, Fluorescence Spectroscopies and Cyclic Voltammetry at the MWCNT-DNA-GCE

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Abstract

Sulfamethazine (SMZ), is a commonly used sulfonamide in veterinary medicine as an antibacterial compound to treat livestock diseases such as gastrointestinal and respiratory tract infections [1]. It has also been used in animal feeds to promote growth [2]. The usage of sulfonamides is regulated because of the concerns about its possible effect on human health. Sulfonamides mechanism of action is based on the inhibition of dihydropteroate synthetase. Resistance arises through multiple mutations in this gene [3]. Nucleic acids offer the analytical chemist a powerful tool in the recognition and monitoring of many important compounds [4]. Electrochemical investigation of DNA–drug interactions can provide a rapid and inexpensive method for the determination of drugs and biological molecules. Electrochemical DNA biosensors comprise a nucleic acid recognition layer that is immobilized over an electrochemical transducer. The role of the nucleic acid recognition layer is to detect the changes that occurred in the DNA structure during interaction with DNA-binding molecules [5]. So, in the recent years, growing interest has arisen in electrochemical investigations of interaction between nucleic acid binding molecules and DNA due to their promising functions and biological activities [6]. Carbon nanotubes are an interesting class of nonomaterial offering high electrical conductivity, high surface area, significant mechanical strength and good chemical stability. One of the most important characteristics of the electron mediators, which are used in modified electrodes, is lowering the overpotential required for electrochemical oxidation of the analyte and enhancement the sensitivity and of course selectivity of the response sensor [7].

In this work, the interaction of (SMZ) with double-stranded DNA was studied by cyclic voltammetry at MWCNT-DNA-GCE, photochemically-induced-fluorescence emission spectroscopy and UV-Vis spectroscopy. The presence of DNA results in a decrease of the

current and a negative shift of the electrode potential of the oxidation peak current of SMZ, indicating the electrostatic interaction. The corresponding heterogeneous rate constant (k_s) and the electron transfer coefficient (α) were calculated for the bound SMZ.DNA. The binding constant was determined from UV-Vis spectroscopy with a value quite close to that obtained from CV. Furthermore, the photochemically-induced- fluorescence emitted by the SMZ at 348 nm could be quenched in B-R buffer solution (pH=7, 0.04 M), 0.4 gr Na_2SO_3, by DNA increasing. The mechanism of photochemically-induced-fluorescence quenching was a static quenching and the binding constant and numbers of binding sites were obtained from the Stern-Volmer plot. The calibration curve was found to be linear between F_0/F and the concentration of DNA in the two dynamic ranges of 0.7-8.1 and 13.1-65.0 mg L^{-1} with the detection limit of 0.43 mg L^{-1}. The method was successfully applied to analyze DNA in the serum sample.

Keywords: Sulfamethazine, DNA, Multi-walled carbon nanotubes, photochemically-induced-fluorescence, Cyclic voltammetry

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Voltammetric Determination of Dopamine in presence of Uric acid Using a Silver Nanoparticles Modified Electrode

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Abstract

Dopamine (DA) and uric acid (UA) are important human body compounds that play determining role in metabolism [1], hence, monitoring their concentration in biologic fluids such as blood and urine may prevent and control many diseases. These are electrochemically active compounds that can be determined by different techniques. In recent years, the development of voltammetric methods for their determination in human body fluids such as urine and serum has received considerable interest. However, at bare electrodes DA and UA are oxidized at nearly the same potential, which result in overlapped voltammetric responses making their simultaneous discrimination highly difficult. Thus, it is essential to develop reliable methods with good sensitivity and selectivity for simultaneous determination of DA and UA in routine analysis. Among the methods, chemically modified electrodes (CMEs) with metal nanoparticles are becoming popular ways because of the characteristics such as easier fabrication process, more excellent electrochemical catalytic ability and physical stability [2]. *Nanoparticle modified electrodes* can also show an apparent *increase* in signal to noise ratio in electrochemical systems. Silver is a good substrate electrode for the preparation of modified electrodes.

In the present work, after the synthesis of the nanosized silver colloids by a chemical reduction process in aqueous solution in the presence of polyvinylpyrrolidone (PVP) as a stabilizing agent [3], a silver nanoparticle modified carbon paste electrode was prepared. The modified electrode was studied for the DA voltammetric responses in the presence of uric acid. The oxidative potentials of DA and UA could be separated by the modified electrode, thereby enabling the independent determination of DA in the presence of UA (Fig. 1). The modified electrode shows

an excellent electrocatalytic activity towards the oxidation of DA in 0.1 M phosphate buffer solution (pH 8.0) and the linear dynamic range of DA extends from 5×10^{-6} to 7×10^{-5} molL^{-1} and the sensitivity was 1.85×10^{8} µA $\text{M}^{-1}\text{cm}^{-2}$.

Keywords: *Dopamine*, *Uric acid, cyclic voltammetry*, *Modified electrode, Silver nanoparticle*.

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Electrocatalytic ability of porous Pt film on nanoporous stainless as a new catalyst for hydrogen production reaction

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Abstract

The energy consumption of the world is mainly delivered by fossil fuels which cause many problems such as greenhouse effect and environmental pollution. Hydrogen is widely considered to be the cleanest energy source whose product is only water when it burns. It has a high combustion value per mass (287 kJ/mole) and thus a minimal impact on environment [1, 2]. Among noble metals, platinum (Pt) is regarded as an ideal catalyst for electrochemical production of hydrogen due to its best catalytic activity and the high corrosion resistance in acidic media [3].

In this research, Pt coated nanoporous stainless steel (Pt-NPSS) is fabricated as a catalyst for hydrogen production. The NPSS is prepared by anodization of the Stainless Steel substrate under high potential (35 V) in the ethyleneglycol electrolyte containing 5 vol.% $HClO_4$. Then the NPSS substrate is used for the preparation of Pt/NPSS by pulsed electrodeposition of Cu and followed galvanic replacement reaction of deposited Cu with K_2PtCl_6 solution. The as-prepared electrode was characterized by using the techniques of scanning electron microscopy (SEM), atomic force microscopy (AFM) and energy dispersive X-ray spectroscopy (EDS). The result of HER at Pt/NPSS is studied by cyclic voltammetry (CV) and chronoamperometry (CA) techniques in the acidic media. The effects of important parameters for fabrication of electrode for hydrogen evolution reaction were comparatively investigated.

Keywords: *Nanoporous stainless steel, Electrodeposition, Galvanic replacement, Hydrogen Production*

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Preparation of modified carbon paste electrode with multi-walled carbon nanotubes and its application for determination of cefixime

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Abstract

Cefixime is an orally third generation cephalosporin antibiotics (1). It is used for the treatment of bacterial infections, including otitis media, respiratory-tract and urinary-tract infections (2). It is reported to be determined cefixime in body fluids through many methods such as, spectrophotometry (3), HPLC (4), and voltammetry (5). Regarding the significance of determination of Cefixime and its slow oxidation at the surface of bare electrodes, in this work, we aim to use modified carbon paste electrode with multi-walled carbon nanotubes (CPE/MWCNTs) to improve electrocatalytic oxidation of cefixime. To achieve this goal, at first prepared modified carbon paste electrode with multi-walled carbon nanotubes (CPE/MWCNTs), and then, we investigated the voltammetric response of the modified electrode at potential range 0.2 to 1.2 V in the presence of cefixime. Then, the optimum conditions such as the ratio of MWCNTs to graphite, pH, etc., were widely evaluated. Cyclic voltammetry and chronoamperometry were used to investigate electrochemical behavior of (CPE/MWCNTs) in the absence and the presence of cefixime.

Finally, cefixime was determined in the linear range of 1.00×10^{-6} to 1.20×10^{-2} M with the low detection limit. According to the observations, the current of anodic peak increased in the presence of cefixime, and potential of anodic peak was appeared in less potential. The results confirmed the electrocatalytic oxidation of cefixime at the surface of (CPE/MWCNTs).

Keywords: Cefixime, Multi-Walled Carbon Nanotubes, Electrocatalytic Oxidation, Cyclic Voltammetry, Chronoamperometry

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Non-enzymatic Electrochemical Detection of Superoxide anion Based on Gold Nanoparticles

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Abstract

Over the past few decades, researchers interested in enzyme mimetic compounds as highly stable and low-cost alternatives to the natural enzymes in a wide range of applications [1]. Recently, some nanomaterials have been found to exhibit enzyme mimetic activities, and great advances have been made to use them in fabrication electrochemical sensors [2]. This research describes the detection of superoxide anion by immobilized gold nanoparticles (AuNPs) on 1,6-hexanedithiol (HDT) modified Au electrode. HDT forms a monolayer on Au surface through one of the two SH groups and the other SH group is covalently attach colloidal AuNPs [3]. The electron transfer reaction of $[Fe(CN)6]^{4-/3-}$ was hindered at Au/HDT electrode while it was restored after the immobilization of AuNPs on Au/HDT (Au/HDT/AuNPs) electrode. So, it can indicate a good electronic communication between the immobilized AuNPs and the Au electrode through a HDT monolayer. The amperometric response of superoxide anion on Au/HDT/AuNPs electrode in potential 250 mV (vs. Ag/AgCl) and pH 7.4 phosphate buffer 0.1 M was monitored. The linear detection range and detection limit of superoxide anion were from 5 to 216 and 1.5 µM respectively. The sensitivity of this superoxide sensor was 0.017 (nA/µM).

Keywords: *Superoxide anion, Sensor, Gold nanoparticles, Hexanedithiol*

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Fabrication and electrochemical characterization of hybrid nanostructures as photoanode in dye sensitized solar cell

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Abstract

In recent researches, fabrication of the binary semiconductor nanostructures as photoanode for application in Dye Sensitized Solar Cell (DSSC) has been greatly investigated and much effort has been made to improve their performance [1]. Among metal oxide semiconductors, TiO_2 and ZnO are important candidates and mostly used in this field. Despite their unique properties [2, 3], there are some disadvantages such as recombination reactions which reduce their performance in DSSCs [4]. Also, in ZnO nanostructure system, the rate constant for electron injection of dye (N719) into ZnO is slower in compare to TiO_2 [5]. In addition, it is chemically unstable and is easily dissolved in the acidic and basic solutions. So, these parameters decrease the performance of ZnO based DSSCs. Consequently, fabrication a binary semiconductor nanostructure such as ZnO/TiO_2 can provide their especial characteristics as well as reduce their disadvantages and improve the performance of DSSCs.

In this research ZnO/TiO_2 nanolayer thin films were fabricated by electrochemical deposition and Dr. Blade technique for application in dye-sensitized solar cells (DSCCs). The effect of thickness and ZnO morphology as a function of electrodeposition time was investigated for achieving the best result. During electrochemical deposition, bath condition along with the effect of polyvinyl alcohol (PVA) to control the morphology of ZnO depositions was investigated [6]. Since deposition time has a key role in ZnO thickness, various deposition times carried out to achieve the optimum performance in DSSCs where the best result obtained at 5 min deposition.

For studying structure and morphology of ZnO layer, field emission scanning electron microscopy (FE-SEM) was carried out. Electrochemical impedance spectroscopy (EIS) was

employed to determine the equivalent circuit for comparing the charge recombination behavior of cells in different electrodeposition condition. While the charge recombination optimum value indicating the ZnO/TiO_2 nanoparticle hybrid film can be considered a superior material to TiO_2 nanoparticle in many respects.

Keywords: *ZnO/TiO_2 hybrid photoanode*, *Dye sensitized solar cell*, *electrochemical impedance spectroscopy*.

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Electrochemical characterization of new dye sensitized solar cell fabricated by sonochemical synthesized ZnO nanoparticles

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Abstract

Recently, synthesis of nanostructured compounds with various techniques has extensively fascinated a great deal of attention in scientific researchers. Among the variety of approaches, sonochemical methods have been extensively examined in this field [1], whereas sonochemical method is utilized as routine methods in synthesis of variety nanostructured material [2]. Among various nanomaterials, zinc oxide nanostructures with wide band gap (3.37 eV) have drawn considerable interest as a good candidate for solar cell applications [3, 4].

In this study a new type of ZnO based DSSC was fabricated using sonochemical synthesis of ZnO nanoparticles. Nano-sized ZnO supramolecular compound prepared by a self-assembling system containing pyridine ligand in both water and methanol solvents. *For revealing the structure and morphology of ZnO, field emission scanning electron microscopy (FE-SEM), FTIR spectroscopy and* thermal gravimetric analysis (TGA) *were carried out. Finally,* ZnO *DSSC was fabricated using N719 Ruthenium dye and all photovoltaic* such as short circuit current density (J_{SC}), open circuit voltage (V_{OC}), fill factor (FF) and conversion efficiency (η) were measured as well. *The electrochemical impedance spectroscopy was employed to study the properties of ZnO/electrolyte interfaces [5]. An appropriate circuit equivalent was considered for obtaining* the electron lifetime, charge transfer and transport resistances values to exhibit the performance of the new ZnO photoanode. The results demonstrated the overall efficiency about 1.3% for cell performance.

Keywords: *ZnO photoanode; Dye sensitized solar cell*, *Sonochemical synthesis*, *Electrochemical impedance spectroscopy*.

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Methyldopa selective liquid membrane graphite electrode based on surface imprinted carbon nanotubes

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Abstract

A new polyvinylcholoride (PVC) liquid membrane electrode for the determination of methyldopa has been developed based on carbon nanotubes modified using surface imprinting technique as novel ionophore and dibutylphthalate as plasticizer. The electrode exhibits a near Nernstian slope of 58 mV decade^{-1} in a concentration range of 1.0×10^{-8} to 1.0×10^{-2}M. It has a fast response time (<16 s) and can be used for a period of 50 days without any divergence in potentials. The proposed electrode reveals a good selectivity for methyldopa over a wide variety of other tested cations and could be used in the pH range 4.0 – 10.0.

Keywords: methyldopa; Potentiometry; carbon nanotube (CNT); surface imprinting; ion selective electrode

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Application of ion selective electrode based on surface imprinted carbon nanotubes for the determination of methyldopa in pharmaceutical samples

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Abstract

Methyldopa is used to treat high blood pressure. Methyldopa is in a class of medications called antihypertensive. It works by relaxing the blood vessels so that blood can flow more easily through the body. Methyldopa may cause various side effects. In this work, a new polyvinylcholoride (PVC) liquid membrane electrode for the determination of methyldopa has been developed based on modified carbon nanotubes using surface imprinting technique as ionophore and dibutylphathalate as plasticizer. The proposed electrode was used as indicator electrode for the determination of methyldopa in real samples such as tablets. The obtained results showed good agreement with data from high performance liquid chromatography.

Keywords: Methyldopa; Carbon nanotubes, liquid membrane; pharmaceutical samples.

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Selective Determination of Arsenic (III) Using Anodic Stripping Voltammetry after Electromembrane Extraction

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Abstract

As one of the major environmental pollutants, arsenic exists in four different oxidation states, −3, 0, +3, and +5, and As(III) is the most toxic [1]. The World Health Organization limits the arsenic level in drinking water to be below 10 μg L^{-1}. Various methods have been developed for the detection of trace arsenic, including inductively coupled plasma-mass spectrometry (ICP-MS) [2], graphite furnace atomic absorption spectrometry [3],surface plasmon resonance (SPR) sensor [4] and high-performanceliquid chromatography with ICP-MS detection [5].

In this study for the first time Electromembrane extraction (EME) was used as a sample pre-treatment method for the determination of Arsenic (III) in aqueous samples using Anodic stripping Voltammetry.

A short segment of porous polypropylene hollow fiber was penetrated with 1-octanol and 0.5%v/v bis(2-ethylhexyl) phosphonic acid, which selectively transported and pre-concentrated Arsenic (III) into the fiber lumen filled with 20 µL of a 100 mM sodium hydroxide solution as acceptor solution. Donor solutions were standard solutions and real samples dissolved in deionized water at neutral pH. Before running the electrochemical detection 10 µL of a 1.0 M hydrochloric acid solution was added to the acceptor solution and the mixture was analyzed using Anodic Stripping Voltammetry.

At optimized EME conditions (penetration time, 10 s; applied voltage, 70 V; and stirring rate, 750 rpm), 63% recovery of Arsenic (III) was achieved for a 10 min extraction time and a limit of detection of 0.1µg.L^{-1} was obtained. The developed EME sample pre-treatment procedure was successfully applied to the analysis of Arsenic (III) in tap water and natural waters.

Keywords: *Arsenic (III), Electromembrane extraction, Modified electrode, Anodic Stripping Voltammetry*

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Conductivity of graphene sheets derived from graphite oxides with different oxidation degree

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Abstract

Excellent electrical properties of graphene are raised from a π-network extended over the whole sheet of the graphene. Functionalization of graphene is essential to interface it with other moieties to expand the scope of its electrical/electronic applications. However, chemical functionalization and/or molecular interactions on graphene change its electrical properties. Oxidizing the graphene interrupts the π –network, which may change the electrical conductivity (π) and permittivity (π) of the graphene. In this study several kinds of polar groups such as hydroxyl, epoxy and alkoxy groups as well as carbonyl groups was generated on the surface of graphite oxide and evaluated their electrical properties. To evaluate the electrical properties of various kinds of graphite oxide, the electrical conductivity and permitivity of the samples were measured using two-probe technique. To investigate their effects concurrently, the characteristic charge relaxation time $\tau_C = \varepsilon / (4\pi\sigma_e)$ was used. The electrical conductivity and permittivity of graphite oxide decreases as the oxidation level of graphite is increased. However, charge relaxation time increased with oxidation level.

Keywords: *Electrical properties, Graphene, Oxidation degree, Conductivity*

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Electrocatalytic determination of L-Cysteine using a nanostructure based electrochemical sensor

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Abstract

L-cysteine is a proteinogenic amino acid contributing to building protein and includes the element sulphur. It can be synthesized in the human liver and is therefore not an essential amino acid [1]. L-Cys is built directly from the essential amino acid L-Methionin making its abundance in the body a critical factor to the body's supply of L-cysteine. Other roles are the detoxification of the body's excess sulphuric acid and the protection of cells of free radicals with its strong antioxidant properties. L-Cys can also contribute to building Glutathione the body's main antioxidant when combined with Glycine and Glutamic acid. The presence study describes the development a novel modified carbon paste electrode for the electrocatalytic determination of L-cysteine (L-Cys). For this goal we used 8,9-dihydroxy-7-methyl-12H-benzothiazolo [2,3-b]quinazolin-12-one and ZnO nanoparticle for modification of electrode. ZnO/NPs characterize with X-ray diffraction (XRD) method. The modified electrode was used as a high sensitive and selective voltammetric sensor for determination of L-Cys in real samples. The mediated oxidation of L-Cys at the modified electrode was investigated by cyclic voltammetry, chronoamperometry, and square wave voltammetry (SWV) methods. Also, the values of catalytic rate constant (k) and diffusion coefficient (D) for Cys were calculated. Square wave voltammetry of L-Cys at the modified electrode exhibited linear dynamic range with a detection limit (3σ) of 0.05 μmol/L.

Keywords: L-cysteine analysis, Voltammetry, ZnO nanoparticle

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The effect of CdO/CNTs nanocomposite size on charge transfer resistance at electrochemical systems

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Abstract

Nanoscience and nanotechnology represent new and enabling platforms that promise to provide a broad range of novel uses and improved technologies for environmental, biological and other scientific applications [1]. Materials in the nanoscale such as graphene, nanoparticles, carbon nanotubes and nanocomposite are being used for several analytical and bioanalytical applications [2].

In this paper we describe synthesis of CdO/CNTs nanocomposite using chemical precipitation method in different conditions. The CdO/CNTs nanocomposites were characterized with different methods such as TEM, SEM and XRD. In continuous, the effect of CdO/CNTs nanocomposite particles size on charge transfer resistance (R_{ct}) investigated using electrochemical impedance spectroscopy method in the presence of 1 mM $K_4[Fe(CN)_6]$. Results shows, reduction in nanoparticle size can be improve electrical conductivity electrode and decrease charge transfer resistance in the presence of 1 mM $K_4[Fe(CN)_6]$. This condition suggests application of this nanocomposite as modifier in preparation electrochemical sensor for drug or environmental samples analysis.

Keywords: CdO/CNTs nanocomposite, Electrochemical impedance spectroscopy, Synthesis

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Ionic liquid modified ZnO/CNTs nanocomposite carbon paste electrode as a high sensitive voltammetric sensor for determination of Carbidopa

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Abstract

the catecholamines are a group of compounds bearing a dihydroxyphenyl moiety known as main neurotransmitters, and have been employed as markers of neuroblastoma, stress condition and other autonomic nervous system disorders [1]. Carbidopa is one of the important catecholamine and it is used in the treatment of Parkinson's disease. Carbidopa inhibits aromatic-L-amino-acid decarboxylase (DOPA decarboxylase or DDC), an important enzyme in the biosynthesis of L-tryptophan to serotonin and in the biosynthesis of L-DOPA to dopamine (DA).

Electrochemical behaviors of carbidopa (CD) at the surface of the carbon paste electrode modified with an ionic liquid and ZnO/CNTs nanocomposite were studied. The oxidation peak potential of the CD at a surface of the modified electrode appeared at 580 mV that was about 80 mV lower than the oxidation peak potential at the surface of the traditional carbon paste electrode (CPE) under similar condition. On other hand, the oxidation peak current was increased for about 3.5 times at the surface of modified electrode compared to CPE. The linear response range and detection limit were found to be 0.09–450 μmol L^{-1} and 0.06 μmol L, respectively. Another physiological species did not interfere for determination of CD at a surface of propose sensor in the optimum condition. The proposed sensor was successfully applied for the determination of CD in real samples such as human urine and serum.

Keywords: ZnO/CNTs nanocomposite, Electrochemical impedance spectroscopy, Carbidopa analysis

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Assessment of Rubus caesius extracts by GC/MS and its antioxidant capacity by carbon nanotube modified electrode

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Abstract

Electrochemical techniques are relatively more comprehensive and sensitive than spectroscopic methods for the evaluation of antioxidant capability in medicinal plants. The carbon nanotubes represent a type of carbon based nanostructures that have large surface area, high catalytic capability and fast electron transfer rate. Such properties of carbon nanotubes make them extremely attractive for use in electrochemical application [1]. The chemical composition and antioxidant properties of the leaf extracts of Rubus caesius were determined by gas chromatography coupled with mass spectrometry (GC/MS) and cyclic voltammetry, respectively.

Leaves of R.caesius were collected from Jirandeh (Iran) and were identified in University of Tehran. The powdered leaves of the plant (5 g) were macerated in 100 mL EtOH (96%), EtOH-H2O (80:20), MeOH, EtOAC and CH_2Cl_2 for 48 h. The analysis were carried out by GC/MS model Agilent triple quad, equipped with a HP-5 MS column. Voltammetric experiments were performed by the EmStat1 potentiostat/galvanostat equipped with the PSTrace 4.0 software. The utilized electrodes were glassy carbon (GC) and multi-walled carbon nanotubes modified glassy carbon (MWCNTs/GC) electrodes as the working electrode, a platinum wire as auxiliary electrode and Ag/AgCl (KCl, 3 M) as reference electrode. For preparation of MWCNTs modified electrode mixture of 1 mg MWCNTs, 7.6 mg N-Butylpyridinium hexafluorophosphate and 0.5 mL of N,N- dimethyl formamide was dispersed in 0.5 mL of acetonitrile and

ultrasonicated for 2 min to obtain a relative stable suspension. The electrode was coated with 6 µL of the resulting suspension and allowed to evaporate solvent.

According to the results of GC/MS 15 compounds were detected in leaf extracts of R. caesius. The cyclic voltammograms for R.caesius leaf extracted with EtOH-H_2O, EtOH and MeOH shows one anodic peak at forward scan and one cathodic peak at reversed scan but no anodic and cathodic peak was observed for extracts of EtOAC and CH_2Cl_2. In fact, due to the low polarity of these solvents, the amount of antioxidant compounds extracted from R.caesius leaf is low.

Part (A) of Figure 1 shows two anodic (A_1,A_2) and corresponding cathodic peaks (C_1,C_2). The first redox peaks (A_1/C_1) is related to compounds which also oxidized on the bare GC electrode. Second peaks (A_2/C_2) is related to compounds which cannot oxidize on the GC but due to nanotubes electrocatalysis property oxidized them on the MWNTs modified electrode. Part (B) of Figure 1 were compared the voltammograms of methanolic extract of R.caesius at a bare GC and MWCNTs electrodes. The peak was sharper and the peak current increased significantly on the MWCNTs modified electrode as compared with the bare electrode. The electrode surface modification with MWCNTs augmented its effective surface area and the oxidation currents of antioxidants [2]. Due to the electrocatalytic properties and relatively large surface area of carbon nanotubes, their application in voltammetric measurements improves the analysis of many parameters such as sensitivity, detection limit and response times.

Keywords: Carbon nanotubes, Antioxidant capacity, Electrochemistry, Rubus caesius

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Pulsed Electrodeposition of Phosphonium-based Ionic Liquid Supported/MWCNT Platinum Nanocomposite On FDTO as a Highly Efficient Nanoelectrocatalyst

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Abstract

As a highly efficient nanoelectrocatalyst, Platinum-based nanocomposite can be electrosynthesized using Multi-Walled Carbon Nanotube (MWCNTs) in the presence of phosphonium-based ionic liquid (Trihexyl Tetradecyl-phosphonium bis (trifluoromethylsulfonyl) amide. Applying optimized appropriate reducing potential or differential current pulses in the quaternary phosphonium ionic liquid and functionalizer MWCNTs, noble metal nanocomposite of Pt are electrodeposited on Fluorine Doped Tin Oxide plates, as a conductive substrate. In order to achieve size monodispersity instantaneous nucleation is essential, and 3D growth is preferable to produce high surface area deposits.

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Simultaneous determination of hydrazine using a nanostructure based electrochemical sensor

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Abstract

Hydrazine has been recognized as a neurotoxin, carcinogenic mutagenic and hepatotoxic substance, which has adverse health effects such as liver, brain, DNA damage, creation of blood abnormalities, and irreversible deterioration of the nervous system. Moreover, hydrazine and its derivatives have been reported as environmental pollutants by Environmental Protection Agency (EPA) and the maximum recommended value of hydrazine in effluents is set to 1ppm [1]. Carbon paste electrode (CPE) is a special kind of heterogeneous carbon electrode consisting of mixture prepared from carbon powder (as graphite, glassy carbon and others carbonaceous materials) and a suitable water-immiscible or non-conducting binder. the feasibility of incorporation different substances during the paste preparation (which resulting in the so-called modified carbon paste electrode), allow the fabrication of electrodes with desired composition, and hence, with pre-determined properties [2]. The modification of the surface of electrodes by nanoparticles has long been a significant area of the theoretical and applied researches. The unique properties of nanoparticulate materials (e.g. enhanced mass transport, high surface area, improved signal-to-noise ratio) can often be advantageous in electroanalytical techniques. It is because of dependence of the electrochemical heterogeneous procedures on the properties of electrode surfaces, adsorption and diffusion mechanisms, and coatings applied on the electrode surface [3].

In the present work, the electro-oxidation of hydrazine at the surface of a modified carbon paste electrode was studied using electrochemical approaches. Under the optimized conditions, the square wave voltammetric peak current of hydrazine increased linearly with hydrazine concentrations in the range of 2.2×10^{-7} to 3.0×10^{-4} M and a detection limit of 9.8×10^{-8} M was obtained for hydrazine. Finally this modified electrode was used for determination of hydrazine in some water samples.

Keywords: Hydrazine, Voltammetry, Modified electrodes, Nanoparticles

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Biosynthesis of Ag nanoparticle using seed extract of chaerophyllum macrospermum and effect of it in reduction of electron charge transfer resistance

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Abstract

Nanomaterials are at the leading edge of the rapidly developing field of nanotechnology. The development of reliable experimental protocols for the synthesis of nanomaterials over a range of chemical compositions, sizes, and high monodispersity is one of the challenging issues in current nanotechnology. [1]. Silver nanoparticles have unique optical, electrical, and thermal properties and are being incorporated into products that range from photovoltaics to biological and chemical sensors [2]. In this study, the biological synthesis of Ag nanoparticles (AgNPs) using seed extract of chaerophyllum macrospermum as reducing agent is reported. The nanoparticles obtained are characterized by UV–Vis spectroscopy, transmission electron microscopy (TEM) and X-ray diffraction (XRD) analysis. In continuous, the effect of AgNPs particles size on charge transfer resistance (R_{ct}) investigated using electrochemical impedance spectroscopy method in the presence of 1 mM $K_4[Fe(CN)_6]$. Results shows, reduction in nanoparticle size can be improve electrical conductivity electrode and decrease charge transfer resistance in the presence of 1 mM $K_4[Fe(CN)_6]$. This condition suggests application of this nanoparticle as modifier in preparation electrochemical sensor for drug or environmental samples analysis.

Keywords: *Ag nanoparticles, Biosynthesis, Electron charge transfer resistance*

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Electrochemical behavior of modification Au electrode with AuNPs, Polypyrole/ L-cystein/ Fe3O4@SiO2@NH2 structured for determination Oxytocin and Epinephrine in human blood serum sample.

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Abstract

In this study, a novel sensitive sensor is designed based on the Au/ AuNPs, Polypyrole/ L-cystein/ Fe3O4@SiO2@NH2 nano structure for monitoring of Oxytocin and Epinephrin (Adernalin) in human blood serum sample. Cyclic and square wave voltametry, Impedance spectroscopy and Scaning Electron Microscopy techniques are used to identify and verify the electrochemical behavior and characterization of the new modified electrode. The proposed sensor has good sensitivity, selectivity, stability and long-term maintenance of electro activity and is used for application in Oxytocin and Epinephrine determination in biological fluids without any side interferences effects.

Keywords: Cyclic and square wave voltametry, Impedance spectroscopy, Scaning Electron Microscopy, Oxytocin, Epinephrine, Modified electrodes

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Voltammetric Determination of Hydrazine using a Carbone Paste Electrode Modified with Zirconium Oxide Nanoparticles

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Abstract

Hydrazine (HZ) and its derivatives are widely used in agricultural chemicals (pesticides), chemical blowing agents, pharmaceutical intermediates, photography chemicals, and boiler water treatment in hot-water heating systems for corrosion control. It is also employed as a starting material for many derivatives such as foaming agents for plastics, antioxidants, polymers, and plant-growth regulators. Moreover, HZ, its salts, and its methyl and dimethyl derivatives are used as rocket fuel, gas generators, and explosives. HZ and its derivatives are industrial chemicals that enter the environment primarily by emissions from their uses as aerospace fuels and from industrial facilities that manufacture, process, or use these chemicals. HZ is volatile and toxic and is readily absorbed by oral, dermal, or inhalation routes of exposure. Acute exposure can also damage the liver, kidneys, and central nervous system in humans. The carcinogenic risks to humans of HZ and its derivatives have been considered on a number of occasions by the International Agency for Research on Cancer of the World Health Organization. The Environmental Protection Agency (EPA) has classified HZ as a group B_2 (human carcinogen) [1].

Nanotechnology represents a rather broad interdisciplinary field of research and industrial activity involving particles less than 100 nanometers (nm) in diameter. Engineered materials made of such small particles exhibit novel properties that are distinctively different from their conventional forms and can affect their physical, chemical, and biological behavior. These nano-

scale particles can be tubular (nanotubes), spherical, irregularly shaped, and may also exist in aggregated formations. Future applications of NPs show promise in advancing the fields of medical treatment (gene therapy and targeted drug delivery), semiconductors, environmental remediation technology and electroanalysis [2].

In the present work, the electro-oxidation of hydrazine at the surface of a modified carbon paste electrode was studied using electrochemical approaches. Under the optimized conditions, the square wave voltammetric peak current of hydrazine increased linearly with hydrazine concentrations. Finally this modified electrode was used for determination of hydrazine in some water samples.

Keywords: Hydrazine, Modified electrodes, ZrO_2 Nanoparticles

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Modification of pencil graphite electrode surface by polypyrrole/functionalize multiwall carbon nanotubes; Application for the preparation of DNA biosensor for 6-mercatopurine anticancer drug detection

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Abstract

Mercaptopurine inhibits the biosynthesis of adenine nucleotides by acting as an antimetabolite. In the human body, 6-MP is converted to the corresponding ribonucleotide that is a potent inhibitor of the conversion of a compound called inosinic acid to adenine. 6-MP as a thiopurine category was used to treat leukemia [1]. A novel and high sensitive biosensor employing immobilized DNA on a nano-structured conductive polymer/multiwall carbon nanotubes fixed onto a pencil graphite electrode (PP/MWCNTs/PGE) is presented. In the first step, we modified pencil graphite surface electrode with Polypyrrole and functionalize multiwall carbon nanotubes (MWCNT/COOH) and characterize electrode by scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), IR spectroscopy, X-ray photoelectron spectroscopy (XPS) and electrochemical impedance spectroscopy (EIS) methods. In the second step, we used decreasing of the oxidation signals of guanine and adenine as a sign for study interaction of 6-mercaptopurine (6-MP) with salmon sperm double-stranded DNA (ds-DNA) using differential pulse voltammetry (DPV). Under the optimum conditions, a linear dependence of the guanine oxidation signal was observed to the 6-MP concentration in the range of 0.2–100 μmol L_{-1} with a detection limit of 0.08 μmol L_{-1}. The modified electrode was successfully used for the determination of 6-MP in real samples with satisfactory results.

Keywords: 6-Mercaptopurine detection, DNA biosensor, Surface modification, Polypyrrole, Multiwall carbon nanotubes

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Electrochemical oxidation of catechols in the presence of the cycloheptylamine and cyclopropylamine

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Abstract

A vast number of quinones with great structural divergence are provided by nature and play a major role in the redox electron-transport chains of living system [1-3]. More complex quinonoic compounds are used extensively in medicine, especially as anticancer agents, and their activity stems from their special ability to undergo one-electron transfer reaction to form reactive radicals [4,5]. The electrochemical synthesis of catechols has been studied in the presence cycloheptylamine and cyclopropylamine as a nucleophile, using cyclic voltammetry. During recent years a number of methods have been developed to propose the mechanism of reaction between quinones and some nucleophiles, and many quinones been synthesized [6] . As part of our ongoing program to investigate the electrochemical behavior of catechols with nitrogen nucleophiles [7] because of importance of aminoquinones as biologically active compounds.

Keywords: *Cyclic voltammetry. Electrochemical synthesis. Catechol. Cycloheptylamine. Cyclopropylamine. aminoquinones*

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Electrochemical Oxidation of 2,2'-Biphenol In The Presence of Arilsulfinic Acids

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Abstract

Electrochemical methods are widely used for the study of electroactive compounds in pharmaceutical forms and physiological fluids due to their simple, rapid, and economical properties [1]. Unique selectivity because of in situ formation of an active species at the interface, inversion in polarity by transfer of electron and variability in product formation by control of potential are some of advantage of electrosynthesis. Michael addition reaction, as a one of the effective organic reaction, has been shown its importance during last years. Electrochemical oxidation of 2,2'-biphenol has been studied in the presence of arilsulfinic acids as nucleophile using cyclic voltammetry and controlled-potential coulometry methods.

Keywords: 2,2'-Biphenol, Arilsulfinic acids, Oxidation, Electrosynthesis

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Electrochemical study of thiourea adsorption on gold electrode surface

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Abstract

Organic additives are often used in electroplating bath to improve the appearance and the properties of the deposits and / or to improve the performance of the plating bath. Thiourea is one of the most highly used organic additives, due to its ability to refine the grain size [1]. The interest of the electrochemical study of thiourea (TU) is mainly related to certain chemical characteristics, which provide different possibilities of application. TU is an appropriate inhibitor of the metallic corrosion and it is also widely used as an additive in electrochemical processes like electroplating and electrolytic refining, owing to its strong adsorption and the consequent influence on the interfacial characteristics [2,3].

It has been found that TU can adsorb to the metal surface via S atom and blocking active sites or promoting a local nucleation [4]. Because of this wide application of TU in electrochemical industries, in this work we tried to make an electrochemical study on TU adsorption on gold surface. For this purpose we used cyclic voltammetry and EIS techniques for description of electrochemical behavior of TU on gold electrode surface and the results were explained.

Keywords: Thiourea, Electrochemical behavior, Gold surface, Electro-oxidation, Adsorption

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A Novel Uric Acid Biosensor Fabricated By Modified Potassium Ferricyanide And Strontium Oxalate MWCNTs-paste Electrode

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Abstract

Uric Acid (UA), the primary product of purine metabolism in the human body is normally present in the milli molar range in urine and in micro molar levels in serum. Abnormal levels of UA are symptom of several diseases such as gout, hyperuricaemia and Lesch-Nyhan syndrome (1). Therefore, the measurement of UA is very important in the food, biochemical and clinical diagnosis (2). Various methods have been developed for the simultaneous determination of UA such as surface plasmon resonance and capillary electrophoresis. Among these methods, the electrochemical methods offers advantages including simplicity, speed and sensitivity (3). Considering the facts described above, the present work describes the preparation and application of a a novel uric acid biosensor fabricated by modified potassium ferricyanide and strontium oxalate MWCNTs-paste electrode. Paste electrode prepared by 80% MWCNTs, 10% potassium ferricyanide, 10% strontium oxalate sediment and paraffin. The modified electrode showed excellent electrocatalytic activity for UA determination in 0.1 M phosphoric acid pH=7 solution. Electro-catalytic oxidation of the modified electrode towards UA was studied by cyclic voltammetry (CV) and square wave voltammetry (SWV). As shown in fig.1 the cyclic voltammogram of modified potassium ferricyanide and strontium oxalate MWCNTs-paste electrode is the best of all voltammograms for its high current density, which was attributed to the redox peaks of potassium ferricyanide,and unsolubility of strontium oxalate that prevent permeation of potassium ferricyanide to the electrolyte. Under optimized conditions with an applied frequency of 25 Hz, square wave voltammetry results reveal that the proposed sensor exhibits desired selectivity to UA. The sensor showed good selectivity to conventional intermediates such as ascorbic acid and dopamine. The application of the modified sensor for

monitoring UA in human urine sample is also successfully detected. In summary, a new nonenzymatic UA sensor based on MWCNTs/potassium ferricyanide/strontium oxalate electrode was developed. The data from UA determination in human urine samples are in accordance with the calculated ones. This modified electrode is easily fabricated and can be used as a sensitive sensor for routine analysis of UA in clinical diagnostics.

Keywords: Biosensor, Uric Acid, Ferricyanide, Strontium Oxalate, MWCNTs

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Proton-Coupled O_2 Reduction Reaction Catalyzed by Iron and Copper Phthalocyanine and Gold Nanoparticles at Liquid/Liquid Interfaces

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Abstract

Molecular oxygen, (O_2), reduction reaction, (ORR), is one of the most *important* events in life processes such as biological respiration, and in energy converting systems such as fuel cells, batteries, corrosion. ORR can occur at solid electrodes or at the interface of two immiscible electrolytes, (ITIES). ITIES provides a soft interface to study proton-coupled electron transfer reactions. In these reactions the protons locating in the aqueous phase and electron donors in the organic phase.

Iron Phthalocyanine (FePc) and Copper phthalocyanine (CuPc) can catalyze the reduction of oxygen by a weak electron donor, namely ferrocene (Fc), at the polarized water/1,2-dichloroethane, (DCE), interface. Two-phase shake flask experiments and ion transfer voltammetry results suggest that the catalytic reaction proceeds as a proton-coupled electron transfer reduction of oxygen to mainly hydrogen peroxide. Presence of an adsorbed monolayer of citrate-coated gold nanoparticles (AuNps) at the polarized liquid|liquid interface increases the reduction and oxidation of Fc in the interface. Presence AuNps and FePc in the interface can catalyze reduction of oxygen more than FePc alone. AuNps can increase the charge density or the corrugation of the interface. Comparison between the catalytic effect of CuPc and FePc showed that FePc has a more catalytic effect than CuPc.

Keywords: Oxygen reduction reaction, Iron Phthalocyanine, Copper phthalocyanine, Proton-coupled, Liquid-Liquid interface, gold nanoparticles.

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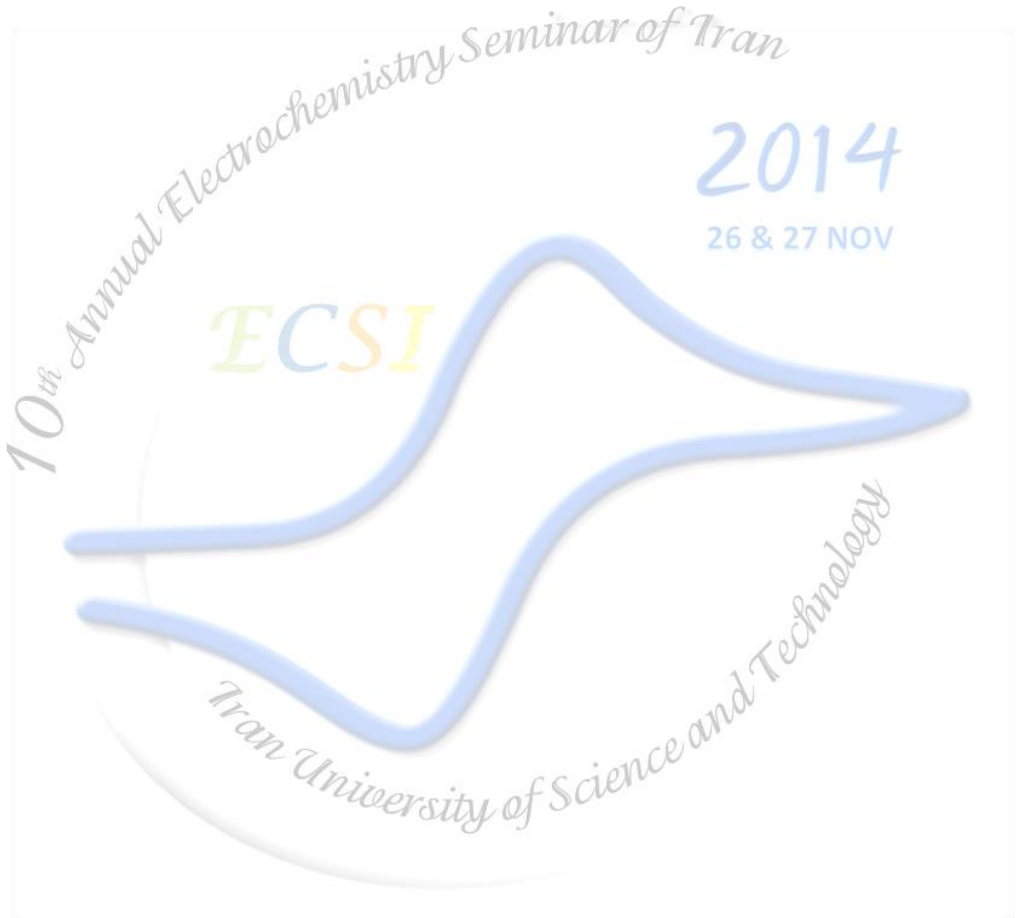

Electrochemical Determination of N-acetylcysteine and Folic Acid in Pharmaceutical and Biological Samples

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Abstract

N-acetylcysteine is a pharmaceutical drug used primarily as a mucolytic agent since it is able to cleave disulfide bonds and converting them into two sulfhydryl groups. This reduces the chain length, which thins the mucus and so makes it easier to eliminate [1]. Folic acid, often regarded as a part of vitamin B complex, possesses the considerable biological importance for general human health, especially during periods of rapid cell division and growth. The deficiency of folic acid will cause serious diseases, notably for women planning for pregnancy, which can result in malformations of the spine, skull, and brain [2]. Electrochemical techniques in the field of pharmaceutical analysis have developed due to their simplicity, reasonable accuracy and precision, low cost, and rapidity. There is no need for derivatization or time-consuming extraction steps in comparison with other techniques because of less sensitivity of electroanalytical methods to the matrix effects [3].

In this work, 2-chlorobenzoyl ferrocene, was synthesized and used to construct a modified carbon nanotube paste electrode. The electrooxidation of N-acetylcysteine at the surface of the modified electrode was studied. Under the optimized conditions, the square wave voltammetric (SWV) peak current of N-acetylcysteine increased linearly with N-acetylcysteine concentration in the ranges of 5.0 $\times 10^{-8}$ to 4.0 $\times 10^{-4}$ M. The prepared modified electrode exhibits a very good

resolution between the voltammetric peaks of N-acetylcysteine and folic acid which makes it suitable for the detection of N-acetylcysteine in the presence of folic acid in real samples.

Keywords: N-acetylcysteine, Folic acid, Real sample analysis

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An efficient microbial fuel cell using functionalized woven carbon fibres and Shewanella algae bacteria

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Abstract

Microbial fuel cells (MFCs) represent a completely new method for using microorganism to convert bioelectro-chemical compounds to sustainable and clean electrical energy [1, 2]. Among microorganisms *Shewanella sp.* has proved as one of the most useful bacteria species for generating electricity in mediator less MFCs [3, 4]. These bacteria are able to code cytochromes and nanowire located on the outer membranes which act as electron shuttles [5-7].

In the present report at first we designed the cell in which electrodes are placed close to each other to decrease internal resistance. Carbon fiber electrodes were functionalized so that carboxylic acid functional groups were produced on their surfaces and the anode surface were coated with a nanocomposite consisting of amine functionalized carbon nanotube and an ionic liquid. Bacteria were grown in anode compartment of the cell. It took three days to form the biofilm on electrode surfaces. We have isolated one of the *Shewanella sp.* bacterium with higher current yielding quality almost 7×10^{-3}(A/m^2) this is performed by cyclic voltametry analysis and considerate Electrochemical behavior. The results were compared and the amine functionalized anode was chosen as more efficient electrode. By using this anode two anodic polarization curves were obtained at the times of 6 and 12 days of bacteria exposure in the anodic chamber. Using the mentioned MFC, we could produce a power density of 105.2 and 124.4 mW/m^2 for 6 and 12 days of bacteria exposure, respectively. Comparison of the results revealed that the anode which was coated with 2 mg/ml nanocomposite produced the highest power density of 242mW/m^2.

In the present research using a modified anode beside pure culture inoculation of *Shewanella algae* we could increase power generation in the MFC. The more efficient microbial-power harvesting system that could produce higher energy density level was a result of reduced internal resistance due to use of improved cell's architecture in the system and increase immobilization of the bacteria and conductivity by an amine functionalized anode. These results reveal that through a better electrochemically performing bioanode and the use of low internal resistance MFCs, it is possible to generate high power densities from particulate substrates such as lactic acid.

Keywords: Microbial fuel cell, Shewanella algae, mediator less microbial fuel cell, functionalized woven carbon fibres, anodic polarization, and Electric power density.

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Covalent attachment of [Ni (phendion)(phen)]Cl_2 complex onto MWCNT-COOH as an efficient mediator for electrooxidation of NADH and design of glucose/oxygen compartment-less biofuel cell

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Abstract

Enzymatic biofuel cells (EBFCs) have received much attention in recent years, because they convert energy derived from biofuels to electrical energy by means of the catalytic activity of enzymes (1, 2). As glucose is a ubiquitous fuel in living system the glucose based EFBCs are promising as biocompatible power sources for implantable devices (3). In this study, solid phase interactions and combinatorial approach used for synthesis and covalent attachment of [Ni (phendion) (phen)] Cl_2 complex onto carboxyl functionalized multi wall carbon nanotube (MWCNT-COOH) modified glassy carbon electrode. The attached [Ni (phendion) (phen)]Cl_2 complex displayed a surface controlled electrode process with electron transfer rate constant and surface coverage 1.96 s^{-1} and 5.95×10^{-9} $mol.cm^{-2}$, respectively, also it acts as an effective redox mediator for electrocatalytic oxidation of NADH at reduced overpotentials. With co-immobilization of glucose dehydrogenase enzyme (GDH) as anodic biocatalyst by crosslinking an effective system for glucose oxidation was designed. The onset potential and current density were -0.1 V versus Ag/AgCl electrode and 0.550 mA cm^{-2}, which indicated the applicability of the proposed system as an efficient bioanode for biofuel cell design. Another integrated system was designed as biocathode using hybrid of MWCNT and electrodeposited gold nanoparticles (Au NP) as a platform for immobilization of bilirubin oxidase (BOD) enzyme on the electrode surface. The as-prepared BOD/MWCNTs/Au NP

biocathode exhibited and onset potential of 0.56 V versus Ag/AgCl. The performance of the fabricated bioanode and biocathode in a membraneless enzyme based glucose/O_2 biofuel cell (BFC) is further evaluated. The open circuit voltage of the cell and maximum current density were 520 mV and 0.233 mA cm^{-2}, respectively, while maximum power density of 40 μWcm^{-2} was achieved at voltage of 280 mV. The immobilized enzymes in anode and cathode are very stable and output power of the BFC is approximately constant after 24h continues operation.

Key words: Phendione ligand, Ni-complex, NADH and Glucose oxidation, BOD biocathode, Enzymatic biofuel cell

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Design and construction of a novel Cu2+ selective graphite electrode modified with liquid membrane based on a new ionophore

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Abstract

A new copper (II) ion-selective electrode based on carboxy methyl chitosan as ionophore was developed. The electrode exhibited Nernstian slope of 29.7 ±0.2 mV decade-1 and a linear range of 1.0×10−7 to 1.0×10−2 M for copper (II). The limit of detection was 1.0×10−7 M. This electrode represents a fast response time (10–15 s) and can be used for at least 3 months without any divergence in potential. The proposed electrode exhibited very good selectivities with respect to alkali, alkali earth and some transition metal ions in the pH range 4-11.

Keywords: Copper (II) ion; Graphite electrode; Potentiometry; Chitosan.

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Electrochemical and DFT study on the inhibition of Stainless steel corrosion in acidic medium by newly synthesized 3-BrPhOXTs

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Abstract

Stainless steels, especially austenite stainless steel, are widely applied in many fields because of their excellent corrosion resistance. The high corrosion resistance of austenitic stainless steel is primarily attributed to the passive film that consists of iron and chromium oxides and hydroxide- and water-containing compound. Type 316L stainless steel is widely used in the chemical, petrochemical and petroleum industries because of its good corrosion resistance, especially pitting resistance As. One of most important tasks is the retardation of the attack by acid solutions used during pickling, industrial cleaning and descaling. The use of an additive is one of the major solutions for this problem. Hence, various additives are used to protect iron and its alloy against corrosive attack [1, 2]. The use of organic molecules containing functional groups and p electrons in their structure, as corrosion inhibitors, is one of the most practical methods for protecting metals against corrosion and it is becoming increasingly popular.

In the present work, 3-BrPhOXTs was synthesized and its inhibiting action on the corrosion of stainless steel 316L stainless steel (SS) in sulfuric acid was investigated by means of potentiodynamic polarization and electrochemical impedance spectroscopy (EIS). The results of the investigation show that the newly synthesized compound show excellent inhibition efficiencies against the corrosion of SS in acidic solution. The adsorption of 3-BrPhOXTsonto the SS surface followed the Langmuir adsorption model with the free energy of adsorption ΔG^0_{ads} of -9.44 kJ mol^{-1}. Electronic properties such as highest occupied molecular orbital (HOMO) energy, lowest unoccupied molecular orbital (LUMO) energy and frontier molecular orbital coefficients for inhibitor have been calculated. The molecular sketches of inhibitor were

drawn using Gauss View 03. Quantum chemical calculations were employed to give further insight into the mechanism of inhibition action of inhibitor.

Keywords: Stainless Steel L 316, impedance, inhibitor, corrosion

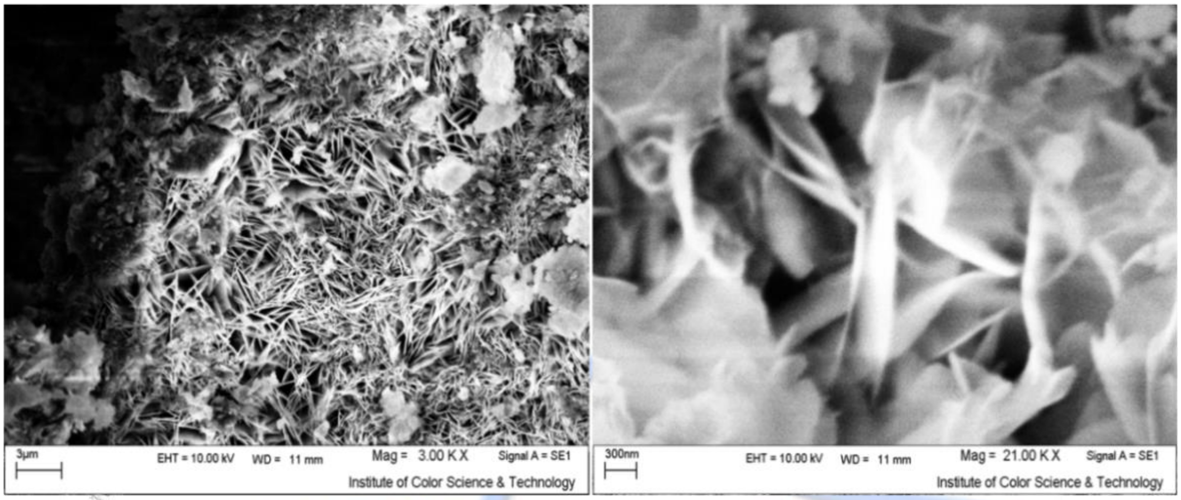

Fig. 1. Optimized molecular structure of inhibitor and Nyquist plots of SS in the presence of different concentration of inhibitor

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A novel zinc sensor based on the ion imprinted polymers and multiwalled carbon nanaotubescomposite modified glassy carbon electrode

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Abstract

A new selective and sensitive electrochemical sensor for detection of Zn^{2+} ions was developed by modified glassy carbon electrode(GCE) using a synthesized Zn-ion imprinted polymers(Zn-IIPs) and multi-walled carbon nanotubes(MWCNTs) film [1,2] .

IIPs were prepared by the copolymerization of styrene as a functional vinyl monomer in the presence of Zinc-8-hydroxyquinoline complex. This polymer has been characterized on the basis of FTIR. In this work, it was shown that IIPs can act as selective recognition zinc ions and due to the high electrical conductivity and high surface area of MWCNTs, electron transfer is accelerated. The potential was scanned from -0.3 V to +0.3V versus Ag/AgCl and variable affecting parameters such as pH, deposition duration time, deposition potential and stirring speed were optimized for SWASV detection. The resulting calibration curve exhibited a linear response over a concentration range of 5×10^{-12} to 15×10^{-8}mol/L^{-1}with excellent detection limit 5×10^{-12}mol/L^{-1}. The method was used successfully for Zinc detection in blood serum sample and human hair.

Keywords: Ion imprinted polymer; Multi-walled carbon nanotubes; Square-wave Anodic stripping voltammetry; Glassy carbon electrode.

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Cyclic voltammetry characterization of polyaniline film and polyaniline/graphenenanocomposite in presence potassium chloride

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Abstract

Cyclic voltammetry of polyaniline film and polyanilin/graphenenanocomposite on 2B pencil graphite in acidic solution containing 1M KCl as supporting electrolyte is performed. The electrosynthesis of polyaniline/graphenenanocomposite in contrast to polyaniline indicate that the current of redox peaks increase at over 20 mV while the FT-IR and UV-Visible spectrums illustrate that the conductivity of polyaniline/graphenenanocomposite is much more than polyaniline film. A possible reason for this is the attendance of graphene nanoparticles in electrochemical performance of the electrode materials.

Keywords: polyaniline, polyanilin/graphenenanocomposite, potassium chloride, cyclic voltammetry, conductivity

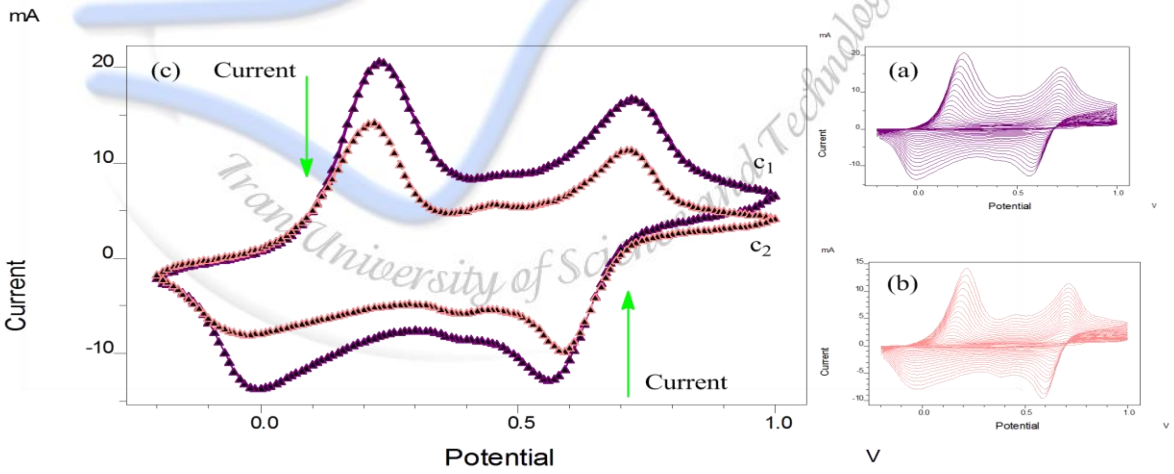

Fig.1 CVs of polyaniline film and polyaniline/graphenenanocomposite in 1M H_3PO_4 containing 1M KCl (a)polyaniline/grapheme nanocomposite (PANI/GR) CVs (b) polyaniline (PANI) CVs (c_1) 20th cycle of (PANI/GR) (c_2) 20th cycle of (PANI)

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Electrochemical study of Enrofloxacin on carbon paste electrode modified with multi-walled carbon nanotubes

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Abstract

The electrochemical behavior of Enrofloxacin was investigated by cyclic voltammetry (CV) on carbon paste electrode modified by multi-walled carbon nanotubes in the potential range of 0.7-1.0 V. In the acetate buffer solution of pH=5.3, irreversible anodic peak of Enrofloxacin oxidation appeared at 0.90 V (vs. Ag/AgCl). A sensitive, simple and time-saving differential pulse voltammetric procedure was developed to determine Enrofloxacin, using our proposed method.

Keywords: Enrofloxacin, Modified carbon paste electrode, Cyclic Voltammetry, Carbon nanotubes

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Investigating the Effect of Nitrite Ions on Fetal Hemoglobin

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Abstract

It is known that nitrite anions in drinking water oxidize and degrade hemoglobin (Hb). Oxidation of fetal hemoglobin (HbF) by nitrite ions to produce methemoglobin is one of the more employed procedures to oxidize the hemoprotein. As known, electrochemical survey based on nano-composites is one of the accurate ways to detect the structural changes. In this study, we examine the effect of nitrite ions on the human HbF which is immobilized on the surface of modified GC electrode using cyclic voltametery at potential scan rate of 50 mV s^{-1}. Modification was done by a nano-composite made of carboxylated multi-walled carbon nanotubes (MWCNTs) and a hydrophilic ionic liquid (IL).

Keywords: *Fetal Hemoglobin, Cyclic Votammetry, Nitrite, Carboxylated multi-walled carbon nanotubes, Ionic liquid.*

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One-Step Electrochemical Synthesis of Graphene/ Polyaniline Composite Film and Application as a Supercapacitor

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Abstract

This work describes a new one-step large-scale electrochemical synthesis of graphene/polyaniline (PANI) composite films using graphene oxide (GO) and aniline as the starting materials. An electrochemical route is reported for the production of graphene oxide (GO) suspensions using the following steps: electrochemical intercalation of sodium dodecyl sulfate (SDS) into graphite followed by electrochemical exfoliation of a SDS- intercalated graphite electrode. The aniline monomer and GO suspension were first mixed to form GO/aniline composite by electrostatic interaction. The obtained graphene/PANI composite film showed large specific area, high conductivity, good biocompatibility, and fast redox properties and had perfect layered and encapsulated structures. Electrochemical experiments indicated that the composite film had high performances and could be widely used in applied electrochemical fields. The potential application of the composite as electrode material for supercapacitors was analyzed using standard CV technique.

Keywords: Graphene oxide, Aniline, electrochemical synthesis, supercapacitor

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Electrochemical synthesis of molybdenum oxide nanoparticles on polypyrrole and its electrochemical behavior

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Abstract

A variety of methods are available for the preparation of nanoparticles: sol-gel, thermal decomposition, vapor condensation, reverse micelle or micro emulsion, high-energy ball milling, ultrasonic shot peening, lithography, vapor deposition and electrochemical synthesis. Electrochemistry has not been employed as a means of preparing large numbers of metal nanoparticles, but some advantages of electrochemical methods over chemical ones in synthesis of small metal particles are the high purity of the particles, the possibility of a precise particle size control, direct synthrsis on electrode [1-2].

In the present work, molybdenum oxide nanoparticles were synthesized by different electrochemical methods including galvanostatic, potentiostatic and cyclic voltammetric methods from aqueous molybdate solution on polypyrrole ,Ppy . Ppy was synthesized from pyrrole, galvanostatically on St-12 steel [3-4]. The resulting nanoparticles were characterized by scanning electron microscopy, SEM, and energy-dispersive X-ray spectroscopy ,EDX.

The catalytic performance of these layer by layer assemblies on methanol electro-oxidation reaction was studied by electrochemical methods .

Keywords: Molybdenum Oxide; Polypyrrole; Nanoparticles; Methanol electro-oxidation

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Electrochemical properties and electrocatalytic activity of graphene oxide / nickel nanoparticles/poly orthoaminophenolcomposites

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Abstract:

The electro-oxidation of small organic molecules has received more attention in the last decades due totheir application for electrochemical energy conversion in direct liquid feed fuel cells [1]. Among these molecules; methanol is used as liquid fuel for direct methanol fuel cells (DMFCs). The relatively poor methanol oxidation kinetics significantly limits the methanol oxidation reaction [2]. It has been acknowledged that the success of fuel cell technology depends strongly on the electrocatalysts,which can lower its electrochemical over-potentials and obtain high voltage output [3]. However, efficient and stable fuel-cell electro-catalysts are unavailable.Therefore, design of the catalyst with improved electrode kinetics for methanol oxidation and enhanced efficiency, stability and durability is demanded. Graphene (or reduced oxide graphene, rGO) possesses a unique two-dimensional (2D) material with high surface area, good electrical conductivity and charge carrier mobility as well as high mechanical strength. Theynot only maximize the availability of the nanosized electro-catalyst surface area for electron transfer, but also can offer enhanced mass transport of reactants to the electro-catalyst [4,5].

Herein we synthesized GO/NiPOAP composite by cyclic voltammetry (CV) methods and investigated electrochemical properties of film by using electrochemical techniques, viz. CV and electrochemical impedance spectroscopy (EIS). Furthermore, we investigated the activity of the composite film toward electrocatalytic oxidation of methanol. To elucidate the effect of GO on the property of POAP films, electrochemical performance of composite films was evaluated by carrying out CV measurements in 0.1 M HCl. The cyclic voltammograms of the GO/POAP films showed a couple of strong and broad oxidation and reduction waves. Their wave currents were

stronger than that of pure POAP films electrodes. The voltammetric behavior of both films is similar and the CV curves show thatthe electrodes are stable in HCl solution within the sweeping potential range. Cyclic voltammograms of Ni–GO–POAP/GC electrode in 0.1 M NaOH solution in the presence of methanol was investigated at a potential sweep rate of 10 mV s^{-1}. The larger methanol response at the Ni–GO–POAP/GC in respect to Ni–POAP/GC electrode is proposed to be the Ni–GO–POAP/GC enhances the catalytic properties of nickel oxide through fine dispersion of the catalyst particles into the conductive polymer matrix to result in a drastic increase in surface area. Cyclic voltammograms of Ni–GO–POAP/GC electrode in 0.1 M NaOH solution in the presence of various concentrations of methanol were investigated at a potential sweep rate of 10 mV s^{-1}. At Ni-GO–POAP/GC electrode, oxidation of methanol appeared as a typical electrocatalytic response in alkaline media by $Ni(OH)_2/NiOOH$. Modified glassy carbon electrodes were examined for their redox process and electrocatalytic activities towards the oxidation of methanol in alkaline solutions by chronoamperometry (CA) and electrochemical impedance spectroscopy (EIS). In comparison with a NiPOAP/GC, theGO/NiPOAP/GCelectrode shows a better catalytic performance for the electrocatalytic oxidation of methanol. The results show that, the GO/POAP/GChas better capacitance performance. This is mainly because of the really large surface area and the better electronic and ionic conductivity of GO/POAP/GC, which lead to greater double-layer capacitance and faradic pseudo capacitance.

Keywords: poly orthoaminophenol, composite, graphene oxide, oxidation of methanol

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Highly dispersed Ag nanoparticles on graphene nanosheets for Oxygen reduction reaction in alkaline media

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Abstract

We report a Ag/graphene catalyst for oxygen reduction reaction in alkaline media. Graphene is synthesized from graphite electrodes using ionic liquid-assisted electrochemical exfoliation. silver (Ag) nanoparticles were deposited on graphene sheets by chemical reduction and Ag/graphene (Ag/G) catalysts with different Ag loadings (10% , 20% , 25% , 30% and 40%) were prepared by the self-regulated reduction of sodium dodecyl sulfate (SDS). Cyclic voltammetry (CV), liner sweep voltammetry (LSV) and chronoamperometry (CA) were used to evaluate the electrochemical performance of the Ag/G catalysts in alkaline electrolyte. The Ag/G (25%) catalyst shows high electrocatalytic activity toward the oxygen reduction reaction (ORR) in alkaline media. The proposed catalyst is promising, facile and low-cost, and can be a potential candidate for application in alkaline fuel cells.

Keywords: *Silver nanoparticles , Graphene , Catalyst , Oxygen reduction reaction , Alkaline electrolyte*

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One-step synthesis and electrochemical properties of nitrogen-doped graphene decorated with nickel cobalt alloy nanoparticles for ethanol oxidation

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Abstracts

We report NiCO/N-graphene catalyst for the ethanol oxidation in alkaline media. Graphene is synthesized from graphite electrode using ionic liquid-assisted electrochemical exfoliation. Urea was used as a multifunctional agent for reducing and N-doping graphene. In order to study of catalyst characterizations X-ray diffractometer (XRD) and scanning electron microscopy (SEM) were used for determination of crystallite size and surface morphology respectively. The electrochemical characteristics of the NiCO/N-graphene, Ni/N-graphene and CO/N-graphene catalysts are investigated by cyclic voltammetry (CV), linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS) and chronoamperometery (CA) in nitrogen saturated in ethanol aqueous solutions.

Key word: nickel cobalt alloy nanoparticles, urea, nitrogen-doped graphene, Ethanol oxidation

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Surface characterization and electrochemical activity study of RuO_2-TiO_2/Ni cathode for oxygen reduction reaction

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Abstract

Nickel, is the most widely used cathode material in the alkaline solutions. The Electrocatalytic activity of Ni is not high, but this metal exhibits high resistance to corrosion in concentrated alkaline solutions. Enhancement of the cathode activity of Ni has been achieved by increasing the real surface area or by increasing the intrinsic activity using alloys or composites. The intrinsic activity of Ni can be increased by deposition of metal oxides like RuO_2, IrO_2 and etc., on the Ni-based material. Among composite catalysts, the Ni-RuO_2 composite catalyst was one of the most investigated, due to the fact that ruthenium oxide and ruthenium exhibit one of the highest activities for the cathode reactions [1]. Common Ni-based cathodes are usually composed of a mixture of a noble metal oxide, such as RuO_2, and an electrochemically inert, non-conductive or semi-conductive oxide (TiO_2, Ta_2O_5) [2-4], which stabilizes the coating and enhances the catalytic properties of the material [5]. In binary systems, the combination of active RuO_2 and inert Ta_2O_5 or TiO_2 exhibits good performance in cathodic stability and electrocatalytic activity [6, 7]. This paper presents the study of mixed metal oxide (MMO) on Ni mesh as cathode. RuO_2-TiO_2 metal oxide was prepared by thermal decomposition method in the laboratory. The surface morphologies and compositions of MMO coating of cathode was determined by energy dispersive X-ray spectroscopy (EDS) and scanning electron microscopy (SEM) techniques. The results showed that the cathode consist of mud-cracks structure and flat area. In RuO_2-TiO_2/Ni cathodes, there were many nano sized crystallites along the inner side of cracks with average sizes about 19-23 nm. The electrocatalytic activity of cathode towards the oxygen reduction reaction (ORR) was studied by using the cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and chronoamperometry techniques. The kinetics

of oxygen reduction on cathode has been investigated by polarization measurements. The higher cathodic current and more positive ORR potential was obtained for RuO_2- TiO_2/Ni electrode in the compare of commercial cathode. The number of active sites for this cathode was at least 3 times higher than the values of commercial ones. This cathode also showed the lowest Tafel slops and highest current densities. According to EIS results, the faster dissolution of Ru species from the commercial coating surfaces occurred in the comparison of the RuO_2 -TiO_2/Ni prepared cathode. The addition of Ti oxide into the coating increases the stability of cathodes.

Keywords: Oxygen reduction reaction, Electrocatalysis, Ruthenium oxide, Cyclic voltammetry, Electrochemical impedance spectroscopy

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Investigation of Oxygen reduction reaction on halogen-doped graphene nanosheets

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Abstract

Metal-free graphene electrocatalyts for the Oxygen Reduction Reaction (ORR) are attractive for their high activity and economic advantages. We demonstrate F-, Cl-, Br- and I-doped graphene oxide (X-GO) catalysts for ORR in alkaline media. Graphene is synthesized from graphite electrodes using ionic liquid-assisted electrochemical exfoliation. We have evaluated the effectiveness of doping and performed electrochemical measurements of the ORR activity on these halogenated graphene materials. In order to study of catalysts characterization X-ray diffractometer (XRD) was used for determination of crystallite size. The electrochemical characteristics of the X-GO catalysts are investigated by cyclic voltammetry (CV), linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS) and chronoamperometry (CA) for oxygen reduction reaction (ORR) in alkaline media.

Keywords: *halogen-doped graphene nanosheets, alkaline media, metal-free, oxygen reduction reaction.*

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An electrochemical sensor for the determination of trace amounts of copper in biological and environmental samples

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Abstract

Copper is one of the most widely distributed elements in the environments of industrialized countries. It is present in all organisms, land and marine. It has been shown that copper is an essential element in many biological processes, such as blood formation and the function of many important enzymes (1). Copper is classified as a biogenic element, playing a significant role in photosynthesis, metabolism of nitrogen compounds, or regulation of RNA and DNA transcription process (2).In this paper, a new modified carbon paste electrode based on multi-walled carbon nanotubes and Dicyclohexyl-18-Crown-6(DCH) acting as a chelating agent for Cu(II) ions, is described. The influence of variables such as the reduction potential and time, accumulation time, pH solution and stripping medium was tested by differential pulse anodic stripping voltammetry. The best results were obtained under the following conditions: 20 s reduction time, -0.8 V reduction potential, 200 s accumulation time and 30 mV s^{-1} scan rate. The electrochemical responses were found to be analytically suitable to develop a method for the determination of copper at low concentration levels. Under optimized operational conditions, a linear response range from 4.0 to 200 ng mL^{-1} was obtained. The detection limit for Cu determination was 1.1 ng mL^{-1}. The proposed sensor presented good repeatability, evaluated in terms of the relative standard deviation (R.S.D. = ± 2.3%) for n=7 and was applied for copper determination in water and hair samples.

Keywords: *Anodic stripping voltammetry, Carbon paste electrode, Copper*

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New Nanoparticle as a Modifier to Develop a Carbon Past Electrode for Determination of Silver ion in Aqueous Solutions

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Abstract

Here, we are going to report the synthesis of amine-functionalized silica nanoparticles (SNP-NH_2s), by Stober method. The synthesized SNPs and multi-walled carbon nanotubes (MWCNTs) were used as modifier for construction a new carbon paste electrode. Then, the modified electrode was successfully applied in Ag^+ ion quantification by potentiometric method. Over results showed that the modified electrode exhibits a Nernstian slope of -59.79 (±0.22) mV/decade for Ag^+ ion in aqueous solution. The detection limit of the system was found 5.0×10^{-9} while it is independent of the pH from 3.5 to 8.0.Also, it shows a quick response time (45 s) with lifetime of about 2 months.Then, the proposed electrode was successfully used as an indicator sensor in the determination silver ion in waste-water of photographic and radiological films.

Keywords: *carbon nanotubes, carbon paste electrode, modifier,silicananoparticles.*

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Voltammetric nanosenesor of Acesulfame-K

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Abstract

The presence in the market of non-caloric sugar substitutes has increased because of the demand for new products. Aspartame, Cyclamate, Caccharin and Acesulfame-K are synthetic and non-caloric sweeteners that have been widely used by the food industries to replace sugars in foods such as soft drinks, juices, jams, candies, and many others [1]. These so-called dietic foods are indicated for people that desire or need to reduce caloric intake as well as for individuals with diabetics for whom sugar restriction is recommended. Because of lack of calorie this material doesn't increase weight. Without License we can't use it because In terms of safety it must get required standards and this license is very important because of kids and pregnant women [2, 3]. Therefore, good analytical methods to assure quality control and product integrity are essential in meeting the needs of this widespread market.

In this work at first step we construct nano-Pt modified electrode and then use it in two ways including cyclic voltammetry and Differential pulse voltammetryin order to Acesulfame potassium assay .The voltammograms were recorded with µAutolab FRA2 Potentiostat-Galvanostat. A three-electrodes system was used with nano-Pt modified electrode as working, a glassy carbon electrode as the counter and an Ag/AgCl as the reference electrode (Autolab comp.). All tests were carried out under room temperature. A digital pH meter (Jenway 370) was applied for pH adjustment. The effect of pH, supporting electrolyte, scan rate, interferences and concentration of Acesulfame-K was evaluated. Proposed nanosensor was used for determination of Acesulfame-K in real samples, successfully.

Keywords: *Acesulfame-K, Cyclic voltammetry, Differential pulse voltammetry, Nanosensor*

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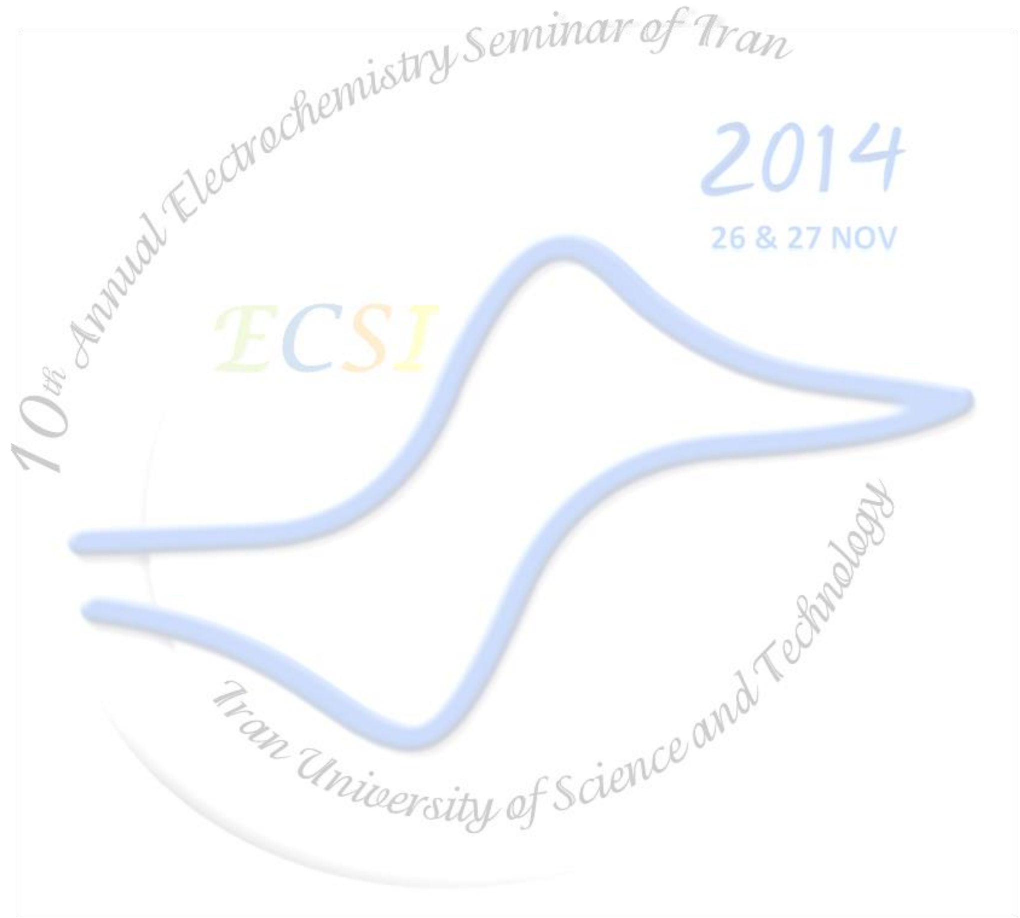

Electrochemical performance for bioactivity criteria of nanocomposite bioactive glass and MWCNT for tissue engineering

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Abstract

Bioactive glass including SiO_2, P_2O_5, CaOsynthesis by means of and chloric acid assisted sol-gel process. In this research used carbon nanotube In order to improve the mechanical properties and bioactivity of composite. MWCNT functionalized with carboxylic acid were immersed in a mixture of sulfuric acid and nitric acid (3:1). Functionalized bioactive glass reacted with carbon nanotube in anhydrous tetrahydrofuran (THF). FTIR analysis exhibited the links between BG and CNT. The in vitro bioactivity of the BG compare with BG-CNT was examined in immersion it in simulated body fluid (SBF). Reaction between BG and CNT reduced the toxicity of CNT.

Keywords: bioactive glass, sol-gel, carbon nanotube, tissue engineering

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Application of electrocoagulation in the removal of pollutants in mineral processing wastewater

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Abstract

The presence of heavy metals and various chemical materials in the production of wastewater in mineral processing units, especially in flotation units, has led us to encounter a complex wastewater. A high percentage of the produced wastewater is recycled back to the system as process water. Paying attention to pollutant removal not only preserves the environment, but also increases the efficiency of the units that use processed water. This is due to the fact that the recovery and grade of concentrated materials in these units are related to the quality of the used water. Since there exists a variety of pollutants in these types of industries, in order to better assist the refining or purifying process qualitatively and economically, implementing hybrid methods is essential. In this paper we investigate the hybrid methods together with electrocoagulation that enables us to better purify wastewater.

Keywords: *Electrocoagulation, Hybrid method, Process water, Mineral processing, wastewater, Flotation*

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Trace determination of indium by using of modified carbon paste electrode with In-ion imprinted polymer and multi-walled carbon nanotube

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Abstract

Indium is estimated to have an abundance in the earth's crust of 50 mg kg^{-1}, which is similar to silver. As with other comparatively rare metals, indium becomes more concentrated in by-products arising during the extraction of major metals such as zinc [1]. Consumption of indium is expected to increase throughout the next decades, especially due to the production of liquid crystal displays, high-definition television, semiconductor materials, batteries, low-temperature solders and electronic application. Flat panel display applications for indium in the form of indium tin oxide (ITO) are the most important end uses and represent more than one-half of the world's indium consumption [2]. In this paper, a high selective voltammetric sensor based on ion imprinted polymer was introduced for the determination of indium using 2-(5-bromo-2-pyridylazo)-5-diethylaminophenol (5-Br-PADAP)as a ligand. The electrochemical method is based on closed circuit accumulation of indium ions onto a modified carbon paste electrode with ion imprinted polymer and multi-walled carbon nanotubes, following by differential pulse anodic stripping voltammetric determination. Under optimized conditions, the response of the electrode is linear in the range from 10.0 to 140.0 ng mL^{-1} andthe detection limit is 2.5ng mL^{-1}. The method was applied for the determination of indium in some real samples.

Keywords: Ion imprinted polymer, Anodic stripping voltammetry, Carbon paste electrode, Indium.

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Electrochemical behavior of 1,4dihydropyridine on the carbon nano tube modified electrode using cyclic voltammetry

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Abstract

There is a continuous widespread interest in the synthesis of pyrano-pyrimidinones because of the diverse biological properties associated with this system. Compounds with such annulated uracils have antitumor, antibacterial, antihypertensive, hepatoprotective, cardiotonic, vasodilator, bronchiodilators and antiallergic activities and some of them exhibit antimalarial, antifungal, analgesics and herbicidal properties [1-5].

In this work, we construct MWCNT modified electrode and use it in order to electrochemical investigation of pyrano-pyrimidinones .The voltammograms were recorded with µAutolab FRA2 Potentiostat-Galvanostat. A three-electrodes system was used with MWCNT modified electrode as working, a glassy carbon electrode as the counter and an Ag/AgCl as the reference electrode (Autolab comp.). All tests were carried out under room temperature. A digital pH meter (Jenway 370) was applied for pH adjustment. The effect of pH, supporting electrolyte, scan rate, interferences and concentration of pyrano-pyrimidinone was evaluated. Proposed nanosensor was used for determination of pyrano-pyrimidinones in hand making samples, successfully.

Keywords:*Pyrano[2,3-d]pyrimidinones;Nanosensor;Cyclic voltammetry; electrochemical behavior*

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Sensitive Electrochemical Determination of Food Red No. 106 using Multi-Walled Carbon Nanotube Carbon Paste Electrode

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Abstract

Synthetic dyes are widely used for color enhancement of practically all types of produced food. Although most food colorants are expected to be safe, there are studies that prove carcinogenicity and toxicity of commonly used food dyes [1]. Food Red No. 106 is a xanthene-class color that contains two sulfonate groups [2] and widely used in food and cosmetic products.

In the current study a simple procedure was developed to prepare a carbon paste electrode modified with multi-walled carbon nanotubes (MWCNT-CPE). Then the electrochemical behaviour of Food Red No. 106 was investigated using this electrochemical sensor in phosphate buffer (PBS) at pH = 7.0 using Cyclic voltammetry (CV), chronocolumetry (CHA) and differential pulse voltammetry (DPV) techniques. The experimental parameters, such as pH, scan rate, pulse height, accumulation time and amount of MWCNT were optimized for determination of Food Red No. 106. All the electrochemical measurements were carried out using an Autolab potentiostat/galvanostat PGSTAT 35 equipped with a three electrode system that used a carbon paste working electrode, a Ag/AgCl and a Pt wire as the reference and counter electrode, respectively.

After optimizing the experimental conditions, electrochemical parameters including the diffusion coefficient (D), the electron transfer coefficient (α), and the electron transfer number (n) were determined for Food Red No. 106 on the surface of MWCNT-CPE. The peak current increased linearly with the Food Red No. 106 concentration within the concentration range of 0.1 to 50.0 µM for DPV with a detection limits (S/N > 3) of 30 nM and a correlation coefficient of 0.9987. The effect of foreign spices on the voltammetric determination of Food Red No. 106 was studied and the tolerance levels were obtained. Finally, this modified sensor was applied to the

determination of Food Red No. 106 in cosmetic products with good recovery. High sensitivity, very easy preparation and easy regeneration of the electrode surface and also long and reproducibility of this sensor make the system very useful for the determination of Food Red No. 106. In addition, the method has been successfully used to detect Food Red No. 106 in hair color with satisfying recoveries, which proves the method is feasible to be used for real samples.

Keywords: *Voltammetry, sensor, determination, Food Red No.106, Multi-walled carbon nanotube*

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Design and Fabrication of Graphen/β-Cyclodextrin Nanocomposite for ElectrochemicalBiosensor Applications

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Abstract

Electrochemical biosensors seem to possess great potential for sensing applications. In recent years nanomaterial have been great attention in designing new sensors with high performance. So the use of nanostructures in electrochemical biosensors due to their biocompatibility, high surface area, good electrical properties and chemical stability have provided promising application in this area[1,2]. Graphen is a two dimensional nanosheet from pure carbon atoms. Graphen based composites because of the unique properties of graphen (high surface area, high electron transportation, high thermal conductivity) gives their potential for electrochemical biosensors[3].

Betacyclodextrin (β-CD) is a cyclic oligosaccharide consists of seven glucopyranose units. It has a hydrophobic cavity and a hydrophilic outside structure. As a result of this structure they can form inclusion complexes with many hydrophobic guest molecules[4].This molecules can be accumulated on the surface of glassy carbon electrode modified with graphen/β-CD nanocomposite. In this work we designed a graphen/β-CD nanocomposite with good electrochemical properties for determination applications.

Keywords: Beta Cyclodextrin, Electrochemical Biosensors, Graphen Oxide, Nanocomposite

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Fabrication of $La(OH)_3$ Nanospheres by Cathodic Electrodeposition Method

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Abstract

In recent years, great attention has been focused on the synthesis and characterization of nanospheres. Under certain conditions, such nanoparticles can undergo self-organization into well-ordered one-, two- and three-dimensional (1D, 2D and 3D) superstructures [1–4]. These novel structures have revealed electronic and optical properties distinctly different from those of individual nanoparticles [5-8]. In this work, we set the electrodeposition parameters for preparation lanthanum hydroxide nanospheres and found that $La(OH)_3$ nanospheres can be easily achievable at galvanostatic conditions. So, the deposition experiments were performed on galvanostat mode at the current density of 0.1 mA cm^{-2} using an electrochemical workstation system (potentiostat/galvanostat, Model: NCF-PGS 2012, Iran). Figure 1 and 2 shows the structural characterization of the prepared sample by XRD and FT-IR, respectively.

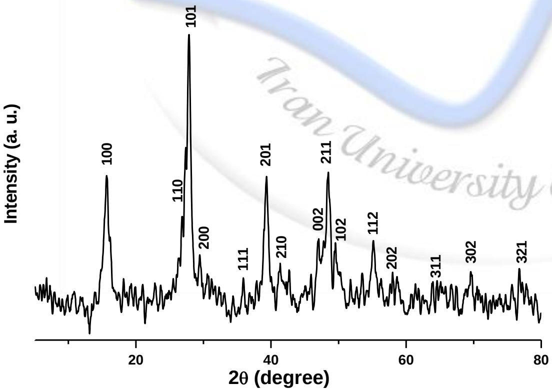

Fig. 1. XRD pattern of $La(OH)_3$ nanospheres nanospheres

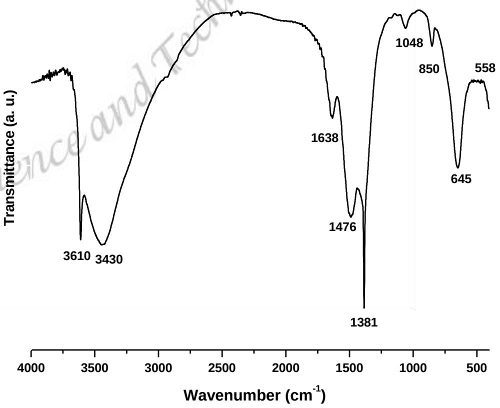

Fig. 2. IR spectrum of the prepared $La(OH)_3$

All diffraction peaks in Fig. 1 can be indexed as the hexagonal $La(OH)_3$ with the lattice constants of a=6.528 A° and c=3.858 A°, which are very consistent with the values in the standard card (JCPDS 41-4019). IR spectrum has the typical peaks of physically adsorbed H_2O and the structural O-H of $La(OH)_3$. The band that appears at 3610 cm^{-1} could be attributed to the tension of the hydroxyl groups of lanthanum hydroxide [3]. The two bands at 3430 cm^{-1} and 1638 cm^{-1} are associated with the hydroxyl groups of molecular H_2O. Other two distinct bands, observed at 645 and 558 cm^{-1}, are characteristic of the La–OH bond vibrations in $La(OH)_3$. A sharp and strong absorption peak at 1381 cm^{-1} is assigned to the vibration modes of NO_3^- anions, which have intercalated in the deposit structure during the electrodeposition process. The peaks at about 1476 cm^{-1} and 1048 cm^{-1} can be attributed to the carbonate group, which originate from the reaction of $La(OH)_3$ with CO_2 from air during the analysis.

Morphological characteristics of the prepared $La(OH)_3$ are shown in Fig. 3. The fine, homogeneous and well-crystallized particles with regular spherical morphologies are seen in this image. So, it was concluded that the cathodic electrodeposition can be recognized as a facile and efficient method for the large-sacle synthesis of uniform $La(OH)_3$ nanospheres.

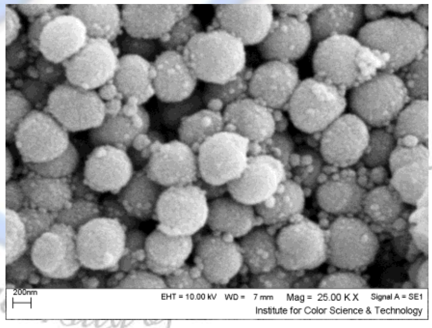

Fig. 2. SEM image of the prepared $La(OH)_3$.

Keywords: $La(OH)_3$, Nanospheres, Cathodic electrodeposition

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Facile Electrochemical Preparation of α-$Co(OH)_2$ Nanoplates with Excellent Supercapacitive Performance

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Abstract

Cobalt hydroxides have received increasing attention in recent years due to their many important technological applications such as electrode material for alkaline secondary batteries and supercapacitors [1,2]. The hydroxides of cobalt have a hexagonal layered structure and exist in two polymorphic forms, α and β [3]. The first form is isostructural with hydrotalcite-like compounds, while the second is brucite-like [$Mg(OH)_2$] and consists of hexagonally packed hydroxy ions with Co(II) ions occupying alternate rows of octahedral sites. α-$Co(OH)_2$ is a hydroxy deficient compound and consists of stacks of positively charged layers of composition $Co(OH)_{2-x}(H_2O)_x$, which intercalate anions and water molecules in the interlayer space to restore charge neutrality [2].

In this work, cobalt hydroxide nanoplates were prepared *via* cathodic electrodeposition and their electrochemical performance was investigated using cyclic voltammetry test. The deposition experiments were performed in the direct current mode with the applied current density of 0.1 mA cm^{-2}. Fig. 1a shows XRD pattern of the hydroxide product. The observed peaks in this pattern are fully matched with the corresponding crystalline α-$Co(OH)_2$ (JCPDS no. 42-1467). No β phase peaks were observed, demonstrating that α phase of cobalt hydroxide was successfully prepared at our applied conditions. Morphological observation by SEM revealed that the prepared α-$Co(OH)_2$ has nanoplates with the sizes in the range of 200–300 nm (Fig. 1b). Fig. 1c shows the CVs of the α-$Co(OH)_2$ electrode in 1M KOH at the different scan rates. A quasi-reversible electron transfer process observed in the CV curves, indicating that the measured capacitance is mainly based on the redox mechanism. Within the applied potential windows, the electrochemical reactions can be expressed as follows [2]:

$$\alpha\text{-Co(OH)}_2 + \text{OH}^- + \text{H}_2\text{O} \rightleftarrows \gamma\text{-CoOOH} + e^- \qquad (1)$$

$$\gamma\text{-CoOOH} + \text{OH}^- \rightleftarrows \text{CoO}_2 + \text{H}_2\text{O} + e^- \qquad (2)$$

The average specific capacitance of the prepared electrode was estimated from the CVs in Fig. 1c by integrating the area under the current–potential curve [3]:

$$C = \frac{1}{mv(V_a - V_c)} \int_{V_a}^{V_c} I(V)\,dV, \qquad (1)$$

where C is specific capacitance of α-$Co(OH)_2$ (F g^{-1}) measured in the potential range of V_a to V_c, *m* is the mass of $Co(OH)_2$ (g), *v* is the scan rate (V s^{-1}) and I(V) is a current response depending on sweep voltage. Using Eq. (1), the specific capacitance of α-$Co(OH)_2$ nanoplates was calculated to be 2263.1, 2105.8, 2000.5 and 1978.5 Fg^{-1} at scan rates of 2, 5, 10 and 25 mV s^{-1}, respectively. The values showed excellent supercapacitive performance of hydroxide nanoplates, which resulted from its α phase and plate morphology.

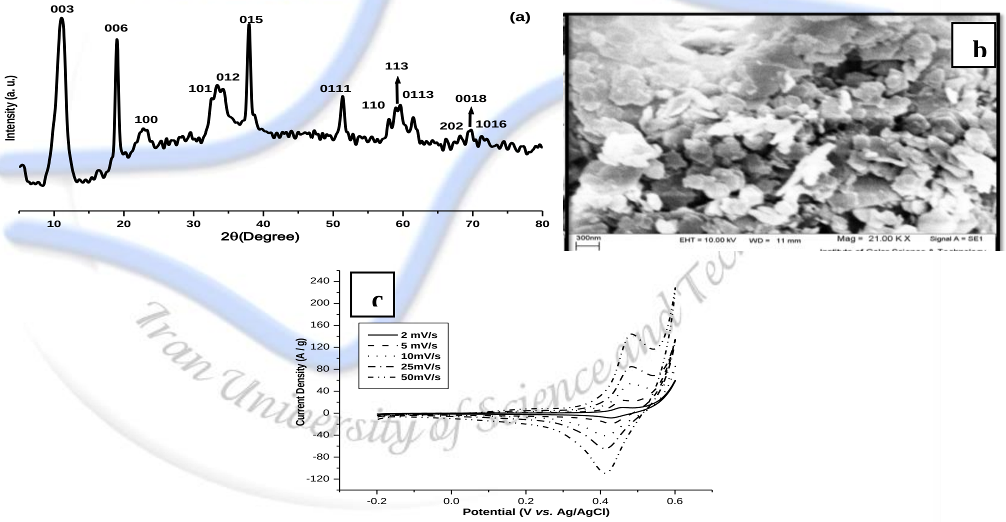

Fig. 1. (a) XRD pattern, (b) SEM image and CVs of the prepared $Co(OH)_2$ nanoplates.

Keywords: α-$Co(OH)_2$, Nanoplates, Electrosynthesis; Electrochemical Supercapacitors

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Voltammetric Determination of Direct Red 16 in Real Samples using Carbon a Paste Electrode modified with Gold Nano Particles

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Abstract

In the recent years, growing concern about environmental issues have brought researchers of both analytical and materials science to investigate appropriate processes for the removal and/or monitoring of various pollutants. Azo dyes constitute over 50% of all textile dyes and have been widely used in many industries, such as the production of textiles, paint, ink and cosmetics [1] and during dyeing operation processes, about 15% of them ends up in wastewaters. Therefore, the development of electrochemical sensors for the detection and/or quantification of various pollutants at trace levels have attracted an increasing interest in the last decade [2].

In this work a carbon paste electrode modified with gold nano particles (GNPs-CPE) was fabricated and used for electrochemical determination of Direct Red 16 (DR16) in phosphate buffer (PSB) at pH 2.0 using cyclic voltammetry (CV) and differential pulse voltammetry (DPV) techniques. The experimental parameters, such as pH, scan rate, accumulation time and amount of gold nano particles were optimized. All the voltametric measurements were carried out using an Autolab potentiostat/galvanostat PGSTAT 30 equipped with a three electrode system that used a carbon paste working electrode, a Ag/AgCl and a Pt wire as the reference and counter electrode, respectively.

Under the optimized experimental conditions, two well defined reduction peaks was observed with good separation and the peaks current increased linearly with the DR16 concentration within the concentration range of 0.1 to 40.0 µM using DPV with a detection limits (S/N > 3) of 30 nM. The effect of foreign spices on the electrochemical determination of DR16 was studied and the tolerance levels were obtained. Finally, this modified electrode was applied to the voltammetric determination of DR16 in sewage of several textile companies and Caspian Sea.

Good sensitivity and selectivity were achieved by DPV experiments with GNPs-CPE with a low detection limit. The modified electrode was successfully applied for the analysis of real samples with satisfactory results.

Keywords: *Voltammetry, Determination, Direct Red 16 , Gold nano-particles, Carbon paste electrode*

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Ethanolelectrooxidation onto carbon paste electrode modified with nickel decorated nanoporous nickel phosphate molecular sieve

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Abstract

The VSB-5 nanorods were synthesized by conventional heating for 72 h in the presence oftriethylamine as template.Then, a novel, cheap and efficient catalyst for ethanol electrooxidation was developed by decorating Ni^{2+} ions on the surface of modified carbon paste electrode (CPE) with VSB-5 molecular sieves. The electrochemical active surface area of the modified electrode (Ni-VSB-5/CPE) was calculated by cyclic voltammetry (CV). Also, the electrochemical behavior of the Ni-VSB-5/CPE electrode towards the ethanol oxidation was evaluated by CV as well as chronoamperometry methods. A sensitive oxidation peak was observed at 0.55 V in 0.1 M NaOH solution for electrocatalyticoxidation of ethanol with EC′ mechanism. It has been observed that VSB-5 at the surface of CPE can improve catalytic efficiency of the dispersed nickel ions toward oxidation of ethanol. The values of electron transfer coefficient, the mean value of catalytic rate constant and diffusion coefficient for ethanol and redox sites were obtained to be 0.657, 1.80×10^{5} cm^{3} mol^{-1} s^{-1} and 3.62×10^{-4} cm^{2} s^{-1}, respectively. Obtained results from cyclic voltammetry and chronoamperometric techniques specified that the electrode reaction is a diffusion-controlled process. The good catalytic activity, high sensitivity, good selectivity and stability and easy in preparation rendered the Ni-VSB-5/CPE to be a capable electrode for electrooxidation of ethanol.

Safaviet al. [1] was used Ag/Pdnanoalloys modified carbon ionic liquidElectrode forelectrooxidation of ethanol in alkaline media by cyclic voltammetry as well as chornoamperometry techniques. Research on porous material such asOpen-framework metal phosphate molecular sieves have attracted considerable attention for applications in catalysis, adsorption, separations, etc [2]. It is important to develop a novel electrode that has high sensitivity and stability for the electrooxidation of ethanolas anode [3]. It is point out that molecular sieves have utilized for zeolite modified electrodes (ZMEs) and applied in electrocatalysis reaction [2].

Keywords:*Nanoporous nickel phosphate, Modified CPE, ethanolelectrooxidation, Fuel cell, Alkaline medium*

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Selective electrochemical determination of levodopa in the presence of ascorbic acid using gold nanoparticles self-assembled improved graphene-modified carbon paste electrode

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Abstract

Parkinson's disease is caused by a progressive loss of dopaminergic neurons in the basal ganglia region of the brain. L-dopa (levodopa, 3,4-dihydroxy-l-phenylalanine) is widely used as a source of dopamine in the treatment of most patients with Parkinson’s disease and epilepsy [1]. Since L-dopa and ascorbic acid (AA) are electroactive materials, electrochemical methods appear to be suitable for their quantitative determination. However, a major problem that inhibits electrochemical determination is that AA and L-dopa have similar oxidation potential at most of the conventional electrodes [2]. Electrode surface modification is a field of paramount importance in the modern electrochemistry especially due to the various application possibilities of modified electrodes [3]. The combination of graphene (GE) and gold nanoparticles (AuNPs) can increase electrode surface and enhance optical, electronic, and catalytic properties. Moreover, GE and AuNPs offer synergistic effects in their composite electrocatalytic applications [4].

In this study, An electrochemical sensor based on AuNPs functionalized improved graphene (AuNPs-IGE) was fabricated for selective determination of L-dopa in the presence of ascorbic acid by a novel self-assembly method. The AuNPs-IGE was characterized by AFM. The electrochemical behavior of L-dopa and AA were investigated with cyclic voltammetry (CV) in

0.1M phosphate buffer solution at pH=4.0. The AuNPs-IGE-modified CPE show a good electrocatalytic oxidation towards L-dopa, However, well-defined redox peaks are observed at the AuNPs-IGE/CPE. Under the optimal experimental conditions, the detection limit, linear range, relative standard deviation (RSD), and recovery of L-dopa were 1.38×10^{-7}M (S/N=3), $(0.4\text{-}50)\times10^{-6}$M, 2.5% (for 3.0×10^{-6}M , n=5), and 100.8% respectively. Compared with unmodified carbon paste electrode (CPE), AuNPs-IGE/CPE shows new properties related to the electrochemical oxidation of L-dopa in phosphate buffer solution at pH=4.0. Electrodes modified with AuNPs-IGE shows excellent electrochemical activity for the oxidation of ascorbic acid (AA).Meanwhile, the proposed sensor can also effectively avoid the interference of AA has been successfully applied to the determination of L-dopa formulations with high sensitivity and good selectivity.

Keywords: L-dopa, ascorbic acid, self-assembly, improved graphene, carbon paste electrode.

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Functionalization of carbon nanotubes with silver nanoparticles and its electrocatalytic application to detection of hydrogen peroxide

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Abstract

Nanocatalysis has recently been a rapidly growing field which involves the use of nanoparticles as catalysts for a variety of organic and inorganic reactions (1). Ag nanoparticles show excellent catalytic and electrocatalytic activities (2). Detection of hydrogen peroxide (H_2O_2) has become extremely important in recent years because of its wide and varied applications (3). Up to now, many techniques including spectrometry, titrimetry, chemiluminescence, and electrochemistry have been employed for determination of H_2O_2 (4). Among them, electrochemical technique is a promising tool for the construction of simple and low-cost sensors due to their high sensitivity, good selectivity, and ease of operation (5).

In this work, we reported a simple and low-cost procedure to functionalize of carbon nanotubes with silver nanoparticles (AgNPs/CNT) by using ascorbic acid as reducing agent. The AgNPs/CNTs were characterized by a variety of means such as transmission electron microscope (TEM), powder X-ray diffraction (XRD) and energy dispersive X-ray (EDAX). AgNPs/CNT modified carbon-paste electrode (AgNPs/CNT/CPE) displayed excellent electrochemical catalytic activities towards hydrogen peroxide (H_2O_2). The reduction overpotential of H_2O_2 was decreased significantly compared with those obtained at the bare CPE. The sensor responded linearly to hydrogen peroxide (H_2O_2) with detection limit of µM at 3*σ*. The studied sensor exhibited good reproducibility and long-term stability.

Keywords: *Ascorbic acid, Hydrogen peroxide, Functionalization, Carbon nanotubes, Silver nanoparticles*

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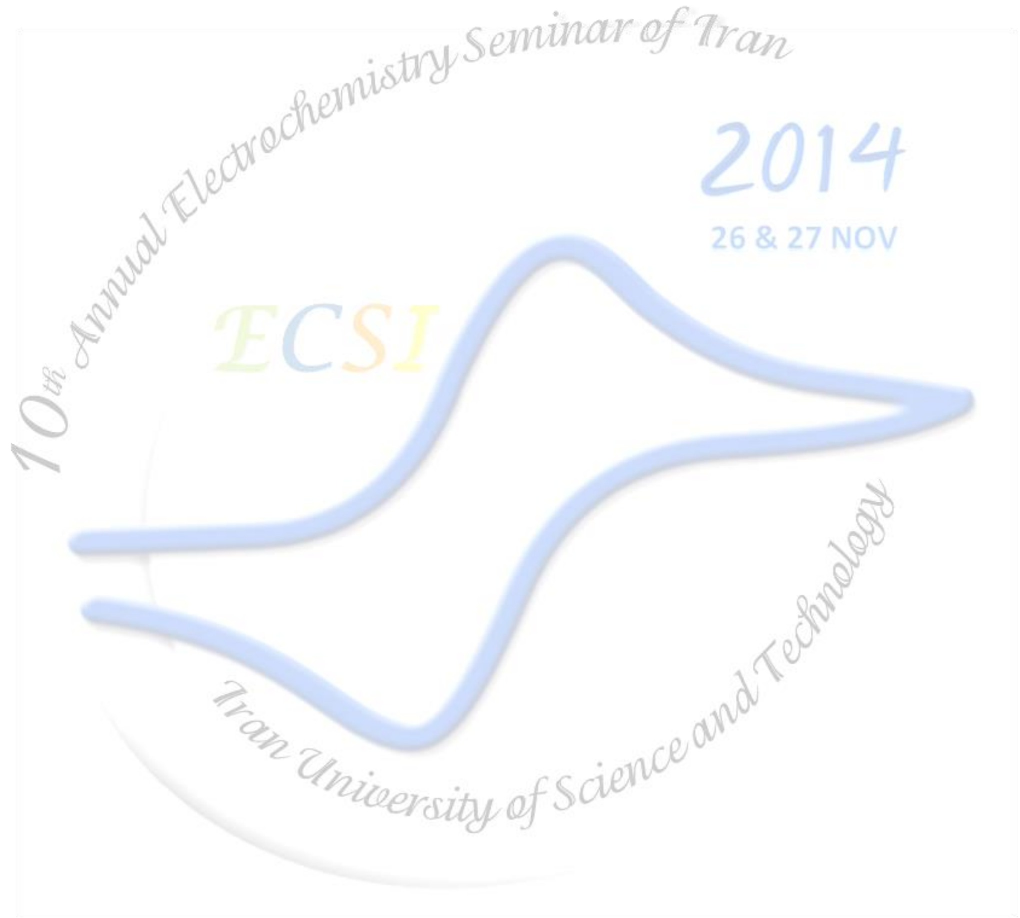

A sensitive simultaneous determination of dopamine, acetaminophen and indomethacin on a glassy carbon electrode coated with a new composite of MCM-41 molecular sieve/ nickel hydroxide nanoparticles/ multiwalled carbon nanotubes

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Abstract

A novel chemically modified electrode is constructed based on a multiwalled carbon nanotubes, nickel(II) hydroxide nanoparticles and MCM-41 composite modified glassy carbon electrode. It is demonstrated that the sensor can be used for the simultaneous determination of dopamine(DA), acetaminophen (ACT) and indomethacin (DA). The measurements were carried out by the application of differential pulse voltammetry(DPV), cyclic voltammetry (CV) and chronoamperometry (CA) methods. Under the optimum conditions the modified electrode provides a linear response versus DA concentrations in the range of 1.5-45 µM and 70-350 µM, ACT concentrations in the range of 0.2-20 µM and 20-220 µM and INDO concentrations in the range of 0.8-40 µM and 60-160 µM, respectively using the differential pulse voltammetry method. The modified electrode was used for determination of DA, ACT and INDO in real samples with satisfactory results.

***Keywords**: Dopamine, Acetaminophen, Indomethacin, Multiwalled carbon nanotubes, Nickel(II) hydroxide nanoparticles, MCM-41.*

Reference

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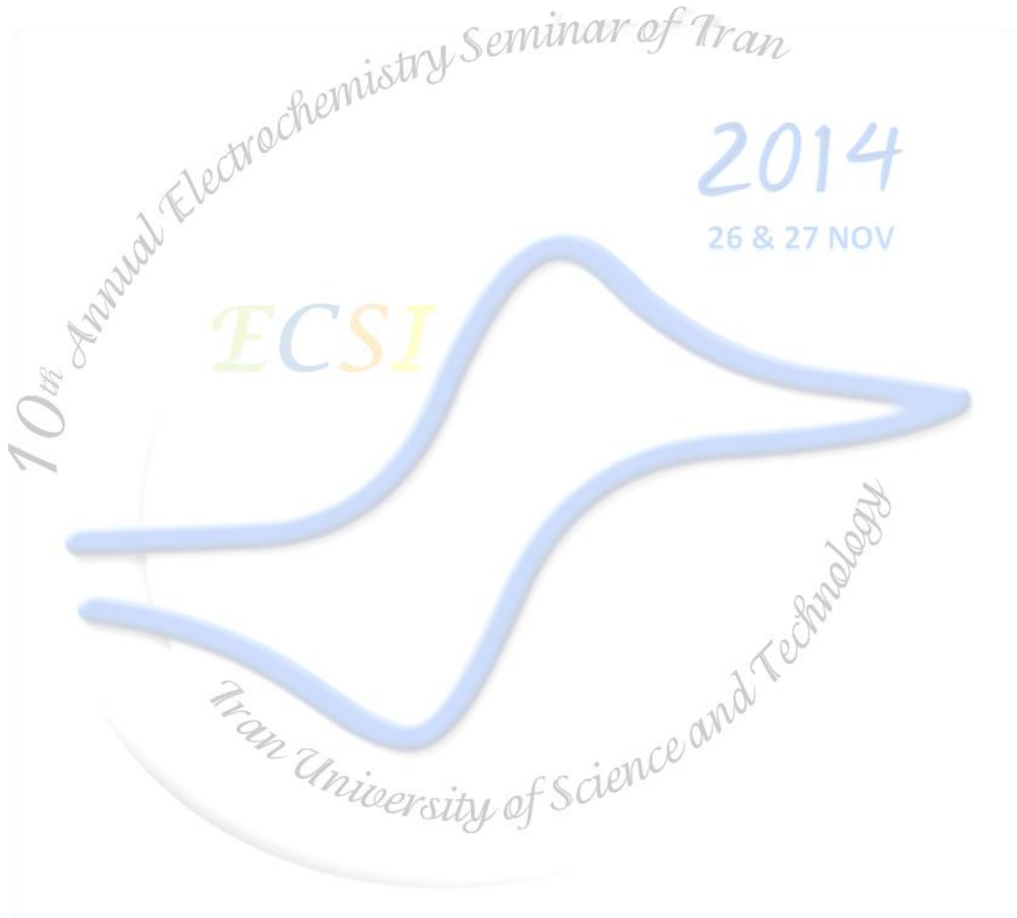

Functionalization of carbon nanotubes by ferrocene: Application for detection of sulphydryl compounds

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Abstract

Carbon nanotubes (CNTs) represent an important group of nanomaterials with attractive geometrical, electronic and chemical properties (1,2). Since the discovery of CNTs in 1991 considerable efforts have been made to study the application of this new material (3).

In this work, we report a simple and effective strategy for functionalization of the carbon nanotubes by ferrocene. Then carbon nanotubes functionalized by ferrocene (FC-CNTs) were studied by FT-IR spectroscopy, scanning electron microscopy (SEM), energy dispersive X-ray (EDAX) and voltammetry methods. In order to study electrocatalytic properties of carbon nanotubes functionalized with ferrocene, carbon-paste electrode modified with carbon nanotubes functionalized with ferrocene (FC-CNTs/CPE) was prepared and electrochemical behavior of this modified electrode was investigated in absence and presence of sulphydryl compounds. The results showed that sulphydryl compounds oxidation was catalyzed by carbon nanotubes functionalized with ferrocene in carbon paste and due to anodic current increase according to concentration of sulphydryl compounds.

Keywords: *Carbon nanotubes, Functionalization, Ferrocene, Sulphydryl compounds*

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Synthesis of silver nanoparticles in presence of pepper extract and its electrocatalytic application

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Abstract

Due to this property being distinctly different from that of the bulk metal, silver nanoparticles have attracted much attention and have found applications in diverse areas, including medicine, catalysis, textile engineering, biotechnology and bioengineering, water treatment electronics and optics (1,2). Furthermore, currently silver nanoparticles are widely used as antibacterial/antifungal agents in a diverse range of consumer products. The hydrogen evolution reaction (HER) is an electrochemical process that has received wide attention because of its importance in both fundamental and technological electrochemistry such as fuel cell technology (3).

In this work, we reported a simple and low-cost procedure to synthesize silver nanoparticles (AgNPs) by using pepper extract as reducing agent. The synthesized AgNPs were characterized by a variety of means such as transmission electron microscope (TEM), powder X-ray diffraction (XRD) and energy dispersive X-ray (EDAX). TEM observations and XRD analysis demonstrated that the size of AgNPs is less than 30 nm. Silver nanoparticles modified carbon paste electrode (AgNPs–CPE) displayed excellent electrochemical catalytic activities towards hydrogen evolution reaction (HER). Finally the kinetic of the hydrogen evolution reaction is also discussed on the AgNPs–CPE.

Keywords: *Hydrogen evolution reaction, Pepper, Silver nanoparticles, Electrocatalysis*

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Application of DC sputtering for preparation of thin film based biosensor

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Abstract

Urea analysis is considerable interested in clinical and agricultural chemistry [1,2]. In this study, zinc oxide (ZnO) thin films were prepared by magnetron sputtering technique onto conductive FTO coated glass, then urea biosensor was prepared by gentle treatment of Nano-ZnO matrix with urease. Zinc oxide has been recently used for fabrication of transducer surface of biosensors because of their unique ability to promote electron transfer between electrode and active site of desired enzyme. For ZnO DC sputtering, the deposited thin film is formed by: 1) Create ionic plasma by applying a high voltage to a glow tube, 2) Ions bombard the target material at the cathode, 3) Target atoms are ejected (sputtered) from the cathode by energy and momentum transfer, and 4) Sputtered atoms from the target are deposited on to the substrate (anode). Characterization of the surface morphology and roughness of sputtered ZnO thin film by field emission-scanning electron microscopy (FE-SEM) exhibits cavities of nanoporous film as an effective biosensing area for enzyme immobilization. Step by step monitoring of biosensor fabrication were performed using electrochemical methods such as cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) techniques. Fabricated biosensor was exploited for urea determination using EIS technique.

Keywords: Thin film; Urea biosensor; Magnetron sputtering; Electrochemical impedance spectroscopy

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Fabrication of urea biosensor using organic/inorganic substrate

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Abstract

Urea biosensor was designed based on the electrodeposited zinc oxide (ZnO)-polymer on the F-doped SnO_2 conducting glass (FTO) to achieve hybrid film as an excellent platform for urease enzymeimmobilization [1]. Electrochemical deposition as a reliable, cost-effective, mild physicochemical method has been an important issue for preparation of nanostructured hybridmetal oxides. Other often cited advantages of electrodeposition include: high deposition speed, no vacuum system need, no use of toxic gases, easy scale up and maintenance, the commercial feasibility of the process, tuning the process parameters, controlling bath conditions (pH, temperature, solvent), and easily controlling electrolyte formula by adding organic additives which can be incorporated in the deposited films to produce hybrid films with controlled morphology and thickness. PVA as a polymeric organic additive can interact with ZnO upon the electrodeposition process and strongly influence on the ZnO growth to form a mixed film made of ZnO crystals embedded in a polymer matrix [2].Surface characterization of the ZnO-polymer hybrid film by field emission-scanning electron microscopy (FE-SEM) exhibits cavities of nanoporous film for enzyme immobilization. Monitoring of biosensor fabrication was performed using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) techniques.

Keywords:Electrochemical impedance spectroscopy; Hybrid films; Biosensor.

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Modified carbon substrate as sensing media for urea detection

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Abstract

Urea analysis is a considerable research area in clinical and agricultural chemistry. An increase in urea level in blood and urine can be caused by urinary tract obstruction, renal failure, burns, dehydration and shock [1]. Moreover, reduced urea level may be seen in hepatic failure, nephritic syndrome, and cachexia [2]. Electrochemical deposition as a reliable, cost-effective, mild physicochemical method and easily controllable electrolyte, produce nanostructured platinum (Pt) with controlled morphology. Urea adsorbs on Pt electrodes and the urea adlayers formed at the surface of Pt electrodes which is immersed in $[Fe(CN)_6]^{3-/4-}$ solutions have been characterized in situ by a combination of cyclic voltammetry experiments for urea determination. Surface characterization of the nanostructured Pt by field emission-scanning electron microscopy (FE-SEM) and electrochemical characterization exhibits Pt surface as an excellent site for urea adsorption. The voltammetric results of biosensor show high sensitivity for urea detection.

Keywords: Nanostructured Pt; Biosensor; Adsorption; Voltammetric assessment.

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Voltammetric pH sensor based on a biopolymer

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Abstract

In this report, a facile and general approach was developed to prepare uniform nanolayer of polydopamine (PDA) at the surface of glassy carbon electrode by using electrochemical method. The thin film was characterized using scanning electron microscopy (SEM) and electrochemical techniques. The analysis is based on the electro-oxidation of PDA at the surface of glassy carbon electrode. A linear response is observed between the peak potential and pH with a gradient of -57.0 mV per pH (at 25 ^{0}C) over the aqueous pH range 1.0 to 12.0.

Keywords: pH sensor, Modified glassy carbon electrode, Polydopamine,electrochemicalpolymerization.

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Electrochemical characterization of semiconductor based biosensor

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Abstract

Urea is an important marker for studies of renal function. The normal level of urea in serum is from 15 to 40 mg/dl (1.7–8.3 mM) in blood serum and level increases up to 100 mM under pathophysiological conditions [1]. An increase in urea level in blood and urine can be caused by urinary tract obstruction, renal failure, burns, dehydration and shock. Moreover, reduced urea level may be seen in hepatic failure, nephritic syndrome, and cachexia which made urea analysis as a considerable area in clinical and agricultural chemistry. Electrodeposited zinc oxide (ZnO) was designed to achieve nanostructured platform for urease enzyme immobilization via covalent attachment. Electrochemical deposition as a reliable, cost-effective, mild physicochemical method and easily controllable electrolyte formula by adding organic additives, produce nanostructured metal oxides films with controlled morphology and thickness. In this study, PVA selection criteria as an organic additive in electrochemical deposition was based on its water solubility, controlling the growth and crystallization of ZnO by tuning polymer content in electrodeposition bath and its removal by a subsequent post-annealing treatment of the layer in 400 °C. Surface characterization of the nanostructured ZnO film by field emission-scanning electron microscopy (FE-SEM) exhibits film surface area as an excellent platform for enzyme immobilization. Monitoring of biosensor fabrication was performed using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) techniques. The impedimetric results were explained for urea detection.

Keywords: Nanostructured ZnO; Urea biosensor; Polymer; Impedimetric assessment.

Reference

(1) Traynor, J.; Mactier, R. BMJ 2006, 333, 733.

Preparation of Gd$_2$O$_3$ Ultrafine Nanoparticles by Electrodeposition− Heat-treatment Method

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Abstract

Gd$_2$O$_3$, as a rare earth oxide, has found use as a high-efficient phosphor [1,2], in waveguide films [3], in high k gate dielectrics [4]. In this work, ultrafine nanoparticles of Gd$_2$O$_3$ were prepared for the first time by a template–free two–step process: First, Gd(OH)$_3$ was galvanostatically deposited from nitrate bath on the steel substrate by pulse current mode. Then heat treated at 700 oC for 3h. The deposition experiments were conducted at a typical on-time and off-time (t_{on} = 5s and t_{off} = 5s) with an average current density of 1 mA cm^{-2} (I_a = 1 mA cm^{-2}).

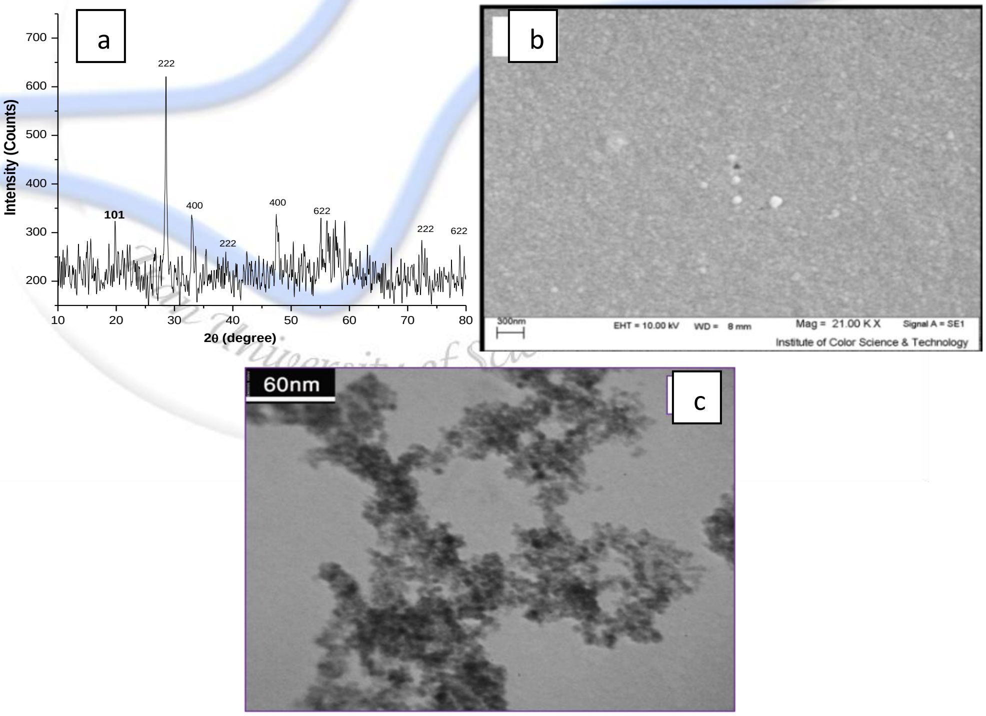

Fig. 1. (a) XRD pattern, (b) SEM and TEM (c) images of the prepared Gd$_2$O$_3$nanoparticles.

The XRD analysis (Fig. 1a) and morphological observation by SEM and TEM (Fig. 1b and c) revealed that the product has cubic crystalline structure, and fine particles with size of 5nm.

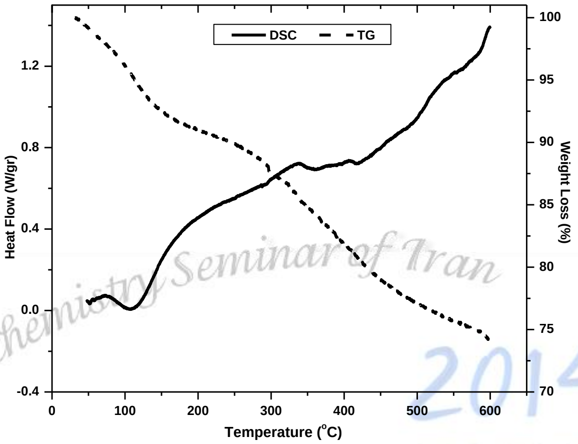

Fig. 2. DSC-TG analysis of the deposited Gd_2O_3nanoparticles.

To evaluate oxide formation during heat-treatment, thermal behavior of hydroxide sample was analyzed using DSC and TG (Fig. 2), which can be interpreted *via* the following reactions:

$[Gd(OH)_{(3-x)}(NO_3)_x\ .yH_2O] \rightarrow [Gd(OH)_{(3-x)}(NO_3)_x] + yH_2O$ (T between 25 and 150ºC) (1)

$[Gd(OH)_{(3-x)}(NO_3)_x] \rightarrow [GdO(OH)_{(1-x)}(NO_3)_x] + H_2O$ (T between 200 and 400°C) (2)

$[GdO(OH)_{(1-x)}(NO_3)_x] \rightarrow [GdO(NO_3)_x] + (1-x)H_2O$ (T between 400 and 500°C) (3)

$2[GdO(NO_3)_x] \rightarrow Gd_2O_3 + 2xNO_2 + xO_2$ (T between 500 and 700°C) (4)

Total weight loss of the deposited sample is 26.1 wt.%, as could be seen from TG curve (Fig. 2). Approximately 9.4 wt.% of the total amount of weight loss corresponds to physically adsorbed water. Furthermore, ~3.1% of total weight loss is due to the removal of intercalated nitrate ions. The results showed that pulse current deposition followed by heat–treatment can be recognized as an easy and facile method for preparation of fine nanoparticles Gd_2O_3.

Keywords: Gd_2O_3, Ultrafine nanoparticles, Pulse electrodeposition, Heat treatment

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Gold DVDtrodemodified with a gold nanoparticles for voltammetric determination of acetaminophen in pharmaceutical samples

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Abstract

Acetaminophen (paracetamol) is one of the most popular and widely used anti-inflammatory drugs for the treatment of pain and fever [1]. Development of a simple, fast, sensitive and precise procedure for determination of acetaminophen in pharmaceutical preparations is of great importance in quality control. So far, various analytical methods have been used for detection of acetaminophen including thin layer chromatography, high-performance liquid chromatography, gas chromatography–mass spectrometry and ultraviolet spectrophotometry. However, these techniques are unfavorable for routine analysis due to their tedious extraction process. Recently, electrochemical techniques, due to their high selectivity, low time-consuming, simple pretreatment procedure and low cost, have received special attention [2].In the present research, the DVDtrodesmodified with gold nanoparticles are introduced as a novel voltammetric sensor for determination of acetaminophen.

Keywords: DVDtrode, Gold nanoparticle, Acetaminophen, Voltammetry.

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Study of porosity of prepared nano-MnO_2 electro catalyst on the oxygen reduction/evolution reaction

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Abstarct

In this study effect of porosity parameter of electro catalyst on efficiency of gas diffusion electrode (GDE) in Zinc-Air semi fuel cell (ZAsFC) was investigated. Mesoporous manganese oxides (MnO_2) microspheres were synthesized by the first chemical deposition of manganese carbonate ($MnCO_3$) precursors at room temperature and followed by the low-temperature calcination under 350˚C. The results of XRD indicate that pure MnO_2 microspheres were acquired at this temperature. Linear Sweep Voltammetry (LSV) and Electrochemical Impedance Spectroscopy (EIS) were used for comparing electrodes that constructed from Merck MnO_2 and synthesized MnO_2. The results revealed that the synthesized mesoporous MnO_2has important role on oxygen reduction and evolution reaction. In optimized conditions, exchange current for oxygen reduction and evolution reaction were improved for 4 and 10 times respectively.

Keywords: Oxygen reduction/evolution reactions, mesoporous, gas diffusion electrode, Zn–air semi fuel cell.

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Sensitive electrochemical determination of salicylic acid at the surface of a new nano ceramic modified electrode

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Abstract

Salicylic acid (o-hydroxybenzoic acid) (SA), that is one of an organic micro-molecular compound is widely present in various plants [1]. SA is a biological substance that acts as a phytohormone and plays an important role in the regulation of many physiological processes in plants such as flowering, heat production, seed germination, stomatal closure, membrane permeability and ion absorption [2]. So it is important to accurately and sensitively detect SA levels. In the present work, the electrochemical oxidation of SA has been studied using cyclic voltammetry (CV) and differential pulse voltammetry (DPV) techniques at the surface of a nickel nanoparticles modified carbon paste electrode. The characterization of the modified electrode was studied using different methods such as scanning electron microscopy (SEM), electrochemical impedance spectroscopy (EIS) and CV. Also for electrochemical studies of SA various electrochemical techniques such as chronoamperometry, chronocoulometry and linear sweep voltammetry (LSV) were applied. The modified electrode exhibited excellent electrocatalytic activity towards the oxidation of SA. After optimizing the experimental conditions, the anodic peak current of SA showed a linear correlation to its concentration in a broad linear dynamic range with low limit of detection. Also the modified electrode presented a good stability and repeatability toward the determination of SA. The results indicated that the nanostructured modified electrode could be employed for the determination of SA in real samples with satisfactory results.

Keywords: Salicylic Acid, Nanostructured Modified Sensor, Carbon Paste Electrode, Electrochemical Studies

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Preparation of epoxy-zeolite nanocomposite coating and investigation of its corrosion inhibition effect on mild steel in NaCl media

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Abstract

Mild steel is the least expensive of all steel and the most common steel used. It used in nearly every type of product created from steel, it is weldable, very hard and although it easily rusts, very durable. This type of steel is able to be magnetized and used in almost any project that requires a vast amount of metal. Due to its poor corrosion-resistance, it must be protected in order to prevent rust from damaging it. Polymeric coatings are usually used to protect metals againstcorrosion and this is most likely achieved by means of barrier propertiesagainst water, oxygen or/and corrosive ions such as; Cl$^-$andH$^+$[1]. Application of inorganic fillers isone the methods to enhance anti-corrosion property of organiccoatings. Smaller filler particles may increase polymer–fillerinteractions and also improve barrier properties of the host polymericcoating. Hence, nano-sized particles with very fine grain sizeand high boundary volume, provide enhanced barrier properties incomparison with conventional fillers [2,3]. Nanocomposite containingcoatings are well known for their outstanding physical, mechanicaland thermal properties. In this work, Epoxy-zeolite nanocomposite coatings were prepared. Morphology of the nanocompositewas evaluated using XRD analyses. Corrosion performance of mild steel coated specimens was investigated using EIS and Polarization techniques. The results show that nanocomposite can improve the protection ability of epoxy coatings and its best weight fraction is 3%.

Keywords: Nanocomposite, Resin epoxy, Corrosion, Electrochemical Impedance Spectroscopy, Polarization, Mild steel

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Designing a nanostructured modified electrode for electrochemical studies of caffeic acid in real samples

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Abstract

Some naturally occurring phenolic acids such as caffeic acid (CA) are known to exhibit a wide sort of physiological and pharmacological properties. These compounds demonstrate antioxidant activity and are able to prevent auto-oxidation via the radical formation inhibition [1]. Because of the importance of antioxidant activities of these compounds in human dietary (such as consumption of fruits, vegetables, coffees, green and black teas, propolis, cocoa), associated with coronary heart diseases and cancers, interest in this field has increased [2]. Recently, various methods have been developed for determination CA. Among these methods, it has been found that liquid and gas chromatography, spectrophotometry and capillary electrophoresis have the facility for the determination of phenolic acids in food samples and plant materials. However, these methods have the disadvantages of being time consuming, expensive instruments and have powerless selectivity and sensitivity [3]. Since CA is an electroactive compound, electrochemical techniques have received considerable interest, because they are easy to use, more selective and less expensive and have good selectivity for biological analysis. The present study explains the synthesis, characterization and application of a nanostructured modified carbon paste electrode based on an imidazolium nitrite nanopowder for electrochemical determination of CA. Scanning electron microscopy (SEM), X-ray diffraction (XRD), electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV) technique were used to characterize the properties of the modified electrode. Using the nanostructured modified electrode there was a clear improvement in peak current and a decreased over potential for the oxidation of CA. The electrochemical

analysis method was based on the adsorption of CA on the modified electrode. After the optimization of all effective experimental parameters, the calibration curve for CA showed a linear range from 0.03 µM to 200.00 µM. Based on these measurements, the detection limit for CA was obtained 3.20 nM. Finally the proposed method was successfully used to determination of CA in plant material (green tea and black tea) at the surface of the nanostructured modified electrode.

Keywords: Caffiec Acid, Scanning Electron Microscopy, Electrochemical Impedance Spectroscopy, Voltammetry, Nanostructured Modified Electrode

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Develop a sensor for simultaneous determination of dopamine, piroxicam and cefixime

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Abstract

Some voltammetric methods were reported for the determination of dopamine (DA), piroxicam (PRX) and Cefixime (CEF) [1-3]. Present work demonstrates that simultaneous determination of DA, PRX and CEF can be performed on a multi-walled carbon nanotubes (MWCNTs), nickel hydroxide nanoparticles (NHNPs) and MCM-41 composite modified glassy carbon electrode (MWCNTs-NHNPs-MCM-41/GCE). The effect of composition of MWCNTs, NHNPs and MCM-41 for Modification of GCE was tested and the mixture of 5% NHNPs, 10% MCM-41and 85% MWCNTs was chosen for the fabrication of the sensor. The MWCNTs-NHNPs-MCM-41 composite were characterized with Fourier transform infrared (FTIR), scanning electron microscopy (SEM) and Energy-dispersive X-ray (EDX) analysis. Under optimum conditions application of differential pulse voltammetry method showed that the linear relationship between oxidation peak current and concentration of DA, PRX and CEF were 0.2-85 µM, 0.1-70 µM and 0.1-200 µM with detection limits of 0.07, 0.04 and 0.05 µM, respectively. The proposed method was applied to determinations of these compounds in human urine and blood serum samples. The electrochemical responses of simultaneous additions of solutions of DA, PRX and CEF in a 0.1M PBS pH 5 using MWCNTs-NHNPs-MCM-41/GCE are depicted in Figure 1. Figure 1 show differential pulse voltammograms and the corresponding calibration curves obtained for various concentrations of DA, PRX and CEF at MWCNTs-NHNPs-MCM-41/GCE. For DA a linear dynamic range from 0.2 µM to 85 µM with a calibration equation of Ip(µA) = 1.0053c (µM) + 0.7271 (R^2=0.9989), and a detection limit of 0.07 µM (S/N = 3) were obtained. For PRX a linear dynamic range from 0.1 µM to 70 µM with a calibration equation of Ip(µA) =

2.020c (µM) + 0.6336 (R^2=0.9992), and a detection limit of 0.04 µM (S/N = 3) were obtained. For CEF a linear relationship was found over the range of 0.1 µM to 200 µM with a calibration equation of Ip(µA) = 0.2971c (µM) + 0.4074 (R^2=0.9992), and a detection limit of 0.05 µM. The investigations showed that these linear ranges were kept in mixture solutions of DA, PRX and CEF, revealing high efficiency of the fabricated modified electrode for determinations in mixed pharmaceutical samples of these compounds.

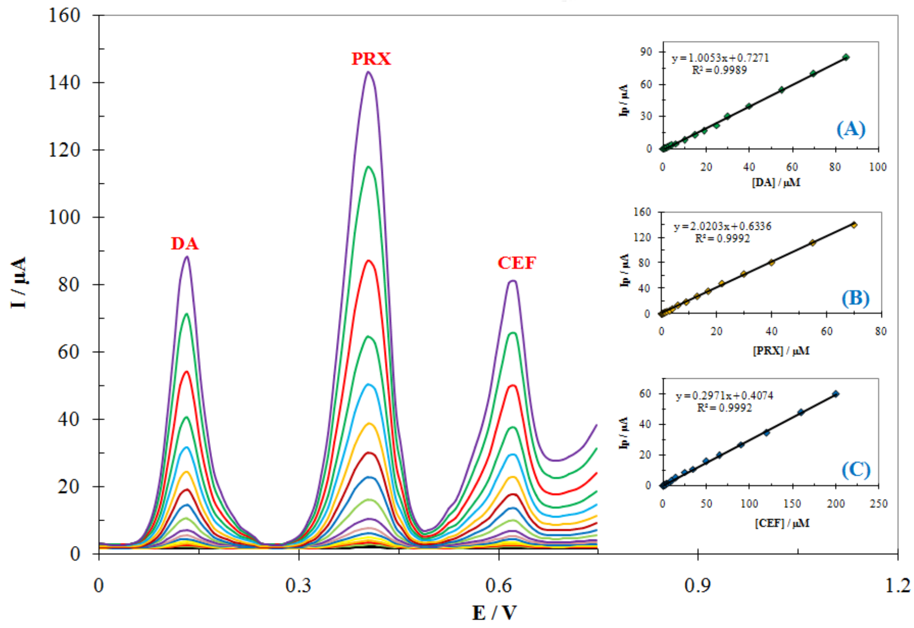

Fig. 1. Differential pulse voltammograms for different concentrations of DA, PRX and CEF mixtures. Insets: (A) Plot of peak currents as a function of DA concentration, (B) Plot of peak currents as a function of PRX concentration and (C) Plot of the peak currents as a function of CEF concentration.

Keywords: *Dopamine*, *Piroxicam*, *Cefixeme*, *Electrochemical determination*, *sensor*, *nanomaterials.*

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Develop a sensor for simultaneous determination of epinephrine and acetaminophen

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Abstract

Several electrochemical methods have been proposed for the simultaneous determination of EPI and ACT [1-3]. In this study, we report the preparation and application of multi-walled carbon nanotubes (MWCNTs), nickel hydroxide nanoparticles (NHNPs) and Mg-Al layered double hydroxide (LDH) composite modified glassy carbon electrode (MWCNTs-NHNPs-LDH/GCE) as a new sensor for nanomolar simultaneous determination of epinephrine (EPI) and acetaminophen (ACT). The electro-oxidations of EPI and ACT were investigated by using cyclic voltammetry (CV), differential pulse voltammetry (DPV) and chronoamperometry (CA) methods. Under optimum conditions application of DPV method showed that the linear relationship between oxidation peak current and concentration of EPI and ACT were 0.04-60 µM and 0.02-40 µM with detection limits of 11 and 5 nM, respectively. The proposed method was successfully applied to determinations of these compounds in human urine and blood serum samples. The modified electrode showed high sensitivity, lower detection limit with a good linear dynamic range.

The electrochemical responses of simultaneous additions of solutions of EPI and ACT in a 0.1M PBS pH 7 using MWCNTs-NHNPs-LDH/GCE are depicted in Figure 1. Figure 1 show differential pulse voltammograms and the corresponding calibration curves obtained for various concentrations of EPI and ACT at MWCNTs-NHNPs-LDH/GCE. For EPI a linear dynamic range from 0.04 µM to 60 µM with a calibration equation of Ip(µA) = 1.477C (µM) + 1.389 (R^2=0.997), and a detection limit of 11 nM (S/N = 3) were obtained. For ACT a linear dynamic range from 0.02 μM to 40 μM with a calibration equation of Ip(μA) = 2.536C (μM) + 1.119 (R^2=0.998), and a detection limit of 5 nM (S/N = 3) were obtained. The investigations showed that these linear ranges were kept in mixture solutions of EPI and ACT, revealing high efficiency of the fabricated modified electrode for simultaneous determinations of these compounds in mixed pharmaceutical samples.

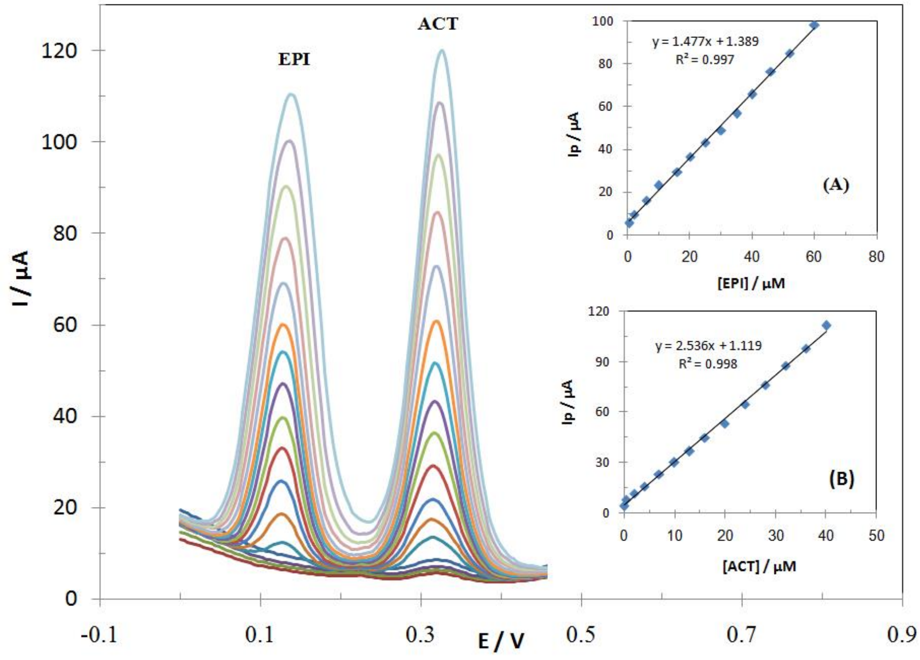

Fig. 1. Differential pulse voltammograms for different concentrations of EPI and ACT mixtures. Insets: (A) Plot of peak currents as a function of EPI concentration and (B) Plot of peak currents as a function of ACT concentration.

Keywords: *Epinephrine, Acetaminophen, Carbon nanotubes, Nickel hydroxide nanoparticles, LDH.*

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Novel sulfonated poly(arylene ether sulfone) for polymer electrolyte fuel cell membrane

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Abstract

Novel poly(arylene ether sulfone)s were prepared using direct copolymerization of 3,3'-disulfonated- 4,4'-dichlorodiphenyl sulfone as synthesized sulfonated dihalide in companion with 4,4'-dichlorodiphenyl sulfone as nonsulfonated dihalide monomer with 2،7-naphtalene diol. Copolymers were synthesized with controlled degrees of sulfonation (40, 50 %). ^{1}H-NMR and FT-IR spectroscopy were used for characterization of prepared polymers. Dynamic mechanical thermal analysis and thermogravimetric analysis were applied for investigation and comparison of their properties. Copolymers showed acceptable properties as proton exchange membrane for fuel cells. Ion exchange capacity of membranes was between 0.74 and 1.47 meq/g. Membranes showed proton conductivities increased by increasing in degree of sulfonation and reached to 0.07 S/cm. The polymers showed potential applications as membrane of fuel cell.

Keywords: *Poly(arylene ether sulfone), Fuel cell membrane, Thermal properties, Proton conductivity, Mechanical properties*

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Investigation and electrochemical deposition of platinum on carbon paper

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Abstract

The electrochemical deposition method is well known for the fabrication of nanostructured catalysts for energy materials. *In this study electrochemical deposition method was chosen for the platinum (Pt) nanostructures deposition onto fuel cell gas diffusion layer (GDL). The typical GDL for fuel cells, carbon paper was chosen as a substrate for the deposition of Pt. The control of electrodeposited platinum catalyst layer properties is one of the most important aspects to improve catalytic activity of platinum. The addition of organic compounds to electrolytic baths is widely used to control the plating process as well as the quality and properties of the metals deposits [1-3]. Cyclic voltammetry* and scanning electron microscopy (SEM) *were carried for electrochemical evaluation and morphological studies of electrodeposited Pt in the presence of an organic additive. The electrochemical experiments were carried out using a potentiostat/galvanostat with a conventional three electrode cell system at room temperature. An electrodeposited platinum carbon paper was used as working electrode. A saturated calomel electrode (SCE) and a platinum wire were used as the reference and auxiliary electrodes, respectively. The ease, flexibility and cost effectiveness of this method for preparing nanostructured catalysts makes it advantageous for application in fuel cell.*

Keywords: Electrochemical deposition; Platinum nanostructure; Carbon paper

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Synthesis of Cu–Co catalyst for thermal CVD carbon nanotube growth from C_2H_2 gas

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Abstract

Cu-Co Nano Particles (Cu-Co NPs) were prepared with various copper and cobalt content by DC-magnetron sputtering method and used as catalysts for CNTs growth. The effect of cobalt content on the catalytic properties of Cu NPs was investigated in this work. Although Cu NPs has no catalytic properties for CNTs growth, adding cobalt NPs improves the process of CNTs growth because of a profound effect it has on catalytic activity. These observations revealed by atomic force microscopic images (AFM). Moreover, scanning electron microscopy (SEM) and transmission electron microscopy.

Keywords: Cu-Co nanoparticles, catalyst, carbon nanotubes, DC-magnetron sputtering

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Porous carbon as electrocatalyst for hydrogen evolution reaction synthesized by the direct carbonization of MOF-199

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Abstract

Hydrogen is the future fuel because of its several advantage as compared with the conventional fossil fuels. Therefore, there are many attempts to use different electrodes (with the minimum of Pt content) for the hydrogen evolution reaction [1]. In this research, the metal-organic framework (MOF-199)-derived nanoporous carbon (MDNPC) is synthesized by direct carbonization of MOF-199 without any addition of carbon precursor under N_2 atmosphere at 900 °C [2-4]. The MDNPC was characterized by XRD, SEM, TGA, and BET technique. As can be seen in SEM image (Figure 1), the octahedral crystalline of MOF-199 was disturbed due to carbonization at 900 °C. The spherical nanoparticles was observed that was assembled in cauliflower-like structure. Electrochemical characterization was performed in a conventional three-electrode cell. A Ag | AgCl | KCl (3 M) and a platinum wire served as reference and counter electrodes, respectively. To prepare of working electrode, 7 µL of suspended MDNPC in ethanol (without adding any binder and conductive agents) were deposited onto glassy carbon electrode. The electrocatalytic activity of the as-fabricated electrodes for HER was investigated by LSV technique over the potential range from 0 to -1.0 V vs. Ag | AgCl | KCl (3 M), and results were shown in Figure 2. A comparison of the LSV for HER in 0.5 M H_2SO_4 demonstrates that current density (current normalized per geometric surface area) at potential of -1.0 V for bare GCE and MOF-199/GCE and MDNPC/GCE are about -0.546, -1.378, and -10.655 mA cm^{-2}, respectively.

This behavior can be related to existence of Cu metal, Cu_2O and CuO, has been confirmed by XRD pattern which could be as a non-platinum catalyst for HER. Furthermore this enhancement can be attributed to high effective BET pore surface area (1025 m^2 g^{-1}) in MDNPC. At the end of this work, transfer coefficient (α) and exchange current density (J_0) for MDNPC/GCE is calculated by Tafel plot about 0.34 and 1.2×10^{-3} $mAcm^{-2}$, respectively. This α value was confirmed a mechanism for HER where the rate is probably controlled by the discharge step and independent of the nature of hydrogen recombination.

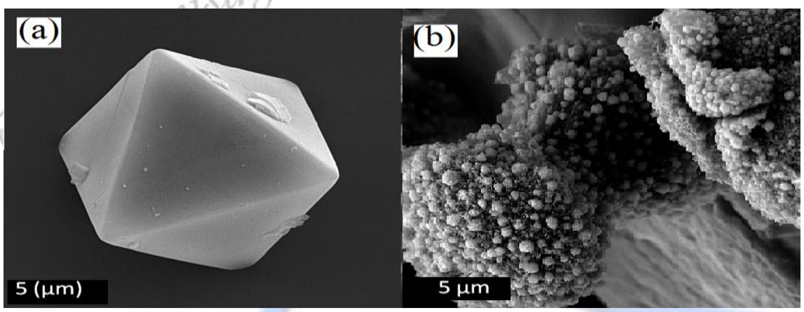

Figure 1. The SEM image of (a) MOF-199, (b) MDNPC

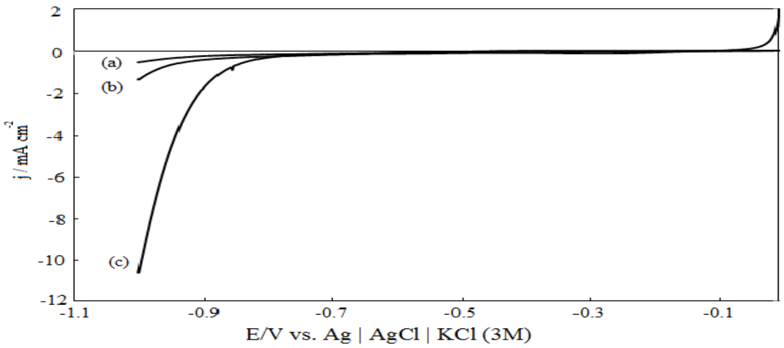

Figure 2. LSVs for the HER on (a) bare GCE, (b) MOF-199/GCE and (c) MDNPC/GCE in 0.5 M H_2SO_4 solution at ν = 10 mV s^{-1}.

Keywords: *MOF- 199, MOF-derived nanoporous carbon, Direct carbonization, Non-platinum catalyst, Hydrogen evolution reaction*

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Investigation of electrocatalytic property of poly methylene blue/nickel-platinum nanocomposite for oxidation of methanol

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Abstract

In this research, poly methylene blue film was synthesized on the surface of platinum electrode by electrochemical method of chornoamperometry and its optimum conditions (potential of 0/9 V, during 480 s) were obtained. Poly methylene blue film, itself, does not have electrocatalytic properties for methanol oxidation. So, the nano-composite of poly methylene blue/Nickel-Platinum was electro-synthesized and the optimum conditions for the deposition of nickel and platinum particles on the polymer matrix were obtained by changing the parameters of time and potential in chornoamprometry. Scanning electron micrograph images of poly methylene blue/Nickel-Platinum nano-composite showed that the spherical particles of nickel and platinum have dispersed on the poly methylene blue and. On the other hand, the spherical particles of platinum of 144-183 nm have settled on nickel particles (with dimension of micrometers). Electrocatalytic properties of nano-composite for methanol oxidation in alkaline medium were investigated by electrochemical methods of cyclic voltammetry and impedance. It was found that the nano-composite has higher Electrocatalytic property than the composites synthesized with nickel particles alone and also platinum particles alone. The charge transfer resistance related to methanol electro-oxidation was reduced with increasing methanol concentration.

Keywords: *Electrocatalytic Property, Methanol Oxidation, Poly methylene blue/Nickel-Platinum, Nano-composite.*

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Water Splitting with Silver coated- TiO_2 Photoanodes under Visible Light Illuminations

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Abstract

A thin silver layer deposited on a conducting support of TiO_2 photocatalyzes the oxidation and reduction of water to O_2 and H_2. The light sensitivity in the visible part of the spectrum is due to self-sensitization caused by reduced silver species. Anodic polarization reoxidizes the reduced silver species. To test its water splitting capability, Silver coated-TiO_2 photoanodes were employed in the anodic part of a setup for photoelectrochemical water splitting consisting of platinum foil for cathode and Ag/AgCl as a reference electrode. Illumination of the photoanode led to photoelectrochemical water splitting to O_2 and H_2. Silver coated- TiO_2 photoanodes increased photocurrent, and consequently a higher O_2 and H_2 production, were observed.

Keywords: Water splitting, Photoanode, Silver-coated TiO_2, Solar spectrum, Photoelectrochemistry

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Water Splitting with Silver coated- TiO_2 Photoanodes under Visible Light Illuminations

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Abstract

A thin silver layer deposited on a conducting support of TiO_2 photocatalyzes the oxidation and reduction of water to O_2 and H_2. The light sensitivity in the visible part of the spectrum is due to self-sensitization caused by reduced silver species. Anodic polarization reoxidizes the reduced silver species. To test its water splitting capability, Silver coated-TiO_2 photoanodes were employed in the anodic part of a setup for photoelectrochemical water splitting consisting of platinum foil for cathode and Ag/AgCl as a reference electrode. Illumination of the photoanode led to photoelectrochemical water splitting to O_2 and H_2. Silver coated- TiO_2 photoanodes increased photocurrent, and consequently a higher O_2 and H_2 production, were observed.

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Electroactive polymer/ reduced graphen oxide as a hybrid supercapacitor: electrosynthesis and characterization

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Abstract

Electrochemical capacitors (ECs) have attracted great attention of scientist for their application in most technology such as electric vehicles (EVs), uninterruptible power supplies (UPS), DC power systems, and mobile devices. Filling the gap between capacitors and batteries, high power, high energy and long lifetime are some of benefits of using ECs [1, 2]. ECs are divided to two parts about charge storage mechanism; EDLC that store charge in electrical double layer and pseudo capacitor that energy storage is due to the faradic process. From the view of active material ECs are divided to four categories; carbon materials, metal oxides, conductive polymers (CPs) and hybrid materials. Some of most famous CP is polyaniline, polypyrol, polythiophene and their derivatives. In recent years graphene have been given considerable attention due to its mechanical and chemical properties, fast electron transfer kinetics and excellent electro-catalytic characteristics. Mechanical and thermal properties are some of benefits for incorporation of graphene in the polymer matrix.

Graphen oxide/ poly tyramine (GO/PT) as a composite materials were deposited on glassy carbon electrode (GCE) by cyclic voltammetry (CV) method and their electrochemical performance was evaluated in an aqueous redox super capacitor in acidic medium. Scanning electron micrographs clearly revealed the formation of nanocomposite on the surface of the working electrode. Different electrochemical methods including galvanostatic charge–discharge (CD) experiments, cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were carried out in order to investigate the applicability of the system as a hybrid supercapacitor. Based on the cyclic voltammograms results obtained, the GO/PT represented high specific

capacitance, specific power and specific energy values than PT at a current density of 1mAcm^{-2}. The present study introduces new nanocomposite materials for electrochemical redox capacitors with advantages including long cycle-life and stable due to synergistic effects from each component**.**

Keywords: electrosynthesis, impedance, nanocomposite, supercapacitor

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Ex Situ prepared SnO_2 for synthesis of Pt-SnO_2/CNT Electrocatalyst for Ethanol Oxidation in Acid environment

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Abstract

A remarkable alternative to H2-fueled PEMFC for portable and mobile application is the use of ethanol as a fuel[1]. Carbon nanotubes (CNTs) have been at the front of novel nanoscale investigations due to their special structure dependent electronic and mechanical properties. They are expected to have a widespread range of practical applications such as catalyst supports in heterogeneous catalysis, field emitters, sensors, gas-storage media and molecular wires for next generation electronic devices [2, 3]. We use CNTs as catalys supports for PtSnO2 catalyst in a proton exchange membrane fuel cell (PEMFC). In this work, we synthesized SnO2 by an ex situ method and made a binary catalyst by adding a tin oxide to Pt and its performance compared with Pt-SnO2/C and Pt/C. Catalysts are supported on carbon and CNTs were synthesized by a modified polyol method. The XRD analysis showed the alloy catalyst was synthesized. Electrochemical tests such as CV,LSV, chronoamperometry and EIS were performed for two catalysts. The CV results indicate that the peak current and onset potential for PtSnO2/CNT is higher than other catalysts. The EIS technique and chronoamperometry were used to investigate the catalytic activity for the CO oxidation and Pt-SnO2 have a beter tolerance to CO2.

Keywords: Tin Oxide, CNTs, Ethanol Oxidation, PEMFC.

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Preparation of nanocomposite membranes for proton exchange membrane fuel cells

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Abstract

Nanocomposite organic-inorganic membranes were prepared with heteropolyacids (HPAs) as the inorganic fillers. The membrane density, water uptake, swelling, ion exchange capacity (IEC) and the conductivity of prepared nanocomposite membranes were measured and compared with the plain membrane. Results showed that by addition of HPA to the polymer, the density of membranes was reduced, the water uptake was increased and the swelling was reduced. As a result, the IEC of nanocomposite membranes was slightly lower than the plain polymer. The conductivity of membranes is increasing by the addition of HPAs.

Keywords: Nanocomposite, membrane, PEMFC, conductivity, Nafion, heteropolyacid

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Preparation of Ni-B modified electrodes with different structures by electroless method and its application for glucose Oxidation

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Abstract

Electrocatalytic processes related to sugars oxidation are of great interest in many areas, as medical applications, wastewater treatment, biological fuel cells and food industry. Oxidizable metal electrodes such as Ni, Au, Pt and Cu can provide simple way for the catalytic oxidation of carbohydrates at constant applied potentials. Non-enzymatic glucose fuel cells will probably replace by lithium batteries because of long-term stability and adequate power density. In these fuel cells of the common electrodes, which are expensive, and have current limited resource, in addition they show serious self-poisoning in the glucose oxidation. Pt electrodes replaced by Ni electrodes as well as by Ni compounds reducing these disadvantageous as reported by several[1]. The purpose of the present work is to study the effect of Ni-B morphology created on the surface of graphite electrode at the glucose electroxidation process in solution of 0.1 M NaOH.

Keywords: Fuel cell, Ni-B, Electrocatalyst ,Glucose

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Fabrication of new Cu^{2+} ion selective electrode for the analysis of waste water samples

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Abstract

At the first, zinc hydroxide Nanoparticles loaded on activated carbon ($Zn(OH)_2$-NP-AC) has been synthesized and characterized by different techniques including XRD and SEM. Then $Zn(OH)_2$-NP-AC was used to construct copper ion selective carbon paste electrode (CPE) for determination of copper in aqua samples. The influences of variables on electrode response has been investigated and their value was set as graphite powder: $Zn(OH)_2$-NP-AC: NaTPB: Nujol: Carrier in the mass (mg) ratio of 100:50:3:50:5. The electrode response was independent of pH in the range of 2.5-5.5 with the short response time of about 7s. The proposed electrode was successfully applied to the determination of Cu^{2+} in water and waste water samples.

Keywords: *Zinc hydroxide nanoparticles, Carbon paste electrode, Cu^{2+}-selective electrode, potentiometry*

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Electrooxidation of glucoseon the Pt-free nanoelectrocatalystsin alkaline medium

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Abstract:

In this study, the activity of Pd/C 10% and Pt free nanoelectrocatalyst for the glucose electrooxidation reaction were investigated.According to CV and choronoamperometryresults,Pt free have better activity thanPd/C10% catalyst.also,Pd/C10% electrocatalyst have better stability and tolerance than that of Pt free one.

Keywords:Glucose,Electrooxidation,Nanoelectrocatalyst,Pt free,Pd/C10%

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Facile Synthesis of Vertically Aligned One-dimensional (1D) $La(OH)_3$ and La_2O_3 Nanorods by Pulse Current Deposition *via* Electrogeneration of Base

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Abstract

In the recent years, there has been growing interest in the synthesis and characterization of $La(OH)_3$ and La_2O_3 with various morphologies at nanoscale. This is due to creating new physic-chemical properties at nanoscale and so enhancing their potential applications in many different areas of science and technology. Nanostructures of these materials are essential in the design of catalysts, sensors and others devices [1–4]. In this work, cathodic electrodeposition of $La(OH)_3$ from lanthanum nitrate bath was performed for the first time. The deposition experiments were conducted at the pulse current mode with a typical on-time and off-time (t_{on}=5 s and t_{off}=5 s) and an average current density of 1 mA cm^{-2} (I_a = 1 mA cm^{-2}) for 50 min. The prepared deposit was then heat treated at 600 ^{o}C for 3h in dry air atmosphere. Thermal behavior of the hydroxide sample during heat treatment process was investigated by thermogravimetric (DSC-TG) analysis. The obtained hydroxide and oxide samples were characterized by XRD, CHN, FT-IR and SEM techniques. The results revealed that the large scale and vertically aligned one-dimensional (1D) $La(OH)_3$ nanorods have been prepared at the applied conditions (as seen in Fig. 1a). It is also seen that heat treatment of the prepared hydroxide nanorods resulted the La_2O_3 nanorods without any change in their morphology (Fig. 1b).

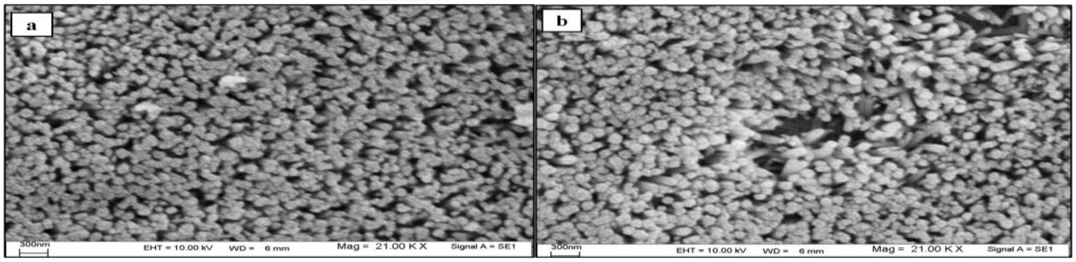

Fig. 1. SEM images of the prepared (a) $La(OH)_3$ and (b) La_2O_3 nanorods.

By recording the potential–time curve during the electrodeposition process, it was fund that water reduction reaction has the major role in the electrogeneration of base at the cathode surface. Based on the H_2 bubbling on the cathode surface, the mechanism of the formation and the growth of $La(OH)_3$ nanorods was proposed and discussed (Fig. 2). Finally, it was concluded that the pulse cathodic electrodeposition followed by heat-treatment can be recognized as a facile and efficient method for the synthesis of large-scale, uniform and vertically aligned nanorods of $La(OH)_3$ and La_2O_3.

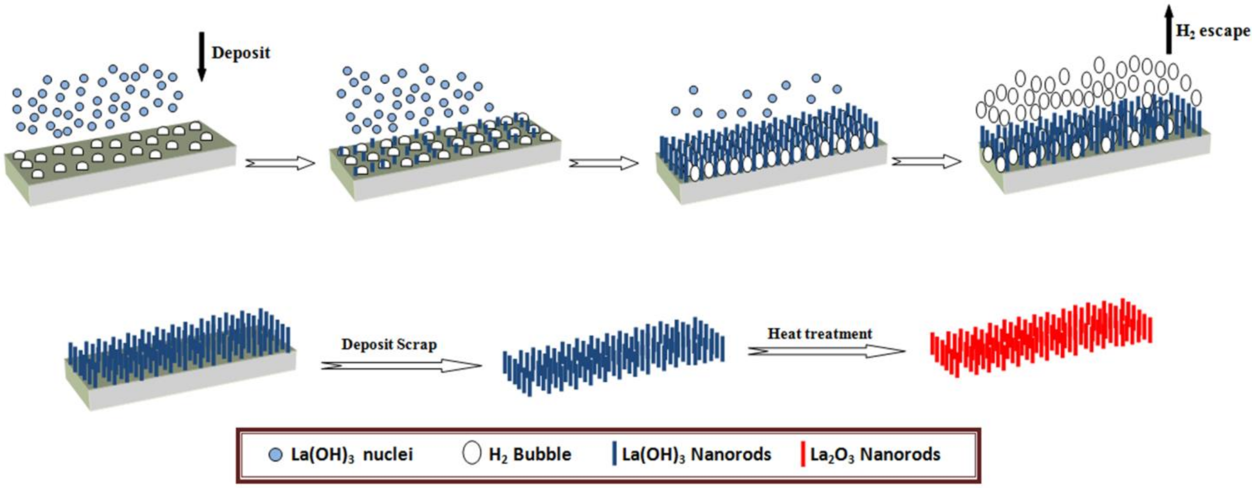

Fig. 2. Schematics of the nucleation and growth of $La(OH)_3$ nanorods.

Keywords: Pulse electrodeposition, $La(OH)_3$, La_2O_3, Nanorods

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Use of graphene based nanocomposites for immobilization of aptamer in electrochemical biosensor applications

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Abstract

In recent years aptamers are of considerable attention due to their unique properties. Aptamers are single-stranded nucleic acid that have been selected in vitro from large randomized oligonucleotide libraries by SELEX (systematic evolution of ligands by exponentialenrichment)[1]. Aptamers have been employed in the design of novel biosensors (i.e., aptasensors) because of their inherent selectivity, affinity ,good stability, reproducibility for synthesis,wide target range and wide applicability to extreme conditions and other advantages[1-4]. aptamers are considered to be ideal candidates as molecular recognition elements in biosensors. aptasensors have been developed using different analytical methods including electrochemical techniques[1].Electrochemical aptasensors offer high sensitivity, highselectivity ,low cost, simple of instrumentation and reproducibility[3,5]. combination of aptamers with novelnanomaterials results in a significantly improved performance for aptasensors[3].Among different nanomaterials, Graphene has attracted great scientific and technologicalinterestrecently[5].Graphene is a two-dimensional sheet of carbon atoms , and is an perfect material for electrochemistry because of its very large electrical conductivity, large surface area and low cost[3]. Composites based on graphene due to excellent properties of graphene gives their potential for electrochemical biosensors[5]. In the present study, the graphene-Chitosannanocomposite was used for the stabilization of aptamer.

Keywords:Aptamer,Electrochemical Biosensors, Reduced Graphene Oxide, Nanocomposite

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Nanocomposite membranes based on sulfonatedpoly(ether ether ketone)(sPEEK) and sulfated zirconia for fuel cell applications

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Abstract

Sulfated zirconia nanoparticles were evaluated asinorganic additivesin the formation of composite sPEEK-based membranes due to their strong acidity and water affinity.The XRD and H NMR analysis were conducted to characterize the filler and membrane.The ion exchange capacity (IEC) and water uptake were indicated that the nanocomposite membranes have higher water retention compared to the plain sPEEK membrane.Also, the membrane durability was investigated via ex situ Fenton test. It is revealed that nanocomposite membrane with 10% of doping level,exhibits higher oxidative stability than others.

Keywords: Fuel cell, sPEEKmambrane, Sulfated zirconia, Water uptake, Durability.

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Methanol electro-oxidation on Pd nanoparticles supported on nitrogen doped graphene in alkaline media

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Abstract

Pd and PdCo nanoparticles were chemically deposited on nitrogen doped graphene by Precipitation method using EG as a reducing agent. nitrogen-dopedgraphene (NG) was synthesized by a solvothermal process. The produced NG was characterized by transmission electron microscopy (TEM) and X-ray photoelectron spectroscopy (XPS). The electrocatalytic activity of Pd/NG and PdCo/NGelectrocatalysts towards methanol oxidation reaction (MOR) was examined using cyclic voltammetry and chronoamperometry tests. The result shows thatPdCo/NG is a suitable as a less expensive electrocatalyst for methanol oxidation in alkaline medium.

Keywords: Nitrogen doped graphene, palladium nanoparticles, Methanol Oxidation.

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Electrochemical identification of pigmentson Manuscript of the 13th centuryusing the voltammetry of micro particles attached to carbon paste electrode

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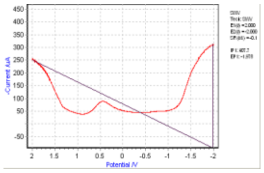
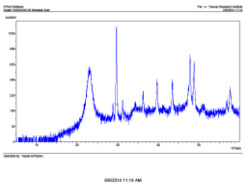
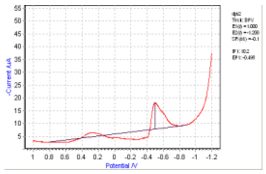
Abstract

The analysis of pigments is of great importance for archeologists, art restorers, and criminologists and in several areas of industrial and research activity. In this paper we present the results of the electrochemical response of different pigments a Manuscript of the 13th century attached to a carbon paste electrode electrodes is described.

Differentialpulse voltammetry is a new electroanalyticaltechnique designed for the qualitative and quantitative analysis of solid materials. It is based upon a preliminary mechanical transfer of trace amounts of a solid sample onto the surface of an electrode. All conventional electrochemical measuring methods can be used. The technique is applicable in many fields of solid state analysis and for fundamental studies of the electrochemistry of solid compounds. The VMP measurements were performed in HCl0.1 M between -2 V and 2 V, in a three electrodes cell, Ag/AgCl/KCl (sat) reference electrode and a platin wire as auxiliary electrode, The working electrode was a carbon paste electrode modified by graphenenanoplatelets. Solid samples of the material attached to the surface of carbon paste electrode were used in each measurement.Micro samples extracted from a Manuscript of the 13th centuryBelonging to the Astan-e-Quds-e-Razavi were electrochemically identified in agreement with polarized light microscopy,XRD data.







differentialpulse voltammetry

XRDred pigment

differentialpulse voltammetry

Keywords:pigments ,Manuscript, voltammetry, micro particles ,carbon paste electrode

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A new, quick& easy Way detectionof Historical artifact copper alloys with the micro particles attached voltammetry electrode modified by graphene

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Abstract

A new technique for the characterization of copper alloys Historical artifactalloys materials is proposed, consisting in the transfer of extremely small amounts metals by abrasion onto the surface of a electrode modified by graphenenano platelets, after which they were anodically stripped off using differential pulse voltammetry. Graphene, a single layer carbon material in a close arrangement of honeycomb two-dimensional lattice Have remarkable properties, such as Young's modulus fracture strength, specific surface area and so on. Significantly, graphene is a promising building block material for composites because of its large surface area Furthermore, decoration of the graphenenanosheets with organic/inorganic materials can bring about an important kind of graphene-based composites They are similar to carbon nanotubes but have exceptional characteristics compared to other nanomaterials. The VMP measurements were performed potential -1.5 V and 0.5 V, in a three electrodes cell, Ag/AgCl/KCl (sat) reference electrode and a platin wire as auxiliary electrode, The working electrode was a carbon paste electrode modified by graphenenano platelets.The work involved two stages. stage First: prepared the optimal electrode modified by graphenenano. The second stage: involved four separate experiments. The first one examined the type of electrolyte, which is suitable to identify the four elements(zn,cu,pb,sn). More specifically the aim was to examine in which electrolyte all elements can be measured simultaneously - as would be the case in a quaternary copper alloy - without seeing any overlap in their current peaks. The second experiment focused on optimizing

the measurement conditions with the aim of having the current peaks of each element well separated from the others. For this part we made use of the central composite design. The aims were to: (i) maximize the separation between current peaks; (ii) to determine which variable has a higher impact on the response; (iii) give an insight in the robustness of the method close to the optimum conditions and (iv) eventually show interactions between variables. In the third experiment the four elements were quantified in their binary mixtures. Here, the percentage of the oxidation current for each metal, which is directly related to the ratio of the metal in the binary matrices, was employed for the calibration. Finally in the last experimentThe analyses were carried out the elements were in two real historical copper :a brass and a lead bronze.

Keywords: alloys historical copper, Carbon paste,nanographene,voltammetry

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Electrochemical Characterization of Synthesized $LiFePO_4$ Nanostructures as a Cathode material in Lithium Ion Battery

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Abstract

Lithium-ion batteries have been considered as an attractive power source for a wide variety of application[1-4]. $LiFePO_4$/carbon composite cathode materials were synthesized by a sol-gel process. The composite synthesized via carbon black, citric acid and sucrose in the developed sol-gel process. The carbon black in this research shows the highest conductivity, highest specific capacity, and best capability among the synthesized materials. The products were analyzed by X-ray diffraction (XRD) and FT-IR spectroscopy. The properties of $LiFePO_4$/C as active cathodic material wasstudied in standard coin cell.The results confirmed low electrical resistance for the prepared electrod.

Keywords:*Lithium-ion battery; LiFePO4/C; Sol-gel, Cathode materials*

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Voltammetric Detection of NaloxoneonMWCNTs /copper nanoparticles/zinc oxide composite modified glassy carbon electrode

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Abstract

The huge interest in nanomaterials, for example in electrochemical sensors and catalysis, is driven by their many desirable properties. Although metal is a poor catalyst in bulk form, nanometre-sized particles can exhibit excellent catalytic activity due to their relative high surface area-to-volume ratio and their interface-dominated properties, which significantly differ from those of the bulk material. Therefore,A promising electrochemical sensor based on MWCNTs /copper /zinc oxide nanoparticles was developed for the sensitive detection of Naloxone.Copper/zinc oxidenanoparticlesby electrochemical deposition process fabricated on MWCNTs/ GCE. The electrochemical behavior of Naloxone on electrochemical sensor was investigated by cyclic voltammetry. The modified electrode displayed excellent activity towards oxidation ofNaloxone, with a significant reduction of overpotential compared to bare GCE. The MWCNTs/Cu/ZnO/GCE exhibited good stability, reproducibility and sensitivity in the determination of Naloxone with a detection limit of 100nm in real samples.

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Design of Gas Sensor Based on Nono-Sized Iron Oxide Particles.

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Abstract

Research on gas sensor materials has gained immense importance due to the rapid industrialization and significant increases in the use of fuels. Also there is a need for industrial gas sensor with improved sensitivity, selectivity and reliability so that gas sensors find widespread application in industries such as steelmaking, heat treating, metal casting, glass and ceramic processing, pulp and paper, automotive, aerospace, utility and power industries. For many of these applications, real time measurements require the sensors to operate at elevated temperatures. Hydrazine is an inorganic compound with the formula N_2H_4, which is highly toxic and dangerously unstable. Hydrazine As of 2002, approximately 260,000 tons were manufactured annually [1]. With this widespread application in industries, we need to monitor and control hydrazine gas. Different kinds of sensing approach including, semiconductor metal oxide (e.g. SnO2 [2], ZnO [3,4], TiO2 [5], CdO [6]), Optical sensors and biochemical sensors have been used for ethanol detection. Among them, the resistive method has the advantages of simplicity, low cost, and popular applications[7]. In this paper we present design and fabrication of Hydrazine gas sensor based on nano-sized iron oxide particles. Fe_2O_3 nano-particles of different sizes range were synthesized chemically by a modified sol-gel method. Decrease in the size of the particles, indicating the role of surface effects in the improved sensitivity, selectivity and reliability. Experimental results show that this senor has high sensitivity and a rapid response to low concentration of hydrazine.

Keywords: *Resistive gas sensor, Fe_2O_3 nano- particles, Hydrazine, SEM.*

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Effect of substrate temperature on the optical, hydrophilic and photocatalytic properties of TiO_2 nanostructured thin film

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Abstract

There are many methods to prepare titanium dioxide thin film.Electron beam physical vapourdeposition(EBPVD) is one of the best techniques to deposit TiO_2 thin film. In this method substrate temperature, oxygen partial pressure and deposition rate are effective parameters on the TiO_2 thin film properties. Substrate temperature is one of the affecting factors on crystalline structure and then transparency, hydrophilic and photocatalytic properties of the TiO_2 thin film[1]. TransparetTiO_2 thin film with hydrophilic and photocatalytic properties can be used in practical application such as mirrors, windows glass and etc[2]. In this research, TiO_2 thin films were deposited on glass substrate at different substrate temperatures(150^0C, 200^0C, 250^0C, 300^0C) by EBPVD. Crystalline structure, surface morphology and optical properties of the thin films were investigated by XRD, FESEM and UV-Vis spectrophotometer, respectively. The hydrophilic and photocatalytic activities of the thin films during UV irradiation were evaluated by a water contact angle measurements and methylen blue degradation, respectively. The optical properties showed that substrate temperature did not have significant effect on the transparency of the TiO_2 thin films. In addition, The water contact angle measurements and methylenblue degradation indicated that the TiO_2 thin film deposited at 300^0C had the best hydrophilic and photocatalytic properties.

Keywords: Physical vapor deposition,Substrate temperature,Titanium dioxide,Thin film.

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Cathodic Electrodeposition of NiO leaf-like Nanostructures and Study of Their Charge Storage Ability

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Abstract

Nanostructured nickel oxide (NiO) has received increased interest because of its potential applications in rechargeable alkaline batteries, supercapacitors, sensors, electrochromic films and solar cells [1-3]. Cathodic electrodeposition followed by heat-treatment can be applied for the preparation of NiO with desired physico-chemical properties. In this method, the hydroxide precursor is firstly deposited on the cathode surface *via* base (OH^{-}) electrogeneration. The prepared deposit is then heat-treated to obtain final oxide. In this work, we report NiO ultrafine nanoleaves prepared by pulse deposition (t_{on}=5s and t_{off}=5s, and i_a=1 mA cm^{-2}) from 0.005 M $Ni(NO_3)_2$ bath (T=25^{o}C) followed by heat-treatment at 300^{o}C for 3h. The supercapacitive performance of the nanoparticles was evaluated by cyclic voltammetry (CV) and charge-discharge techniques.

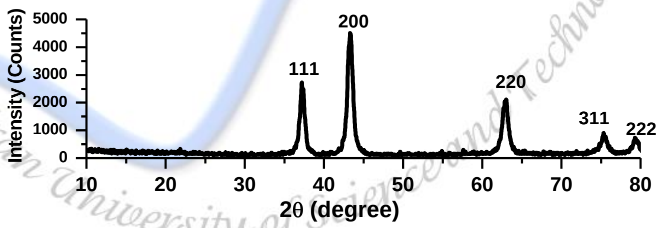

Fig.1. XRD pattern of the prepared NiO nanoleaves.

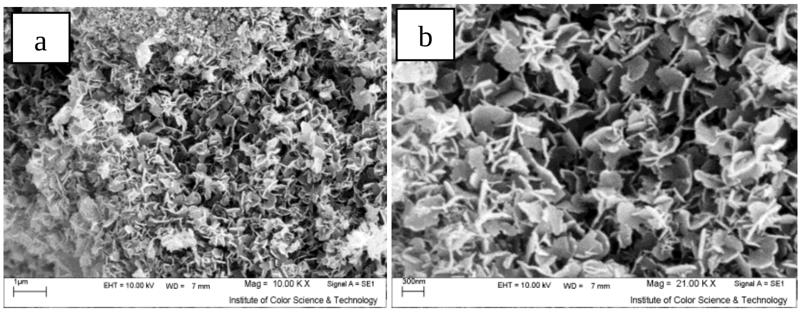

Fig. 2. SEM images of the prepared NiO nanoleaves.

Fig. 1 shows XRD pattern of the oxide product. The observed peaks in this XRD pattern are fully matched with the corresponding pure cubic-structured crystalline NiO (JCPDS 47-1049). The SEM observations in Fig. 2, revealed that the prepared NiO is composed of discrete plate-like structures in large quantity (Fig. 2a). High-magnification SEM image (Fig. 2b) clearly indicates. that these plate-like structures have not a perfect hexagonal shape, i.e. they have an irregular shape. Also this irregularity is completely evident in the edge lengths. In fact, these plate-like structures are more similar to leaf. The edge lengths of the leaf-like structures range from 200 to 300 nm (Fig. 2b).

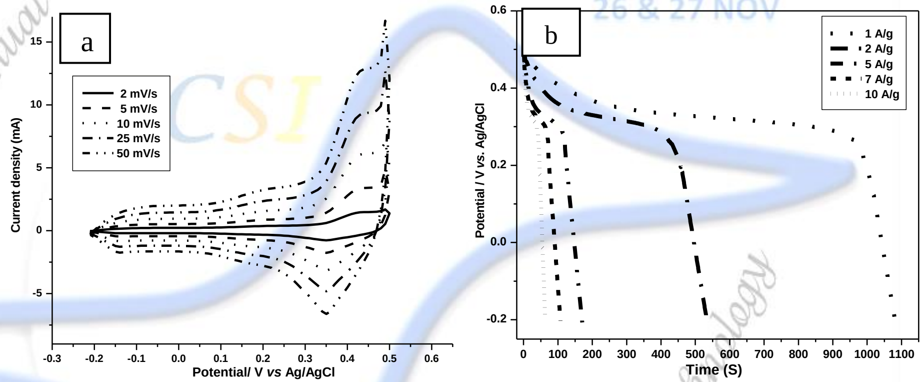

Fig. 3. (a) CVs of NiO at the different scan rates and (b) charge/discharge curves at different current densities.

The average specific capacitance of the NiO was estimated from the CVs in Fig. 2a by integrating the area under the current–potential curve [1]:

$$C = \frac{1}{mv(V_a - V_c)} \int_{V_a}^{V_c} I(V)\,dV, \qquad (1)$$

Using Eq. (1), the specific capacitance of NiO nanoleaves was calculated to be 1814.3, 1682.5, 1436.2, 1211.1 and 1006.1 F g^{-1} at scan rates of 2, 5, 10, 25, and 50 mV s^{-1}, respectively.

Also, the specific capacitances of the electrode at the applied current densities were calculated *via* the following equation:

$$C = [I \times \Delta t] / (m \times \Delta V) \quad (F/g) \qquad (2)$$

The specific capacitance values were calculated as equal to 1612.6, 1472.5, 1224.7, 1000.5 and 825.5 Fg^{-1} at the applied current densities of 1, 2, 5, 7 and10 A g^{-1}, respectively (Fig. 3b). These values are in agreements with the calculated ones from the CVs of the NiO nanoleaves (Fig. 3a) and also confirmed their excellent supercapacitive behavior.

Keywords: NiO; Cathodic electrodeposition; Leaf-like structures

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Rapid synthesis of Fe_2O_3/graphene by Ferrate(VI) in alkaline media and its application for electrocatalytic reduction of H_2O_2

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Abstract

The synthesis of Fe/reduced graphene oxide (rGO-Fe) by sodium Ferrate in alkaline media and its deposition on the surface of glassy carbon electrode (GCE) is investigated and used as a sensitive electrochemical sensor for hydrogen peroxide (H_2O_2) detection in ammonia media. The morphology of the synthesized rGO-Fe was characterized via scanning electron microscope (SEM), Fourier transform infrared and X-ray diffraction (XRD).

Keywords: *Reduced graphene oxide-Fe, Ferrate (IV), Electrochemical determination, Hydrogen peroxide*

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Rapid and sensitive electrochemical determination ofthioridazine and simultaneous voltammetric determination of thioridazine and olanzapine using ZnO nanoparticles modified carbon paste electrode in human plasma serumandtabletsamples

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Abstract

Thioridazine (TR), a member of phenothiazine group, is one of the most widely used drugs in the treatment of psychiatric patients. Thioridazine is used mainly in the treatment of schizophrenia and the control of mania and agitation.In thioridazine hydrochloride [(TR-HCl)-[10-2-(1-methyl-2-piperidyl)ethyl]-2 (methylthio) phenothiazine monohydrochloride] the piperidyl group has important tranquilizing effects. TR is known to kill multidrug-resistant Mycobacterium tuberculosis and methicillin-Resistant StaphylococcusAurous (MRSA) [1] at therapeutical concentration of 0.1mgmL^{-1} [2]. Olanzapine (OLZ) is an atypical antipsychotic agent with thienobenzodiazepinylstructure .It has efficacy against both positive and negative symptoms of schizophrenia [3,4]. The pharmacological treatment of schizophrenia is often performed with the simultaneous use of two or more antipsychotic agents to achieve the desired control of psychotic symptoms. The advantageous therapeutic profiles of the two drugs have led to an increasing use of both TR and OLZ in treatment of schizophrenic patients.

In the present study the electrochemical behavior of TR was investigated using a ZnO nanoparticles modified carbon paste electrode(ZnONP-MCPE), by cyclic voltammetry (CV) and differential pulse voltammetry (DPV). The modified electrode displayed an obvious increase in the peak current and shift in the oxidation potential to lower values (by 60mV) in comparison with the bare carbon paste electrode (CPE). The results indicated that ZnONP-MCPE remarkably enhanced electrocatalytic activity towards the oxidation of TR. The effects of pH of sample solution, modifier amount, scan rate, and time of accumulation has been examined. Under the optimum conditions, two linear range were found over the ranges of 1.00×10^{-8}–1.10×10^{-5}M and 1.10×10^{-5}–1.02×10^{-4} M of TR concentration with a square correlation coefficient (R^2) of 0.999 and 0.995, respectively with a low detection limit of 6.0 nM. The ZnONP-MCPE was applied for simultaneous determination of TR and olanzapine (OLZ) electrochemically. The separation between the two peak potentials of TR and OLZ oxidation is 420 mV. The electrooxidation pathway and kinetics, including transfer coefficient (α) and the standard rate constant (k_S), are estimated. The prepare modified electrode show several advantages such as high sensitivity, long- time stability, wide linear range ,low detection limit,easy of preparation and regeneration of the electrode surface by simple polishing and excellent reproducibilityand repeatabilityand has been used for the determination of TR and OLZ in human plasma serum andtablets samples with satisfactory results.

Keyword: *Thioridazine*, *Olanzapine*, *Human plasma serum*, *Differential pulse voltammetry*, *Scanning electron microscope (SEM)*, *Simultaneous determination*

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High sensitive electrochemical sensor with copper nanostructure for hydrazine determination

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Abstract

Hydrazine and its derivatives are widely used in industrialapplications and agriculture as fuel cells, explosives, antioxidants,rocket propellants, corrosion inhibitor, insecticides and plant-growth regulators. Hydrazine is also a toxic material, whichhas been recognized as a neurotoxin, carcinogenic mutagenic and hepatotoxic substance. Because of the industrial and pharmacological significance, sensitive detection of hydrazine is practicallyimportant. Recent researches have been directed towards thedevelopment of rapid, sensitive and selective analytical methods for the detection of hydrazine[1].

Carbon nanotube (CNT) are suitable materials for electrode modification and support in biosensor application because of their large accessible area, low electrical resistance, extremely high mechanical strength and stiffness, outstanding charge-transport characteristics, and high chemical stability.[3]

As the electrodeposition of copper is both inexpensive and simple several researchers have used the electrodes modified by copper to detect hydrazine in aqueous solutions [4]. However, the majority of these investigations have often focused on obtaining a copper layer by the fixed potential deposition method. Few applications have paid attention to employing different electrodeposition methods to develop a porous and granular sensitive layer, which has been demonstrated can typically yield tremendous improvements for surface catalysed reactions. For this purpose, the work reported herein mainly presents the characterization of a porous copper nanoclusters morphological layer developed by cyclic voltammetry (CV) electrodeposition and its electrochemical response towards nitrate within a concentration range from 6.5 to 220 □M which is relevant to a number of analytical applications. Based on the modified sensor, a portable

electrochemical system for hydrazine determination in water was also developed.The procedure for the fabrication of the modified sensor is presented in Fig. 1

Figure 1. The simplified sketch for the fabrication process of Cu/MWCNT/PG

Keywords: Hydrazine, Cu nanostructure, Carbon nanotube, Electrodeposition, sensor

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Application of a nickel hydroxide nanoparticles / multi walled carbon nanotubes modified electrode as a new sensor for sensitive simultaneous determination of piroxicam and dopamine

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Abstract

The application of nanomaterials in various fields of science and technology has been extensively developed due to the unique properties of these materials [1–3]. Many electrodes have been modified by Ni, NiO_2, $Ni(OH)_2$ particles and nanoparticles on traditional electrode surfaces. In contrast to Ni nanomaterials which are unstable and easily oxidized in air and solution, hydroxide (or oxide) of these materials are relatively stable. Dopamine (DA) is an important neurotransmitter of the catecholamine group and is well characterized by its electrochemical activity [4]. Piroxicam (PRX) is a nonsteroidal anti inflammatory drug (NSAID) that also possesses analgesic and antipyretic properties. This drug has been widely used in the treatment of rheumatoid arthritis and other inflammatory disorders [5]. It has been found that PRX produced dual effects on dopamine-related behaviors in rats [6]. Therefore it would be useful to study simultaneous determination of DA and PRX .In this work the synthesized nickel hydroxide nanoparticles (NHNPs) / multi walled CNTs (MWCNTs) composite film-modified glassy carbon (GC) electrode was fabricated as a new modified electrode. The electro-oxidation of dopamine (DA) and piroxicam (PRX) has been investigated by application of the modified electrode using cyclic voltammetry (CV), differential pulse voltammetry (DPV) and chronoamperometry (CA) methods. The modified electrode showed excellent electrochemical responses for DA and PRX determinations. Under the optimum conditions the electrode provides a linear response versus DA and PRX concentrations in the range of 1.0to100.0 μM and 1.0to 110.0 μM and with a detection limit of 0.72 and 0.53 μM respectively, using the DPV method.

The interfering study of some species showed no significant interference with determination of DA and PRX could be observed at the modified electrode. The modified electrode was used for determination of DA and PRX in human urine and blood serium with satisfactory results. The simple fabrication procedure, wide linear range, low detection limit and high stability suggest that this electrode could be a reliable and attractive candidate for practical applications.

Keywords: Dopamine, Piroxicam, Multi Walled Carbon Nanotubes, Nickel Hydroxide Nano-particles

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Electrocatalyticoxidation of hydrazine on bimetallic copper–gold nanoparticles–multiwalled carbon nanotube modified graphite pencil electrode in alkaline solution

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Abstract

Modified electrodes, particularly, metal nanoparticles modifiedelectrodes have been extensively used in electrochemical studiesdue to their higher catalytic activity, electron transfer rate, and increased electrode surface area compared to the common regularelectrodes [1]. The surface-catalyzed reactions on modifiedelectrodes are extremely depends on catalytic surface compositionand its preparation method. Therefore, various kind of methodshave been used for preparation of modified electrode surfaces withmetal nanoparticles such as electrodeposition, an in situ ionexchange method , and a supercritical liquid method [2].

Hydrazine (HZ) oxidation has been extensively studied because of its relevance to fuel cells , carcinogenic and mutagenic effects and pharmaceutical and agriculture industries.Therefore, different methods have been developed for itsselective determination. Electrochemical methods are relatively simple, fast and precise, but HZ oxidation is kinetically slowand requires a relatively high overpotential at bare electrodes [3]

In the present work electrocatalytic activity of bimetallic Cu–Aunanoparticles modified MWCNT/GCE was studied in oxygen saturated aqueous alkaline solution. The composition of the bimetallicnanoparticles modified MWCNT was characterized by SEM/EDXand its lattice parameters were determined by XPS. Additionally,the results of the electrocatalytic reduction of oxygen on bimetallic

Cu-Au nanoparticles modified MWCNT/GCE were compared withthe bare GC, MWCNT/GC, as well as monometallic Au, and Cunanoparticles modified MWCNT/GC electrodes in O2 saturated0.1 M NaOH.

Keywords: Hydrazine oxidation, Cu–Au nanoparticle, Carbon nanotube, graphite pencil electrode

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Multivariate Optimization of a Novel Carbon Paste Electrode Modified with TiO_2 Hollow Spheres, Multi-Walled Carbon Nanotubes and Polyaspartic Acid Film for Nanomolar Simultaneous Determination of Levodopa and Acetaminophen in Presence of Ascorbic Acid

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Abstract

A novel modified carbon paste electrode is prepared as an electrochemical sensor for simultaneous determination of levodopa (LD) and acetaminophen (AC) in the presence of ascorbic acid (AA).Response Surface Methodology (RSM) was used to optimize voltammetric responses of modified electrode for determination of LD and AC. Thecentral composite design (CCD) as a response surface approach was applied for obtaining theoptimum conditions as well as the maximum heights of LD and AC oxidation peaks(1).Under the optimum condition the DPV data showed that the obtained anodic peak currents were linearly dependent on the LD and AC concentrations in the range of 0.3–700 and 0.1–500 µmol L^{-1}, respectively. The applicability of the modified electrode was demonstrated by simultaneous determination of LD and AC in human serum.In this work for the first time a carbonpaste electrode (CPE) modified with multi-walled carbon nanotube,TiO_2 hollow spheres and polyaspartic acid film (P-ASP / TiO_2 hollow spheres –MWCNTs/CPE) was used as a sensitive sensor for simultaneous determinations of LD and AC. TiO_2 hollow spheres was synthesized in our laboratory using by liquid phase deposition.Fig. 1 shows a typical image of the TiO_2 hollow spheres.

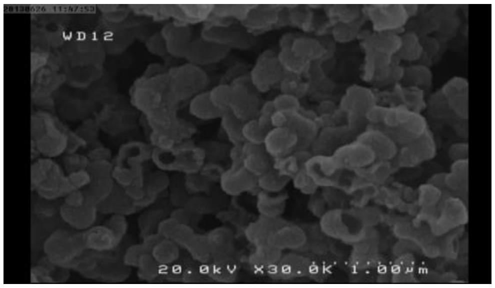

Figure 1 image of the Tio2 hollow spheres

Keywords: Levodopa, Acetaminophen, TiO_2 *hollow spheres*

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Synthesis and characterization of an effective electrochemical platform based on graphitic nanoporous carbon for electroanalysis

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Abstract

Porous carbon structures with outstanding properties, such as tunable pore channels, high surface area, uniform structure, chemical and mechanical stability has already been of considerable interest for gas separation, water purification, catalyst support, energy storage, electrodes of electrochemical double layer capacitors and fuel cells [1,2]. In the present work, a graphitic nanoporous carbon was synthesized via a nanocasting approach by using nano calcium carbonate as hard template; sucrose as carbon precursor and dilute HCl as template removing agent. The prepared material was characterized using nitrogen adsorption/desorption, small & wide angle X-ray diffraction and Fourier transform infrared techniques. The electroanalytical properties of the synthesized material were examined by fabrication of surface renewable graphitic nanoporous carbon paste electrodes (GMC-CPE). Electrochemical behavior of the nanocomposite electrode was evaluated and compared with the conventional graphite paste (GPE) and carbon nanotubes paste (CNT-PE) electrodes. The GMC-CPE provided improved electron transfer kinetics and catalytic capabilities in connection with oxidation and/or reduction of different redox systems, such as ferricyanide and some biological species, e. g. ascorbic acid (AA), uric acid (UA), dopamine (DA), paracetamol (PA), hydroquinone, catechol and L-cysteine. The excellent experimental results implicate that the new developed paste electrode holds great promise in the design of electrochemical devices, such as sensors and biosensors.

Keywords: nanoporous carbon; synthesis; characterization; Carbon paste electrode; biosensor

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Polyaniline/Graphene/Pt Nanocomposite as a Modifier of Glassy Carbon Electrode for Determination of Dopamine

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Abstract

Dopamine (DA) is one of the most important natural catecholamine neurotransmitters in the mammalian brain, playing a significant role in the function of the central nervous, renal and hormonal systems. The abnormal levels of DA may result in several diseases and neurological disorders such as schizophrenia, Parkinson's and Alzheimer's diseases. Since DA is electroactive, electrochemical methods appear to be suitable for their quantitative determination. However, at regular solid electrodes, DA and its coexisting species ascorbic acid (AA) have an overlapping voltammetric response, resulting in rather poor selectivity and sensitivity. Herein, a highly sensitive electrode based on modified glassy carbon electrode (GCE) by graphene nosheets (GNS) and platinum nanoparticles (Pt) modified polyaniline (GNS/Pt/PANI/GCE) has been developed for DA determination in the presence of AA. In optimized experimental and instrumental conditions, two linear calibration curves from 2.0 to 10and from 40 to 400 μMDAwith slope as3.60 and 0.05μA/μM, respectively, r=0.99, and detection limit as 0.6μM DA was observed at pH 7.4for GNS/Pt/PANI/GCE. Prepared sensor showed good sensitivity, reputability, and reproducibility in this work. The data will be presented and discussed.

Keywords: graphene nosheets, platinum nanoparticles, polyaniline, glassy carbon electrode, Dopamine.

Electrocatalytic Determination of Hydroquinone by UsingPolyaniline/Graphene/PtNanocomposite

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Abstract

Herein, a new modified glassy carbon electrode (GCE) by graphene nosheets (GNS) and platinum nanoparticles (Pt) modified polyaniline (GNS/Pt/PANI/GCE) were prepared to electrochemical sensing of hydroquinone (1,4-benzenediol, H_2Q). H_2Q,due to its action as a water soluble reducing agent, plays an important role in a wide number of industrial and biological processes such as coal-tar production, paper manufacturing, radiolysis developers, and cosmetic cream production. The absorption of H2Q from the gastrointestinal tract can induce some disease such as renal tube degeneration and liver function decrease. Due tocombination of the excellent properties of GNS and Pt nanoparticles, the electrode showed good electrocatalytic activity and generate an electrochemical response to H_2Q. In optimized experimental and instrumental conditions, two linear calibration curves from 6.0to 100and from 100 to 1000 µM H_2Q with slope as 1.61and 0.66 µA/µM, respectively, r=0.99, and detection limit as 2.9µM H_2Q was observed at pH 7.0for GNS/Pt/PANI/GCE. Prepared sensor had good sensitivity, repeatability, and reproducibility in this work. The data will be presented and discussed.

Keywords: *graphene nosheets, platinum nanoparticles, polyaniline, glassy carbon electrode, hydroquinone.*

Evaluating the corrosion protection properties of electrochemically synthesized polypyrrole/γ-Al_2O_3 nanocomposite coatings on carbon steel via electrochemical impedance spectroscopy

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Abstract

Carbon steel is used in large tonnages in marine applications, nuclear power and fossil fuel powerplants, transportation, petroleum production and refining, pipelines, construction and metalprocessing equipment. By the nature of limited alloying content, carbon steel is vulnerable to very high corrosion rates in aggressive solutions and atmosoheres. Organic coatings are widely used to prevent corrosion of metallic structures because they are easy to apply at a reasonable cost. Among organic coatings, conductive polymers are considered as the relevant alternatives with numerous advantages. Polypyrrole (Ppy) is one of the conductive polymers which has been attracted much attention due to its high conductivity, environmental stability and corrosion protection behavior. Ppy can be synthesized bt either chemical or electrochemical methods. Aqueous electropolymerization has several advantages such as formation of the polymer and its deposition on the substrate in one process. Recently researches showed that incorporating of nanoparticles in Ppy matrix improve the mechanical and corrosion resistance of the coating. In the present study, the electrochemical synthesis of Ppy/γ-Al_2O_3 (0.2, 1 and 2 g/l) nanocomposite coatings have been achieved on carbon steel via cyclic voltammetry. Synthesized nanocomposites were characterized by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and scanning electron microscopy (SEM). Then the corrosion behavior of coated samples have been investigated using electrochemical impedance spectroscopy (EIS) in H_2SO_4 1 M solution.

Pyrrole was distilled before use as the other chemicals were used as received. Electrochemical synthesis and experiments were carried out with Autolab (PGSTAT-302) in a standard three-

electrode cell; where the counter electrode was a platinum wire, saturated calomel electrode (SCE) was used as reference electrode and mounted carbon steel was used as working electrode.The electrode was polished with 800- 3000 emery papers and pre-treated in acetone solution to remove the impurities. Nanocomposite coatings was electrodeposited from 0.1 M oxalic acid solution contaiting0.3 M pyrrole and γ-Al_2O_3 nanoparicles with different concentrations (0.2,1 and 2 g/l) by cyclic potential sweeping in the potential range between -1 and 1.8 V (vs. SCE) at a scan rate of 50 mV/s. The EIS experiments were carried out in the frequency range of 10 kHz to 0.01 Hz with AC amplitude of ± 5 mV.

The obtained results from FTIR, XRDand SEM showed that the coatings were synthesized successfully.Therecorded voltammograms showed that the current density of nanocomposite electropolymerization is higher than pure Ppy. Also, the current density increased with increasing the γ-Al_2O_3content. This current increase was attributed to increasing the conductivity of coating.

TheNyquist curves were consisted of one depressed semicircle. So, for obtaining the EIS parameters one time constant equivalent circuit was used. The values of charge transfer resistance (Rct) for Ppy, Ppy/ γ-Al_2O_3 (0.2), Ppy/ γ-Al_2O_3 (1) and Ppy/ γ-Al_2O_3 (2) were obtained 25.41, 49.22, 143.02 and 617.35 Ω respectively. As considered, the values of Rct were increased with increasing the nanoparticle concentration. Therefore, the corrosion performance of Ppy was improved in the presence of γ-Al_2O_3 nanoparticle.

Keywords: Polypyrrole, γ-Al_2O_3 nanoparticle, Carbon steel, Nanocomposite, EIS.

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Stable dye sensitized solar cells based on a gel electrolyte with ethyl cellulose as the gelator

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Abstract

A simple gelating process is developed for the conventional acetonitrile-based electrolyte of dye solar cells, based on ethyl cellulose as the gelator. The electrolyte becomes quasi-solid-state upon addition of an ethanolic solution of ethyl cellulose to the conventional acetonitrile-based liquid electrolyte. The photovoltaic conversion efficiency with the new gel electrolyte is only slightly lower than the liquid electrolyte; e.g. 6.5% for liquid electrolyte versus 5.9% for gel electrolyte with 5.8 wt% added ethyl cellulose. The ionic diffusion coefficient is not affected by the gelation, and the devices are remarkably stable for at least 550 h under irradiation at 55 °C. Realization of larger modules and panels using this gel electrolyte is investigated.

Keywords: Dye sensitized solar cell, Quasi solid state, Gel electrolyte, Ethyl cellulose

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A nanostructured voltammetry sensor development for rapid and sensitive determination of clonazepam

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Abstract

Electrochemical sensors and biosensors for pharmaceutical, food, agricultural and environmental analyses have been growing rapidly due to electrochemical behavior of drugs and biomolecules and partly due to advances in electrochemical measuring systems. The merger between fast, sensitive, selective, accurate, miniaturizable and low-cost electrochemistry based sensing and fields like proteomics, biochemistry, molecular biology, nanotechnology and pharmaceutical analysis leads to the evolution of electrochemical sensors [1, 2].

Clonazepam, is an anticonvulsant agent primarily used in the treatment of epilepsy for both adults and children. Its use is based on daily administration of an oral dose to prevent seizures or intravenous infusions in status epilepticus [3] and neonatal convulsions [4], so it is necessary to monitor the concentration of clonazepam in the plasma of epileptic patients for controlling the dosage. In the presence work, for the first time, a CNFs/CNPs glassy carbon electrode is applied for voltammetric determination of clonazepam.

Preparation of the Modified GCE: Before modification, the GCE was polished with 0.05 µm alumina slurry on a polishing cloth, rinsed thoroughly with water and sonicated in water for 5 min. The CNFs/CNPs suspension was prepared by dispersing 2.0 mg CNPs in 2 mL solution of 0.1 % CNFs in dimethylformamide (DMF) under ultrasonic agitation for 30 min. A desired volume (1µL in optimum value) of the suspension was cast on the pretreated GCE surface and dried in an oven at 50 ^{0}C.

Results and discussion: A sensitive and selective electrochemical sensor was fabricated with the drop-casting of 1 µL cellulose nanofibers (CNFs)\carbon nanoparticles (CNPs) suspension (1.0 mg/mL) onto a glassy carbon electrode (GCE). The electrochemical response of the modified GCE (MGCE) and the bare GCE toward the clonazepam were studied by cyclic and square wave voltammetry. The dependence of peak currents and potentials on pH, accumulation time, concentration and the potential scan rate were investigated for clonazepam at the surface of MGCE. It was found that the first cathodic peak potential shifted negatively with increasing pH suggesting participation of H^+ in the reduction process. Regarding experimental results, the 0.04 M BR buffer solution (pH 2.0), accumulation time of 400 s under open circuit, potential sweep rate of 100 mVs^{-1} were chosen as optimum condition for determination step. The results of the electrochemical investigations showed that CNPs enhanced the electroactive surface area and caused a remarkable increase in the peak currents and CNFs had the potential to improve the selectivity and sensitivity of MGCE for clonazepam. The results of CV and SWV investigations showed a considerable enhancement in the cathodic peak current of clonazepam (up to 60 times). Under the optimal conditions, the modified electrode showed a wide linear response to the concentration of clonazepam in the range of 0.1–10 µM. Furthermore, high reproducibility as well as low detection limit of the electrode responses can be considered as significant features of the prepared modified electrode.

In conclusion, in this study, the CNFs/CNPs suspension has been applied to prepare a new sensitive electrochemical sensor. The modified electrode has remarkable electrochemical advantages, such as antifouling behavior, good reproducibility, excellent repeatability, wide linear dynamic range and low detection limit. Therefore, we believe that this sensor has potential to be used for an accurate determination of clonazepam in pharmaceutical and clinical preparations.

Keywords: *Clonazepam, Carbon nanoparticles, Cellulose nanofibers, Voltammetry, Electrode*

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Electrochemical immunosensor for ultrasensitive detection of tumor necrosis factor α based on fullerene-functionalized carbon nanotubes composite

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Abstract

The study developed an electrochemical immunosensor for ultrasensitive detection of tumor necrosis factor α (TNF-α). To immobilize TNF-α antibody and improve the electrical conductivity, fullerene (C_{60})-functionalized carbon nanotubes (CNTs) were deposited on the screen printed electrode (SPE). The electrochemical properties of C_{60}-CNT were characterized by impedance spectroscopy (EIS) and cyclic voltammetry (CV). Finally TNF-α antibody was covalently connected to the C_{60}-CNT film and the target TNF-α antigen was captured onto the modified electrode surface through immunoreaction. The determination of TNF-α antigen was based on its obstruction to the electrocatalytic reduction of catechol by C_{60}-CNT after binding to the surface of electrode through immunoreactions. Parameters that affect the sensitivity of the immunosensor was studied, such antibodies concentration and incubation times of antibodies, EA and TNF-α. The proposed immunosensor showed satisfactory performance for the detection of TNF-α with good linear ranges, low detection limits, good reproducibility and accuracy. The convenient operation and ultrahigh sensitivity of the proposed immunoassay method provided a promising potential in clinical applications.

Keywords: *Immunosensor, C_{60}-CNT composite, Tumor necrosis factor α, Screen printed electrode.*

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Simultaneous oxidation of hydrazine and hydroxylamine based on fullerene-functionalized carbon nanotubes/ionic liquid nanocomposite

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Abstract

The electrocatalytic oxidation of hydrazine and hydroxylamine were investigated by a fullerene (C60)-functionalized carbon nanotubes (CNTs) and Ionic liquid (IL) on a glassy carbon electrode as an excellent bifunctionalelectrocatalyst. Catalyst materials were characterized by different methods including a transmission electron microscopy, scanning electron microscope, electrochemical impedance spectroscopy and voltammetry. At the modified electrode surface, the peaks of differential pulse voltammetry (DPV) and cyclic voltammetry for hydrazine and hydroxylamine oxidation were clearly separated from each other when they co-existed in solution. Thus, it was possible to simultaneously determine hydrazine and hydroxylamine in the samples at a C60-functionalized CNTs and IL nanocomposite (C60–CNTs/IL/GCE). The DPV data showed that the obtained anodic peak currents were linearly dependent on the hydrazine and hydroxylamine concentrations in the range of 0.05–700.0 and 1.0–300.0 µM, respectively. The DPV method also exhibited the detection limits of 17 ± 2 and 28 ± 2 nM for hydrazine and hydroxylamine, respectively. C60–CNTs/IL/GCE was satisfactorily used for simultaneous determination of spiked hydrazine and hydroxylamine in two water samples.

Keywords: *Fullerene, Functionalized carbon nanotube, Ionic liquid, hydrazine, hydroxylamine.*

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Electrooxidation of Urea on the Nickel Oxide Nanoparticles and Multi-walled Carbon Nanotubes Modified Screen Printed Electrode

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Abstract

The utilization of wastewater for useful fuel has been gathering recent attention due to society's need for alternative energy sources. The electrooxidation of urea found at high concentrations in wastewater simultaneously accomplishes fuel production and remediation of harmful nitrogen compounds that currently make their way into the atmosphere and groundwater [1-3].

The multi-walled carbon nanotubes-NiO nanoparticles composite (MWCNT-NiO) was prepared and the composite was used for modification of screen printed electrode (SPE) for urea electrooxidation in alkaline medium (0.1 M NaOH). Nickel oxide (NiO) was accumulated on multi-walled carbon nanotubes (MWCNT) by pulsed potential electrodeposition. The nature and morphology of the MWCNT-NiO were characterized by X-Ray Diffraction (XRD) and Transmission Electron Microscopy (TEM). The results showed that NiO nanoparticles were uniformly electrodeposited on the surfaces of MWCNTs. Also, the electrochemical behaviour of MWCNTs-NiO nanoparticles composite in an alkaline medium of urea was studied using cyclic voltammetry, chronoamperometry and Electrochemical Impedance Spectroscopy (EIS). The peak on the voltammogram for MWCNT-NiO composite electrode in alkaline medium of urea was observed which was ascribed to the urea oxidation in alkaline medium. The results obtained were discussed from the point of view of employment of the MWCNT–NiO composites for the catalytic electrodes of urea for hydrogen production.

Keywords: Nickel oxide; Nanoparticle; Carbon nanotube; Screen printed electrode; Urea; Electrooxidation.

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A new molecularly imprinted electrochemical sensor for dopamine receptor blocker

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Abstract

A new molecularly imprinted electrochemical sensor is generated for determination of a specific dopamine blocker, metoclopramide (MCP).the sensor wich acts as working electrode is composed of nanoparticles of poly methylmethacrylate imprinted with metoclopramide(MCP) (as a recognizer element) embeded in carbon paste, modified by graphene nanoparticles. nanoparticles of metoclopramide imprinted polymer(NMIP) was prepared by suspension polymerisation method in silicon oil as a dispersion phase in a sonification bath. Ethylene glycol dimethacrylate and 2,2'-azobis(2,4-dimethylvaleronitrile) used as cross-linker and initiator respectively and graphene nanoparticles were synthesis by redox method. After extraction of template the sensor is transfer to supporting electrolyte. Square wave voltammetry was used for ex situ electrochemical measurements. Different parameters including the ratio of materials in the electrode composition, extraction pH, extraction time and pH of supporting electrolyte were tested and optimized According to the electrochemical studies the proposed electrode has a linear range of 5×10^{-11}-10^{-10} and 5×10^{-9}-$10^{-5}$with a detection limit of 5×10^{-11}M. The results showed good detection limit of MCP This modified electrode was successfully used for determination of MCP in a real sample.

Keywords: *carbon paste electrode, graphene nanoparticles, molecularly imprinted polymer nanoparticles, electrochemical sensor*.

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Electrocatalytic behavior of silver nanoparticles synthesized in presence of pepper extract

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Abstract

Due to this property being distinctly different from that of the bulk metal, silver nanoparticles have attracted much attention and have found applications in diverse areas, including medicine, catalysis, textile engineering, biotechnology and bioengineering, water treatment electronics and optics (1,2). Furthermore, currently silver nanoparticles are widely used as antibacterial/antifungal agents in a diverse range of consumer products. The hydrogen evolution reaction (HER) is an electrochemical process that has received wide attention because of its importance in both fundamental and technological electrochemistry such as fuel cell technology (3). In this work, we reported a simple and low-cost procedure to synthesize silver nanoparticles (AgNPs) by using pepper extract as reducing agent. The synthesized AgNPs were characterized by a variety of means such as transmission electron microscope (TEM), powder X-ray diffraction (XRD) and energy dispersive X-ray (EDAX). TEM observations and XRD analysis demonstrated that the size of AgNPs is less than 30 nm. Silver nanoparticles modified carbon paste electrode (AgNPs–CPE) displayed excellent electrochemical catalytic activities towards hydrogen evolution reaction (HER). Finally the kinetic of the hydrogen evolution reaction is also discussed on the AgNPs–CPE.

Keywords: Hydrogen evolution reaction, Pepper, Silver nanoparticles, Electrocatalysis

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Synthesis of carbon nanotube and silver nanoparticle composite: Electrocatalytic application to detection of hydrogen peroxide

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Abstract

Nanocatalysis has recently been a rapidly growing field which involves the use of nanoparticles as catalysts for a variety of organic and inorganic reactions (1). Ag nanoparticles show excellent catalytic and electrocatalytic activities (2). Detection of hydrogen peroxide (H_2O_2) has become extremely important in recent years because of its wide and varied applications (3). Up to now, many techniques including spectrometry, titrimetry, chemiluminescence, and electrochemistry have been employed for determination of H_2O_2 (4). Among them, electrochemical technique is a promising tool for the construction of simple and low-cost sensors due to their high sensitivity, good selectivity, and ease of operation (5).

In this work, we reported a simple and low-cost procedure to functionalize of carbon nanotubes with silver nanoparticles (AgNPs/CNT) by using ascorbic acid as reducing agent. The AgNPs/CNTs were characterized by a variety of means such as transmission electron microscope (TEM), powder X-ray diffraction (XRD) and energy dispersive X-ray (EDAX). AgNPs/CNT modified carbon-paste electrode (AgNPs/CNT/CPE) displayed excellent electrochemical catalytic activities towards hydrogen peroxide (H_2O_2). The reduction overpotential of H_2O_2 was decreased significantly compared with those obtained at the bare CPE. The sensor responded linearly to hydrogen peroxide (H_2O_2) with detection limit of µM at 3σ. The studied sensor exhibited good reproducibility and long-term stability.

Keywords: *Ascorbic acid, Hydrogen peroxide, Functionalization, Carbon nanotubes, Silver nanoparticles*

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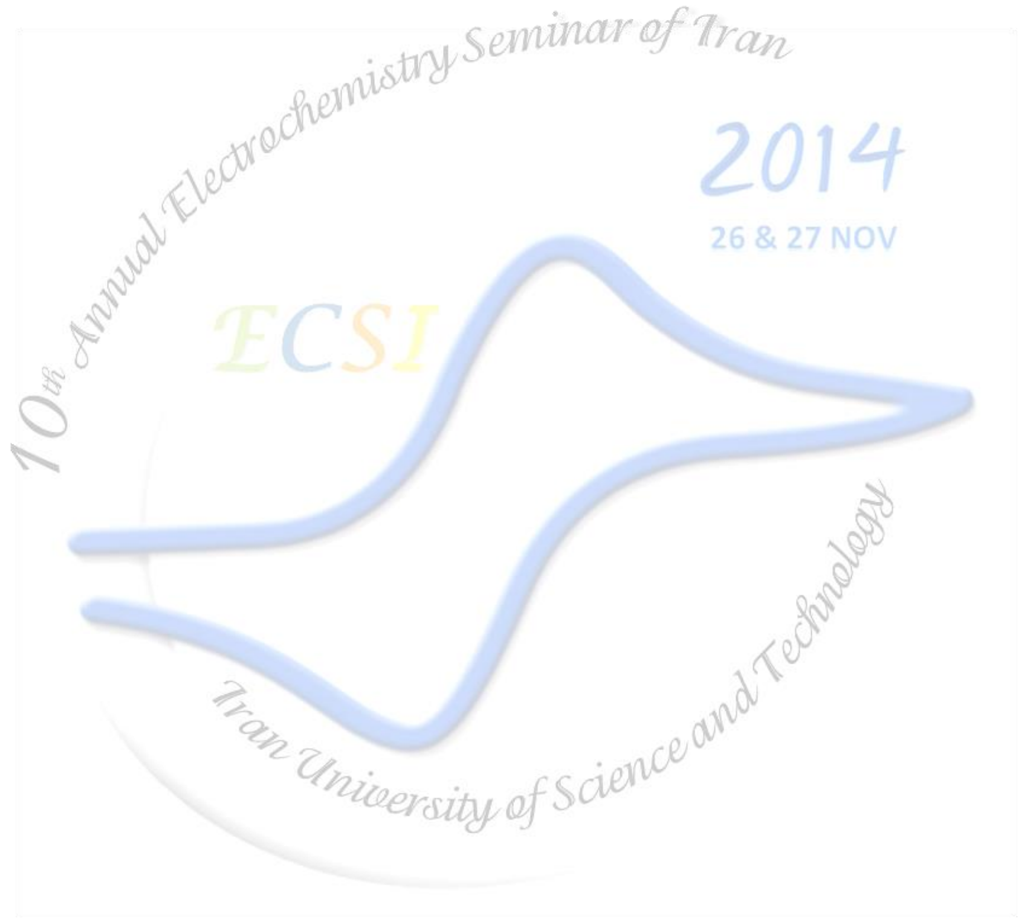

Electrochemical study of the aptasensing of chloramphenicol based on gold nanocubes-modified screen-printed gold electrode

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Chloramphenicol (CAP), is a drug produced by the soil bacterium Streptomyces venezuelae, and was chemically synthesised in 1948 [1].CAP has side effectssuch as genotoxicity, leukaemia and gray baby syndrome [2]. These toxic effects have led to restrict its use in both human and food producing animals. For this reason, the European Union (EU) has set the maximum residue limit (MRL) for CAP at a level of 0.3×10^{-6} g kg^{-1}[3]. In this study we developed an ultrasensitive label-free electrochemical aptasensor for selective detection of chloramphenicol (CAP). The interactions of CAP with aptamer on the gold nano cube/cysteine/screen-printed electrode (SPE) have been studied by cyclic voltammetry (CV), square wave voltammetry (SWV) and electrochemical impedance spectroscopy (EIS). The use of Au NCs-Cys on the SPE surface can improve the biocompatibility of the aptasensor and provided large specific surface area thus increased the current changes that take placed upon analyte binding. In order to get better the analytical implementation of the aptasensor, some parameters such as incubation time, aptamer immobilization time, pH and concentration were optimized. To evaluate the specificity performance of the aptasensor, the responses of the aptasensor to nontarget antibiotics, such as: Cefixime, Cephalexin,Amoxicillin and Florfenicol were checked. In order to have a better perception into the interaction between aptamer and CAP, the effect of ionic strength on the binding of aptamer to CAP was examined too. The proposed aptasensor displayed rapid, high sensitivity and high selectivity response for CAP and will be useful for the detection of CAP in serum samples.

Keywords: *Aptamer, Chloramphenicol, Gold nanocube, Aptasensor, Screen-printed gold electrode*

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Electrochemical sensing of Folic acid using a newly prepared modified electrode based on carbon nanoparticles/cellulose nanofibers composite

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Abstract

A major role has been reported for Folic acid (FA) in biological functions of cell metabolism such as cell division, repair and methylation of DNA, synthesis of nucleotides, amino acids and vitamins [1]. Also, association of FA deficiency in the diet with enhanced risk of megaloblastic anemia, cancer and cardiovascular disease was confirmed [2]. In this research electrochemical oxidation and reduction behavior of FA was thoroughly investigated in detail and then a new simple and sensitive electrochemical sensor was developed for rapid determination of FA in pharmaceutical products.

Keywords: *Folic acid, Modified electrode, Carbon nanoparticles, Cellulose nanofibers*

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Voltammetricdetermination of Diclofenac Sodium in biological samples using multi-walled carbon nanotubes modified pencil graphite electrode

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Abstract

With increasing regulatory pressures on the pharmaceutical industry, there is a growing need for robust sensor systems that allow rapid and reliable determinations, particularly in quality control analysis.Diclofenac [o-[(2, 6- dichloro phenyl) amino] phenyl] acetic acid, is an extensively used, non-steroidal, anti-inflammatory drug with analgesic and antipyretic properties. It is used to relieve the symptoms of many diseases such as rheumatoid arthritis, osteoarthritis, non-articular rheumatism and sport injuries [1]. Several analytical methods have been developed for the quantitative determination of this drug both in pharmaceutical and biological samples [2]. These methodologies include spectrophotometry, Fluorometry, gas chromatography [2] high performance liquid chromatography and nuclear magnetic resonance spectroscopy. Most of these methods require either sophisticated instruments or expensive reagents or involve several manipulation and derivatization steps [3, 4]. In this work, electrochemical behavior for determination of Diclofenac Sodium (DIC) was investigated using multi-walled carbon nanotubes modified pencil graphite electrode (MWCNT-PGE). It was found that the oxidation peak current of DIC at the MWCNT-PGE was greatly improved compared with that of the pretreated PGE. At the MWCNT-PEG, well –defined anodic peak of DIC was observed at about 0.6 V versus SCE (in pH 4.8 solution). The kinetic parameter; charge transfer coefficient, α was determined for DIC at MWCNT-PGE. The influence of several parameters on determination of DIC was investigated. At optimum experimental conditions, differential pulse voltammetry (DPV) was used for determination of DIC, which exhibits a linear calibration graph of $I_p$versus concentration of DIC in the range of 0.005-17 µM with a correlation coefficient of 0.9998. The limit of detection was 2 nM. The interference effects of uric acid(UA) and ascorbic acid (AA) in

the measurement of DIC were also investigated and the results show that the peaks obtained for oxidation of AA , UA and DIC in their mixture could be well resolved by differential pulse voltammetry .permitting us to voltammmetric determination of DIC in the presence of AA and UA. Finally, MWCNT-PGE was usedfor determination of DIC in biological and pharmaceutical samples such as urine and pills.

Keywords: *Diclofenac Sodium, Pencil graphite electrode, Modified electrode, Multi-walled carbon nanotubes, Biological samples.*

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The effect of lanthanum nitrate on ironoxidenanoparticles prepared by electrochemical method

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Abstract

In the last decade, iron oxidenanoparticls have attracted great attention because of their special properties, which differ significantly from those of the bulk materials [1,2].In this study, iron oxide nanoparticles were synthesized by electrocrystallization in the presence of $La(NO_3)_3.6H_2O$as an inorganic additive. The synthesis was performed in an electrochemical cell containing two iron electrodes with an aqueous solution of sodium butanoate and sodium sulfate as electrolyte [3]. In order to investigate the effect of lanthanum salt concentration on products, different samples were synthesized with 0.0001 M, 0.001 M, 0.007 M and 0.014 M of $La(NO_3)_3.6H_2O$ as inorganic additive. The effects of lanthanumsalt concentration on particle size, morphology, structure and their magnetic properties were investigated. The magnetite nanoparticles were characterized by X-ray diffraction, electron microscopy, and magnetometry methods. Based on XRD results the crystallinity of the products is very sensitive to the variation in the concentrationof lanthanum salt and different types of lanthanum compounds such as La_2O_3, LaO, and $La(OH_3)$ can be formed in the electrolyte solution as byproducts, depending on the lanthanum concentration. SEM images show the mean particle size increases from ~36 nm to ~58 nm by increasing the concentrationof lanthanum saltfrom 0 to 0.0001 M and again decreases to ~33 nm by increasing the concentration to 0.014 M.Furthermore, sheet-like structures were observed in those samples prepared in the presence of lanthanum salt (Fig. 1). Manetometery results show that all samples are magnetically soft with a little hysteresis, but their specific magnetization, is highly dependent on the growth conditions.Room-temperature magnetization

ranges from ~3 to ~46 Am^{2}kg^{-1}, depending on the lanthanum concentration and particle size(Fig. 2).

Keywords:Magnetite nanoparticles,Electrocrystallization,Lanthanum salt,Inorganic additive, Magnetization, Structural properties

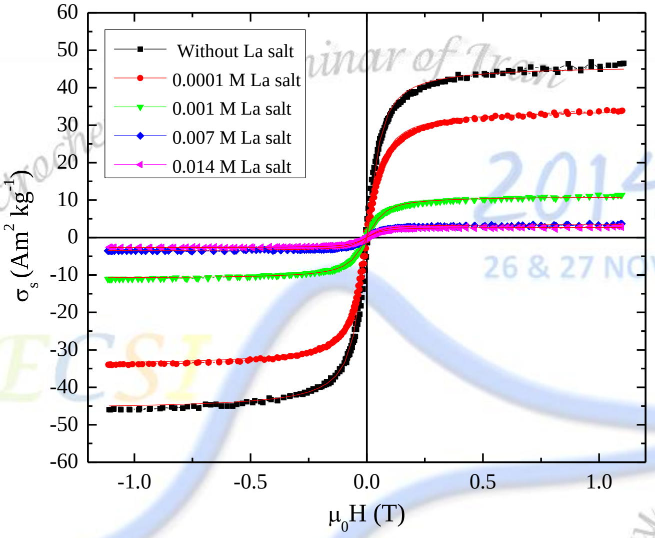

Fig. 1. Room-temperature magnetization curves of the samples prepared with different concentrations ofLasalt.

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Manganeseferritenanoparticles synthesized by a new electrochemical method

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Abstract

Polycrystalline spinel ferrites are the subject of many researches due to their physical and chemical properties. Manganese ferrite nanoparticles have been of great interest because of their remarkable soft-magnetic properties accompanied by good chemical stability and mechanical hardness[1,2]. In this study, manganese ferrite nanoparticles were synthesized using electrocrystallization method. The synthesis was performed in an electrochemical cell containing two iron electrodes with an aqueous solution of sodium butanoate and sodium sulfate as electrolyte [3]. To study the formation of manganese ferrite nanoparticles different samples were synthesized by adding manganese (II) sulfate hydratein the electrochemical cell. We have prepared four samples varying the concentrations of manganese (II) sulfate hydrate from 0.001 M to 0.03 M. After applying an appropriate potential difference of 5 V, water is reduced to hydrogen and hydroxyl anions at the cathode and the iron anode is oxidized to iron ions. Therefore in the solution, manganese, iron and hydroxyl ions meet to react and form $Mn_xFe_{3-x}O_4$, depending on the manganesesalt concentrations.If the quantity of iron ions produced during the electrolysis process is high and the amount of manganese ions incorporated into the ferrite is not sufficient to fill the octahedral positions in the spinel structure, the product could consist a mixture of particles with different nature.Thecrystal structure of the samples was studied using X-ray diffraction. The obtained results show that the Manganese ferrite nanoparticles are formed in the electrochemical cell containing 0.014 M manganese salt. Also, we found that the formation of a paramagnetic secondary phase in the sample without manganese is suppressed by adding 0.001 M manganese salt.Electron microscope images demonstrate that tuning the

manganese salt concentration produces significant changes in particle size and their morphology. Magnetization curves show that all samples are magnetically soft and their magnetization ranges from 15 Am^2kg^{-1} to 73 Am^2kg^{-1}, depending on the growth conditions(Fig. 1).

Keywords: *$Mn_xFe_{3-x}O_4$nanoparticles, Electrocrystallization, Magnetization,Structure property*

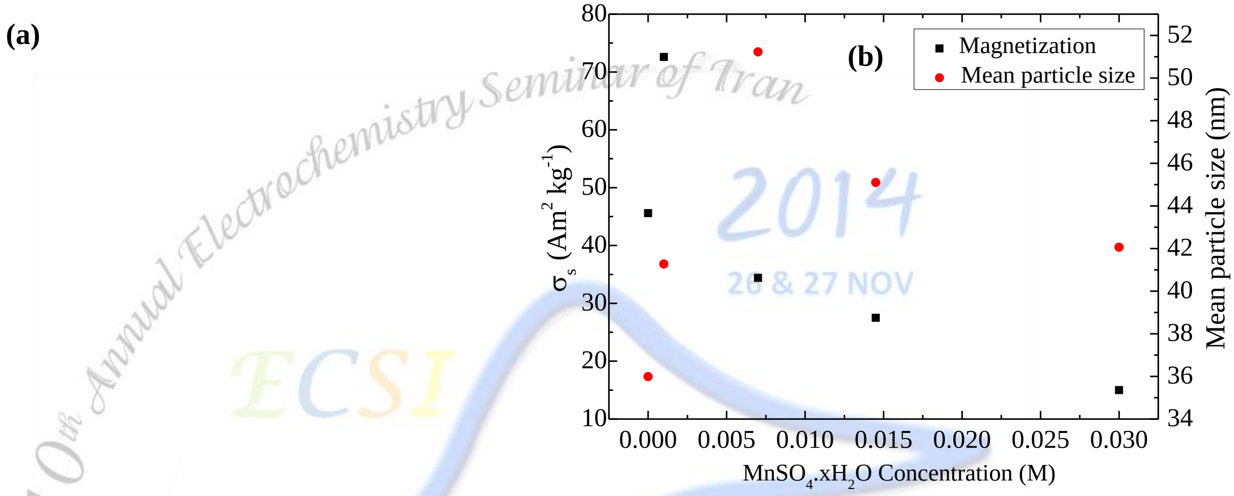

Fig. 1.(a) A typical SEM image of the sample synthesised with 0.001 M of $MnSO_4.xH_2O$, and (b) the plots of mean particle size and specific magnetization versus manganese salt concentration.

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Preparation and characterization of a novel biosensor based on iron oxide nanoparticles for electrochemical studies of tyrosine

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Abstract

Tyrosine(4-hydroxyphenylalanine, Tyr), that is one of biochemical compounds which play important roles in various biological processes. Tyr is an essential aromatic amino acid and vital constituent of proteins, which is indispensable in human nutrition for establishing and maintaininga positive nitrogen balance [1]. Tyr and other amino acids play roles ininducing dementia such as Alzheimer’s disease. Alteration of Tyrconcentration is also related to atherosclerosis and lung diseases[2]. So it is important to accurately and sensitively detect Tyr levels. In the present work, a simple strategy for determination of Tyr based on iron oxide nanoparticles modified carbon pasteelectrode is reported. The iron oxide nanoparticles displayed high effectivesurface area, high porosity, more reactive sites and excellent electrochemical catalytic activity toward the oxidation of Tyr.The characterization of the modified electrode was studied using different techniques such as X-ray diffraction (XRD),scanning electron microscopy (SEM), electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV). The electrochemical oxidation of Tyr has been studied using cyclic voltammetry (CV) and differential pulse voltammetry (DPV) techniques at the surface of the modified electrode. Also for electrochemical studies of Tyr, various electrochemical techniques such as linear sweep voltammetry (LSV),chronoamperometryand chronocoulometry were applied. The modified electrode exhibited excellent electrocatalytic activity towards the oxidation of Tyr. After optimizing the experimental conditions, the anodic peak current of Tyr showed a linear correlation to its concentration in a broad linear dynamic range with low limit of detection. Also

the modified electrode presented a good stability and repeatability toward the determination of Tyr.Finally, the proposed method was successfully applied for the determination of Tyr in human blood serum and pharmaceutical samples.

Keywords: Tyrosine, Nanostructured Modified Sensor, Carbon Paste Electrode, Electrochemical Studies

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Enzymic biosensor Fabrication and Evalution by electro polymerization of polypyrrol- carbon nano tube compositer for Glucose

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Abstract

Biosensors is paramount for improving the quality of human life. The polypyrrole- carbon nano tube composite - glucose oxidase has been investigated in the present work. Poly pyrrole- carbon nano tube composite film via cyclic voltammetric method wase synthesized in standard thee-electrode cell. Graffit and platinum electrode as were used as working and counter electrodes. The synthesized film characterized by Fourier trans from infrared Spectroscopy. A simple technique was used for fabrication of glucose sensor. In this method glucose oxidase as an enzyme was immobilized by glutaraldehyde as cross- linking agent over polypyrrole thin films. Effect of some experimental variables such as PH; temperature; potential were investigated. A maximum current response was resuited at pH 7 and potential 0.7 V.

Keywords: *Nano composite; Enzymic biosensor; Glucose oxidase; polypyrrole*

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Designing an electrochemical nanosensor for determination of carboxylic acids

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Abstract

Carboxylic acids are examples of compounds with wide industrial applications and high potential [1]. Malonic, salicylic, Citric and malic acids are the main organic acids of fruits and are the most important components which wide use in medicine and food applications [2]. Salicylic acid (SA) is a beta hydroxy acid used in organic synthesis and functions as a plant hormone. It is derived from the metabolism of salicin. SA is a main metabolite of acetylsalicylic acid, that is, one of the drugs most widely used in the world as a painkiller and anti-inflammatory, but banned from veterinary therapeutic treatment [3]. Malonic acid (MA) is very damaging especially in cancer and other degenerative diseases because it interferes with respiration. The ionized form of MA, as well as its esters and salts, are known as malonates [4]. In the present research, carbon paste electrode modified by multi-walled carbon nanotube used for determination of SA in the presence of MA. The modified electrode was shown well sensitivity and selectivity for the two analytes in the optimized conditions. The modified electrode used in cyclic voltammetry, choronoamperometry, linear sweep voltammetry and differential pulse voltammetry for determination of some parameters like diffusion coefficient , electron transfer coefficient, linear cencentation range and detection limit. The linear concentration range for SA and MA were 0.158-67.32 and 0.52-5.0 µM, respectively. The detection limit ($3\sigma/m$) for SA and MA were obtained 38.0 and 35.0 nM, respectively. Finally, the modified electrode was used for determination of the two mentioned acids in real samples.

Keywords: Salicylic Acid, Malonic Acid, Multi-walled Carbon Nanotube, Modified Sensor, Electrochemical studies

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Electrochemical properties of Ni/RuO_2-TiO_2 and Ni/RuO_2-Ta_2O_5-TiO_2 active cathodes for hydrogen evolution in alkaline media

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Abstract

It is estimated that ca. 30% of the caustic soda yearly production is presently obtained via the membrane cell process. In this process an ion exchange membrane separates the anode and cathode compartments. Saturated brine is fed to the anode compartment and 30-32 % caustic soda to the cathode compartment. Upon electrolysis, chlorine is evolved at the anode, hydrogen is evolved at the cathode and sodium ions migrate to the cathode compartment, where the concentration of caustic solution may reach 35 %. However, the efficiency of the cathodes is an important issue in the membrane cell process, since the hydrogen overpotential contributes in a non-negligible way to the overall power consumption. Since efficiency must be judged on the long term, it results from a combination of appropriate activity and stability in the strongly alkaline solution that the cathodes have to withstand at the high current densities used in technological application [1]. So, in industrial chlor-alkali electrolysis, the development of the active cathode is very important for saving the power consumption by reducing hydrogen overvoltage [2]. It has been reported that the activation of the cathode was tried to be accomplished by increasing the effective surface area in the case of Raney Ni [3] and by loading the highly active catalysts for the hydrogen evolution reaction on the electrode substrate [5]. Furthermore, it has been recently found that oxide electrodes such as RuO, and IrO, [6] served as a stable and active electrocatalyst for the hydrogen evolution reaction. This paper presents the study of mixed metal oxide (MMO) coatings viz. RuO_2-TiO_2 and RuO_2-Ta_2O_5-TiO_2 prepared by thermal decomposition method and coated on Ni mesh. The surface morphologies and compositions of MMO coating of cathodes were determined by energy dispersive X-ray spectroscopy (EDX) and scanning electron microscopy (SEM) techniques. The results showed

that the cathodes contain mud-crack structures and flat areas. In RuO_2-Ta_2O_5-TiO_2/Ni cathodes, there were many nano sized crystallites along the inner side of cracks with average sizes about 10-50 nm. The electrocatalytic activity of cathodes towards hydrogen evolution reaction (HER) was studied by using the cyclic voltammetry and electrochemical impedance spectroscopy methods. The kinetics of HER cathodes has been investigated by polarization measurements in alkaline media. The cathodic current and slope for RuO_2-Ta_2O_5-TiO_2/Ni electrode was 1.17 mA/cm^2 and 35 mV/dec were obtained, respectively. So, the higher cathodic current and lower slope was obtained for RuO_2-Ta_2O_5-TiO_2/Ni electrode. The number of active sites for this cathode was higher than the values of RuO_2-TiO_2/Ni ones. According to EIS results, the faster dissolution of Ru species from the RuO_2-TiO_2/Ni coating surfaces occurred in the comparison of the RuO_2-Ta_2O_5-TiO_2/Ni prepared cathode. The addition of Ta oxide into the MMO coating increases the stability of cathodes.

Keywords: Hydrogen evolution reaction, Electrocatalysis, Ruthenium oxide, Cyclic voltammetry, Electrochemical impedance spectroscopy

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Understanding mechanism of exfoliation of graphite to graphene in Organic solvents, mixed with surfactant and Li salt

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Abstract

The graphite rod was inserted as cathode into the DMSO solutions mixed with LiClO4 and Triton X100, placed parallel to the Pt wire as counter electrode with a separation of 1 cm and Ag/AgCl as reference electrode.Potential-controlled cathodicreduction is used to intercalate graphite electrodes. Cyclic voltammetry applied to measure influence of electrolyte, CMC of surfactant, kind of surfactant and kind of salt on electrochemical exfoliation of graphite The structures of the synthesized Graphene characterized by X-ray diffraction (XRD) spectrometry, Fourier transform infrared (FT-IR) spectrometry and scanning electron microscopy (SEM).

Keywords: *Graphene, Surfactant, Organic solvent, CMC, Exfoliation of graphite*

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Natural gas components separation on activated carbons columns and analysis on Pd-doped SnO_2 sensors

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Abstract

Pd/SiO_2 doped SnO_2 gas sensors were used for analysis of the hydrocarbon components of the natural gas (NG) separated on an activated carbon column, to evaluate NG heating value. 1 m long 1/8” OD column packed with activated carbon heated from 50 to160ºC at 10ºC/min completely separates NG components in air as the carrier gas. The column effluents pass over the Pd-SiO2/SnO2 sensor. The SiO_2-doped SnO_2 samples were prepared by an ultrasonic-assisted precipitation method and then impregnated with $Pd(NO_3)_2$ solution. The 1.0% Pd-5% SiO_2/SnO_2 is the most stable sample. The sensitivities of these sensors to ethane and propane components of the NG are significantly higher than that to methane. This allows more accurate detection of lower amounts of the components. The separation column-gas sensor combination has advantages such as using air as the carrier gas, higher sensitivity to ethane and propane, and much cheaper than gas chromatographs equipped with FID for analysis of the natural gas.

Keywords: *Sensor, Semiconductor, Metal oxide, Separation, Heating value, Natural gas*

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Determination of Energy Levels of CdS thin film by electrochemical methods: Mott-Schottky, Cyclic and Linear Sweep Voltammetry

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Abstract

The use of photo-electrochemical cells to mediate the direct conversion of optical energy to electricity is receiving widespread attention. CdS as n-type semiconductor has increasingly attracted interest. Because it has many potential applications in various optoelectronic devices with a wide direct optical band gap of 2.42 eV[7, 8]. In this work we focusedon the investigationof CdSphoto-properties by several electrochemical methods such as *Cyclic Voltammetry*(CV) for the quantitative estimation of the position of band energy and surface statesin alkaline electrolyte[10-11]. Surface states act in trapping and detrapping of photoelectrons inducing the charge recombination [13, 14] or provide a path for electron transfer in the electrode/electrolyte interface. Also the band gap energy (E_{bg}) as measured by UV-Vis and CVmethods were obtained 2.5 and 2.3 eV respectively. Mott-Schottky plots were used to find the flat band potential (E_{fb}), the value of donors density (N_D) and the Debye length (L_D). These values are calculated -0.916 V/SCE, 3.21×10^{17}cm^{-3} and4.38×10^{-6}cmrespectively. Also, the presence of surface states is investigated by Mott-Schottky and linear sweep voltammetry (*LSV*) techniques and found to be set at the -0.7 V/SCE.

So, the importance of improved methods as mentioned above, make us to investigate the photo-properties and semiconductor parameters (such as E_{fb}, E_{bg}, N_D and L_D) of CdS thin film by means of UV-Vis spectroscopy and electrochemical methods e.g. *Mutt- Schottky, CV, LSV.*

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[1] PhD student of electrochemistry
[2] Professor

Keyword: *CdS thin film, Mott-Schottky plot, photoelectrochemical studies, energy level*

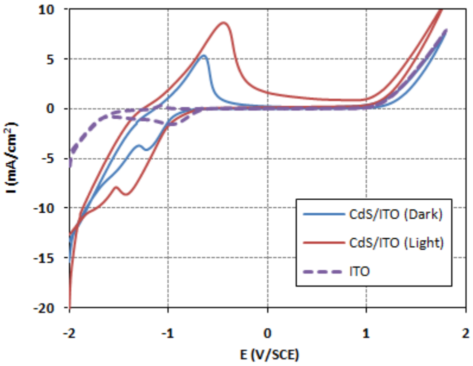

Fig. 1 Cyclic voltammograms of ITO and CdS/ITO samples in 0.1 M NaOH solution under dark and illumination conditions, S.R=100 mV/s

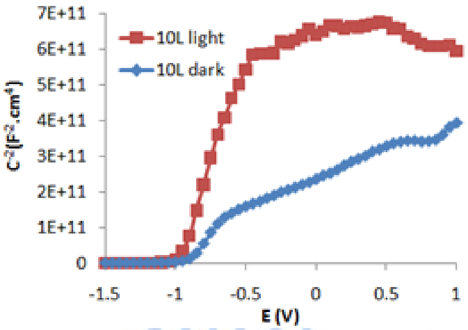

Fig. 2 a) Capacitance-Potential and its insert curves in the depletion region and b) Mott-Schottky plot of CdS/ITO electrode in the 0.1 M NaOH solution in dark and illumination, in 1 kHz frequency and S.R=50 mV/s

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Theoretical and experimental report on the determination of redox potential of triamterene

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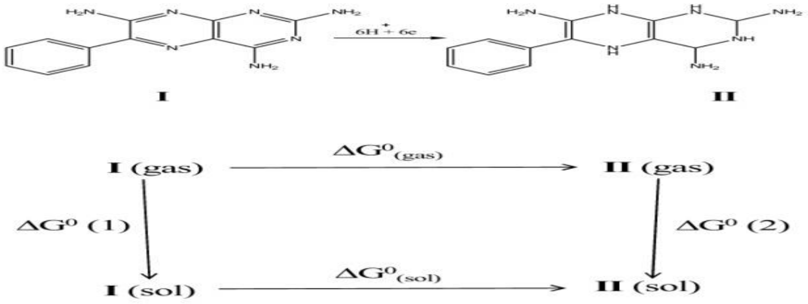
Abstract

Triamterene (Tr), 2, 4, 7-triamino-6-phenylpteridine, is a diuretic drug belonging to the potassium sparing diuretic family [1]. Tr has been included on the list of forbidden substances of the International Olympic Committee. However, different methods have been applied for Tr determination in pharmaceutical preparations and biological fluids but electrochemical behavior of this drug is not reported. Accurate calculation of theoretical electrode potentials has an important role in understanding the nature of electron-transfer reactions and the determination of molecular behaviors [2].This research work focuses on the determination of reduction potential of Tr, both theoretically and experimentally. The result of conductor polarizable continuum model (CPCM) calculations for reduction potential of Tr in dimethyl sulfoxide (DMSO) is presented. Calculations have been carried out using density functional theory (DFT) computations at the B3LYP/6-311G (d) level. Gaussian 03 has been employed for all calculations. Based on the optimized geometries of compounds (**I** and **II**) in the ground states (S_0), the Gibbs free energies were obtained via single point computations both in vacuo and DMSO solution. Scheme **1** was shown thermodynamic cycle can be used to calculate the redox potential in solution.



Scheme **1.** Thermodynamic cycle used to calculate the redox potential in solution.

In order to compare with experimental data, the standard redox potential of the Tr in the ground state relative to the standard hydrogen electrode (SHE) can be calculated using Eq. (1) [3] on the basis of the thermodynamic cycle as shown in Scheme **1**.

$$E^0\ (I/II) = -\ (\Delta G^0_{(I/II)} - \ \Delta G^0_{(SHE)})/\ nF \qquad (1)$$

where

$\Delta G^0_{(I/II)} = -\Delta G^0_{(sol)}$

$\Delta G^0_{(sol)} = \Delta G^0_{(gas)} + \Delta G^0\ (2) - \Delta G^0\ (1)$

$\Delta G^0_{(gas)} = \Delta H^0_{(gas)} - T\ \Delta S^0_{(gas)}$

$\Delta G^0\ (2) = G^0\ (II, sol) - G^0\ (I, sol)$

$\Delta G^0\ (1) = G^0\ (II, gas) - G^0\ (I, gas)$

Based on calculation results and experimentally data (**Fig. 1**), E^0 (I/II) relative to Ag/AgCl were 1.316 V and 1.238 V, respectively. It is clearly can be seen that the calculated results are in a satisfying agreement with experimental results.

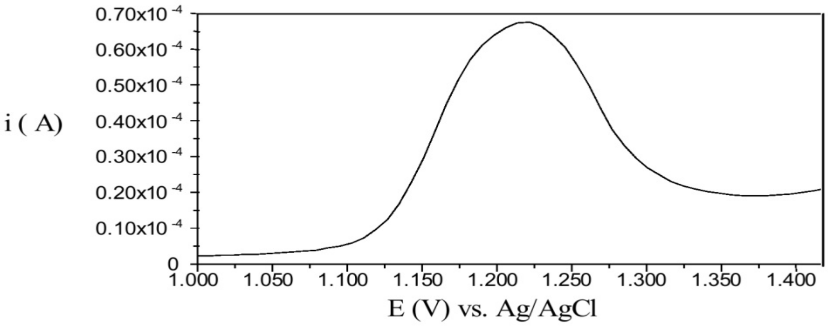


Fig. 1. Differential pulls voltammogram of 1 mM Tr at a pencil graphite electrode in a DMSO solution of 0.1M $NaClO_4$. Scan rate 16 mV s^{-1}.

Keywords: Redox potential, Solvation model, Triamterene, DFT, Differential pulls voltammetry

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Theoretical study of functionalized of Boron Nitride Nano cones with Pyrrole molecule

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Abstract

Boron-nitride nanotubes (BNNTs), which are analogues tocarbon nanotubes (CNTs), possess many desirable properties.For example, all BNNTs are semiconducting with a wide bandgap B5.5 eV only weakly dependent on their diameters,helicities, or the number of the tube walls [1].Moreover, BNNTs Possess enormous mechanical strength [2],high thermal conductivity [3],high thermal and chemical stability, as well as strongoxidation resistivity [4].Recent experiments show that BNNTswith high purity and quality are inherently noncytotoxic[5]whereas CNTs are likely cytotoxic [6],implying that BNNTs may be superior to CNTs for wider biomedical applications.Nano cones have been compound the structure gash and storehouse and were found with protractor. Boron nitride Nano cones compeered with carbon Nano cones have been good properties such as low density, mechanical rigidity and higher broadcast. Boron nitride Nano cones have been very large band gap that reason is semcandetore. In this study boron Nano cones produce with B34N34H12 formula that’s 12A high, 80 atom in 11 ring and optimation B3LYP/6-311+G(d) and investigation length in 3 levels (fig1).In this research, the functionalization of appropriate sites of boron nitride Nano cones with hetrocycle Pyrrole was studied using the density functional theory.Using the released energy, the most appropriate site to obtain the product was identified and the structural, adsorption energy and band gap were studied.Result shows the Pyrrole was cant stable changing ban gap and all structures have beensemiconductor.Summation ban gap energy in thermodynamic stable product shows Summation kinetics stability this structures.

Keywords: *boron nitride Nano cone, Pyrrole, band gap, density function theory and semcandetore*

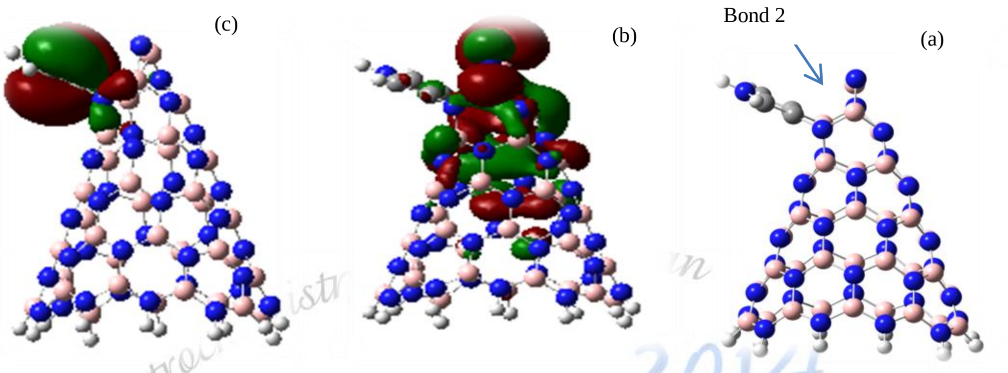

Figure1: (a)cyclo addition bond2 (b) HOMO bond2 and (c) LUMO bond 2

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DFT Study of Substituted Azobenzene as Corrosion Inhibitorsfor Mild Steel

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Abstract

Quantum chemical approach at B3LYP/6-31++G(d,p) level of theory was used to calculate some electronic properties of azo dye derivatives, as mild steel corrosion inhibitors, to as certain the correlation between their inhibitive efficiencies and some of the computed parameters. Calculations of prepared compounds gave useful information to predict the interaction between the surface of metal and the organic molecules as corrosion inhibitors.

Keywords: DFT, Azobenzene, Corrosion Inhibitor.

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Evaluation of the activity of binary PtM/C alloy catalysts towards the oxygen reduction reaction (ORR) for PEMFCs

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Abstract

A comprehensive study of the investigations performed in search for development of electrocatalysts with enhanced catalytic activity and stability for low temperature polymer electrolyte membrane (PEM) fuel cells are presented. we evaluated the activity of binary PtM/C (M = Ni,Co,Cu,Mn,Au,Ag,Fe,Y,W) alloy catalysts towards the oxygen reduction reaction (ORR) in acidic solution. The comparison is done based on the potential difference in ORR .While the ORR kinetics on high surface area Pt catalyst is still sluggish, intensive researches have focused on the Pt alloyed catalysts, such as Pt-Co, Pt-Fe, Pt-Ni and Pt-Cu. It has been established that by alloying Pt with non-precious transition metals, the kinetics of the ORR can be significantly improved and the expense of catalyst can be reduced as well. The enhanced activity of the Pt alloys has been attributed to the electronic structure change and the geometric effects that facilitate the adsorption/desorption of the ORR intermediates .

Keywords : PEM fuel cells , Binary alloys , Oxygen reduction reaction , Geometric effects

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Graphite based dye sensitized solar cell

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Abstract

In this study, we introduced graphite based counter electrode for dye sensitized solar cell [1]. The results showed, graphite can be a good counter electrode in N719 based dye sensitized solar cells. Cyclic voltammetry and photovoltaic studies showed, the I_3^-/I^- redox couple can be reacted on graphite electrode. I_3^- species can be reduced on this electrode to I^- types and I^- species can be oxidized to I_3^- species [2]. This facts means, we can used these electrode for dye sensitized solar cells [3]. On the other hand, photovoltaic results showed the solar cell devices which fabricated from this electrode have acceptable efficiency and another characters. We define the four characters for dye sensitized solar cell such as short circuit current (I_{sc}), open circuit voltage (V_{oc}), fill factor (FF) and photovoltaic efficiency (η). Short circuit current is maximum current of solar cell device in the absence of potovoltage. If the short circuit current of solar cell device to reach its minimum value, the maximum voltage (Open circuit voltage) is obtained. Cyclic voltammetry of this electrode showed I_3^-/I^- redox couple by using $NaClO_4$ as supporting electrolyte in acetonitrile solvent in 0.05 $V.s^{-1}$ scan rate and Pt work and counter and Ag/AgCl reference electrode have two peak in 0.25 V and 0.75 V for this electrode in figure1. This peaks not found for free FTO (fluorine doped tin oxide) electrode.

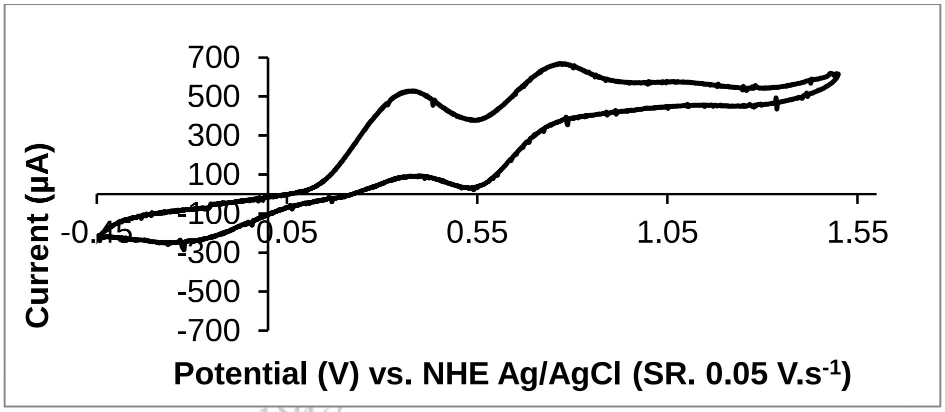

Figure 1. Cyclic voltammetry of graphite based counter electrode for dye sensitized solar cell in I_3^-/I^- redox couple by using $NaClO_4$ as supporting electrolyte in acetonitrile solvent in 0.05 $V.s^{-1}$.

This diagram for platinum based electrode these was studied too, and results showed the graphite based electrode was a suitable electrode for dye sensitized solar cells.

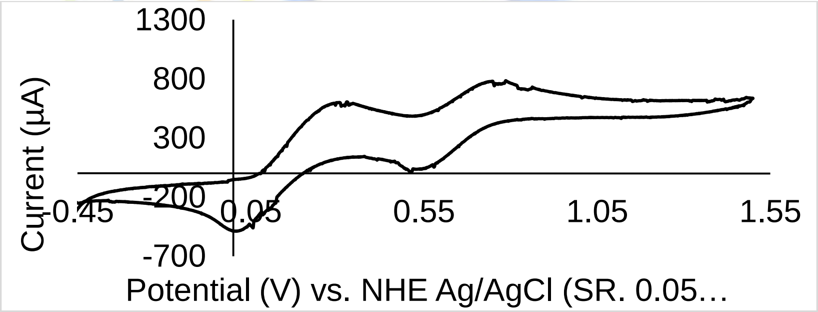

Figure2. Cyclic voltammetry of graphite based counter electrode for dye sensitized solar cell in I_3^-/I^- redox couple by using $NaClO_4$ as supporting electrolyte in acetonitrile solvent in 0.05 $V.s^{-1}$.

This study for graphite free FTO electrode in similar condition showed the graphite free electrode don’t have the electrochemical peaks in 0.25 V and 0.75 V. figure3

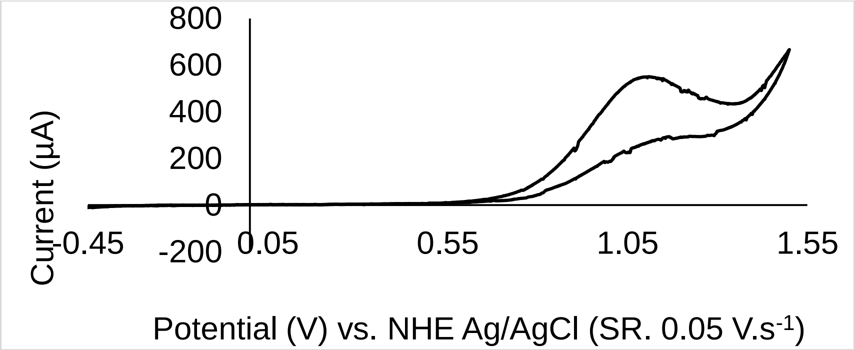

Figure3. Cyclic voltammetry of graphite free FTO counter electrode for dye sensitized solar cell in I_3^-/I^- redox couple by using $NaClO_4$ as supporting electrolyte in acetonitrile solvent in 0.05 V.s^{-1}.

Photovoltaic measurement of dye sensitized solar cell based graphite counter electrode showed these electrode can be reduce the I_3^- to I^-. the platinum counter electrode based N719 dye sensitized solar cell have 2.3% photovoltaic performance and 1838.13 µA for short circuit current and 0.72 V open circuit voltage and 43% fill factor in AM1.5 (100 mW/cm^2) light intensity condition, respectively. In continue, this factors for graphite counter electrode based N719 dye sensitized solar cell have 1.6% photovoltaic performance and 1211.25 µA for short circuit current and 0.7 V for open circuit voltage and 47% for fill factor in AM1.5 (100 mW/cm^2) light intensity condition, respectively. Therefore, this novel counter electrode can be used in dye sensitized solar cells.

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Study of anion effect in platinum electrodepositing solution on platinum electrocatalyst performance for glucose oxidation reaction in biofuel cells

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Abstract

With an increasing demand of pollution free and cheap energy, investigators are focusing on more easily available, less toxic and safer fuel and this bring the investigator to the very enlightening concept of fuel cell which could run on glucose. Studies on electro-catalytic oxidation of glucose are of high interest to the fuel cell community for various reasons. Glucose is easily available, cheap and non-toxic bio-fuel. No storing problem or explosion hazard is associated like hydrogen in hydrogen-oxygen fuel cell. The studies throughout the last few decades on electro-oxidation of sugars was performed and showed that noble metal catalyst based on platinum and gold in alkaline media improve the rate of electro-oxidation of glucose rather than acidic and neutral [1-7]. In this work preparation of platinum (Pt) electro catalyst was performed by electrodepositing of platinum on modified carbon paper electrode. These electro catalysts applied for study of electro-oxidation of glucose in alkaline media. Substrate is fabricated by deposition of 3mg/cm^2 carbon Vulcan paste on carbon paper sheet then it dried by heating in 200^{o}C for 45 minutes. As-prepared substrate expose to precursor solutions included of: 1- H_2SO_4 (0.5 M) with H_2PtCl_6 (2mM) (Merck, Germany) and 2- H_3PO_4 (0.5 M) with H_2PtCl_6 (2mM). Then 50 Cyclic voltammetry (CV) scans (100 mV/s, 1.20 to − 0.60 V vs. Ag/AgCl sat KCl) were applied. The onset oxidation potential for glucose electro oxidation at the Pt/C electro catalyst (-0.85 V) is similar in the two electro catalysts as shown in fig1. On the other hand, the peak current density of glucose electro oxidation at platinum electro catalyst that was prepared in phosphate precursor solution (23 mA /cm2) is about 1.64 times of that at the Pt

electro catalyst that was prepared in sulphate precursor solution (14 mA /cm2) at -0.3 V vs Ag/Cl sat KCl reference electrode.

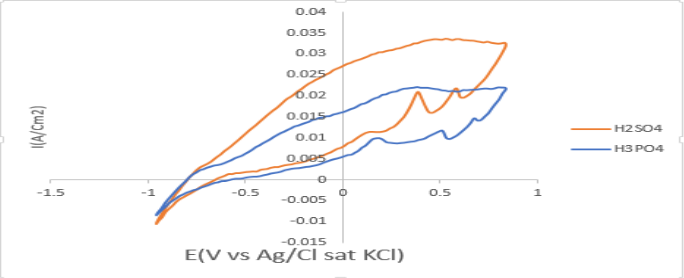

Figure 1: Cyclic voltammogram of Platinum electro catalyst at scan rate of 20 mV/s in the presence of 300mM glucose (measurement were performed in 0.5M KOH solution under nitrogen atmosphere at room temperature.

It is understandable that more catalytic activity of platinum prepared in phosphate precursor solution for reaction of glucose species resulted in high dispersion of platinum nanoparticles on surface of the carbon paper electrode and high roughness factor rather than platinum prepared in sulphate precursor solution as shown in table1. It can be enhance the number of electroactive sites for glucose oxidation reaction.

Table 1 ECAS and roughness factor of *platinum* electro catalyst

Anion	Active surface area (cm^2)	Roughness factor
Sulphate	438	561
Phosphate	485	623

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Cyclic voltammetry study of Ag (I)/Ag (II) couple at IrO_2/Ti anode in a membrane cell

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Abstract

The electrochemistry of Ag (I) /Ag (II) redox couple was investigated using three electrode system in an elctro-membrane cell. The cyclic voltammery responses reveal a diffusion-controlled quasi reversible process with a diffusion coefficient of 5.52×10^{-5} cm^{2} s^{-1}. The reversibility of the redox reaction was improved considerably at low temperatures.

Keywords: *Cyclic voltammetry, Silver (II), Diffusion coefficient, Electro-membrane cell.*

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Electrochemical characteristics of platinum nanoparticles based on graphene sulfonated for ethanol oxidation in acidic media

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Abstract

We report sulfonated graphene catalyst for the ethanol oxidation in acidic media. Graphene is synthesized from graphite electrode using ionic liquid-assisted electrochemical exfoliation. Ammonium sulfate was used as an agent for graphene sulfonation. In order to study of catalyst characterizations, X-ray diffractometer (XRD), scanning electron microscopy (SEM) and transmission electron microscope (TEM) were used for determination of crystallite size, surface morphology and uniform deposition of Pt NPs respectively. The electrochemical characteristics are investigated by cyclic voltammetry (CV), linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS) and chronoamperometery (CA) of Pt/C and Pt/S-rGO in nitrogen gas saturated in 0.5 M H_2SO_4 and ethanol solutions.

Keywords: *platinum nanoparticles, sulfonated graphene, Ethanol oxidation*

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Electrochemical synthesis of carbon quantum dots, and their photoluminescence properties

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Abstract

There are different methods for synthesis of Carbon quantum dot that each of of them has special advantages and disadvantages.

We report the facile one-step alkali-assisted electrochemical fabrication of CQDs with sizes of less than 10 nm and excellent upconversion luminescence properties. By using graphite rods as both anode and cathode, and NaOH/Ethanol as electrolyte, we synthesized CQDs with current intensity of 30-80 mAcm^{-2}.

The CQDs exhibit excitation-dependent and upconverted PL properties. The PL and ECL properties will provide a new route to study the novel materials and broaden the use of them in analyte detection. The electrochemical measurements were performed using a potentiostate-galvanostat instrument. A three-electrode cell was employed in all experiments with a Pt counter electrode, Ag/AgCl, KCl, 3 M as reference electrode, and graphite rod as working electrode in NaOH/EtOH solution at a scan rate of 50 mV s^{-1}.We applied 5 different voltages and results show that by increasing number of cycles and voltage from 1 to 5 , peaks shift on right.

Keywords: *Carbon quantum dot, alkali-assisted, photo induced, electrochemiluminescence*

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Electrodeposition of FePt/Ptmultilayers thin films and their characterization

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Abstract

FePt thin films have many applications in different fields of science and engineering such as national defense andmedical treatment due to their high coercivity and excellent chemical stability[1].Electrodeposition as an alternative deposition technique has some advantages over vacuum based techniques. It is economically important because of its low cost and flexibility[2].

Keywords: FePt/PtMultilayers, Structure, Morphology

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Dynamic Light Scattering of Mixed SDS-Hemin-Imidazole in Different Ionic Strength: As Structural Feature of Artificial Peroxidase

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Abstract

Artificial enzymes can be considered a part of biomimetic chemistry. An alternative approach to the preparation of robust biocatalysts consists in the encapsulation of metalloporphyrins into water-soluble hydrophobic pocket, as Micelles, vesicles[1], that mimic the polypeptide envelope, which protects the catalytic center into inactive complexes. So these studies also can be classified into colloid chemistry as part of interfaces in solutions. The electronic properties and biochemical functions of heme prosthetic group as an active-site of horseradish peroxidase (HRP) is strongly depended on the nature of the protein environment surrounding the heme group. To gain more quantitative insights to study of structural feature of heme-imidazole in SDS micelle (as artificial peroxidase enzyme) at different ionic strength dynamic light scattering (DLS) was used. The distributions of different sizes in each sample indicate that ionic strength has large effect on the biocatalyst's shape and structure. Data has shown that sizes of particles have grown by increasing of ionic strength. Zeta potentials of heme-imidazole-SDS in various phosphate buffer concentrations (pH=7.4) also confirm different structure via different charged SDS aggregation in various buffer concentrations. The structure of peroxidase-like nano biocatalyst system containing heme-SDS micelle and heme-imidazole-SDS micelle were found to be dependent on the environmental electronic properties or ionic strength. The different formation of SDS micelle in various ionic strengths may produce different position for heme moiety as a peroxidase active site via inter and intra molecular interactions. This study indicates

that the evolution of biocatalyst efficiency towards native peroxidase is relative to the enzyme structure.

Keywords: *artificial Peroxidase enzyme*, *Ionic strength*, *DLS*, *SDS*, *Heme*, *Imidazol*

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Effects of potentiodynamic electropolymerization parameters on electrochemical properties and morphology of fabricated PANI nanofiber/Graphite electrode

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Keywords:*Polyaniline; potentiodynamic electropolymerization; Nanofiber;Graphite electrode; electroactivity; Electrochemical Impedance Spectroscopy.*

Abstract

Polyaniline as a conducting polymer is a modern material with various applicationsin a wide range of practical application such as sensors [1, 2, 3].It is clear that the morphology of produced polymer affects its properties to a large extent. Among different morphologies that may be obtained, the formation of fibrous morphology has various important applicationsnamely in the domain of sensors.Among different electrochemical methods, cyclic voltammetry is a preferred method in producing controlled nanofibers with excellent electrochemical properties [4].The aim of the present study is to investigate the effects of scan rate on the morphology and electrochemical properties of produced PANInanofibersusing electrochemical impedance spectroscopy (EIS) and scanning electron microscopy micrograph (SEM).

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Surfactant-assisted Pulse Electrosynthesis of MnO_2 Nanowalls: Preparation and Electrochemical Characterization

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Abstract

Nanostructured metal oxides can be prepared *via* cathodic electrodeposition-heat treatment. In this technique, hydroxide of metal, as a precursor, is prepared by cathodic electrodeposition and then converted to the oxide *via* heat treatment process. Up now, various metal oxides and hydroxides such as ZrO_2 [1], Y_2O_3 [2], La_2O_3 [3], Nb_2O_5 [4], $La(OH)_3$ [5], $Ni(OH)_2$ [6] have been synthesized using this technique. In this work, surfactant-assisted cathodic electrodeposition of manganese hydroxide was conducted on the pulse current mod for the first time. The optimum concentration of CTAB as a surfactant was selected 0.5 cmc. The deposition experiments were performed with a typical on-time and off-time (t_{on}= 10 ms and t_{off} =50 ms), and an average current density of 1 mA cm^{-2} (I_a = 1 mA cm^{-2}). An electrochemical workstation system (potentiostat/galvanostat, Model: NCF-PGS 2012, Iran) was applied. To obtain oxide product, the prepared hydroxide powder was heat-treated at 400°C for 2h in dry air atmosphere. The structural characterizations by XRD and FT-IR revealed that well-crystallized MnO_2 composed of α and γ phases has been prepared (Fig. 1). The SEM observations (Fig. 2) showed that the prepared MnO_2 has completely uniform and unique wall-like texture at nano-scale.

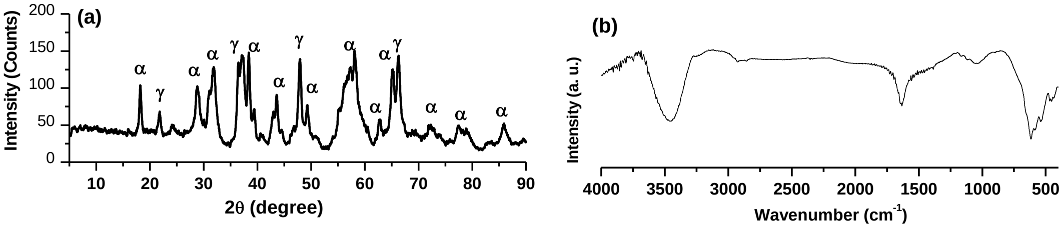

Fig.1. (a) XRD (b) IR patterns of the prepared MnO_2 nanowalls.

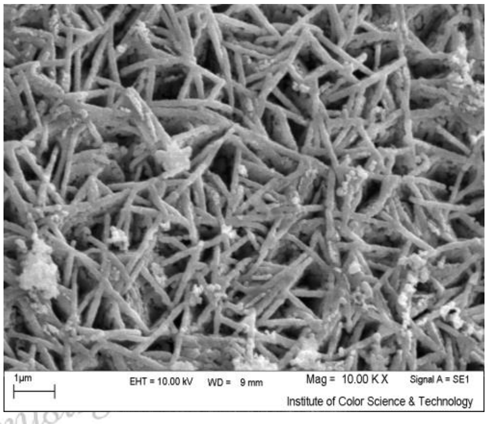

Fig. 2. SEM image of the prepared MnO_2 nanowalls

Keywords: MnO_2; Nanowall; Pulse electrodeposition; Surfactant-assisted synthesis

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Synthesis and Characterization of Pure Magnetic Iron Oxide Nano Particles, via Modified Schikorr-Massart Process

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Abstract

Hereby; new electrochemical method for synthesis and characterization of pure magnetic Iron oxide nano particles, in large scale introduced. Synthesis proceeds via simple agendum at room temperature under sonication by using cheap reagents, green antioxidant-reductant agent; and without using inert gas purge as protective atmosphere condition. Also in this procedure Hydrogen gas as valuable byproduct releases continuously during the anaerobic step of reaction. Probable electrochemical mechanism of reaction proposed according to modified Schikorr reaction and Massart procedure. The as-synthesized products were characterized by using Fourier Transform Infrared (FTIR) spectroscopy, powder X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Energy Dispersive Analytical X-ray (EDAX) spectroscopy, magnetic properties measured via Vibrational Sampling Magnetometer (VSM), surface area calculation by using BET method. Also by using Cyclic Voltammetry (CV) method and modified nanoparticle-graphite paste electrode preparation the surface electrical behavior measured and further electrocatalytic application procedure studied. Characterizations results indicate that the Final product is pure spherical Fe_3O_4 nano particles, with narrow size distribution and about 25 nm in mean diameter. Nitrogen gas adsorption-desorption result measurement, revealed that the BET and BJH calculated surface area of the nano powder is about 12.8 and 15.3 (m^2/g) respectively. These magnetic nano particles behave as strong superparamagnetic with no hysteresis loop and show high saturation magnetization about 77 (emu/g) in the magnetization Curve. Also by various weight ratios, these nano particles have stable dispersion in aqueous media, for long time periods, just after 5 minute sonication. This

procedure has been tested for synthesis of 100 gram of product at one run; and all process could be done less than one day.

Keywords**:** *Fe_3O_4 Nanoparticles, Electrochemical Synthesis, Characterization, Hydrogen Production, Massart Process, Schikorr Reaction.*

Schikorr reaction:

$$2\ \mathrm{Fe(II)} \xrightarrow[\text{Hydrotermal at least 24 h}]{H_2O\ \&\ 90\ ^0C} Fe_3O_4 + H_2$$

Massart procedure:

$$\mathrm{Fe(II)} + 2\mathrm{Fe(III)} \xrightarrow[\text{Under } N_2\ \&\ \text{2h Stirered}]{H_2O\ \&\ 70\ ^0C} Fe_3O_4$$

Proposed Mechanisms:

$$\mathrm{Fe(III)} + \mathrm{Fe(0)} \xrightarrow[\text{Sonication(1h)}]{\text{RT, } H_2O} Fe_3O_4 + 1/2\ H_2$$

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Synthesis, Characterization and Titration Process of Phosphorylated Graphene Oxide

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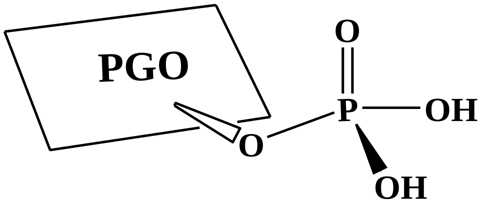
Abstract

Nowadays functionalized graphene based surfaces have potential applications in catalyst, energy conversion, environment protection and other applied scientific fields. In this paper we have reported a new protocol for synthesis of Phosphorylated Graphene Oxide (PGO) via wet chemical methods. At first step Graphene Oxide (GO) was synthesized via modified Hummers method. Afterwards the GO was functionalized by different chemical phosphorylation methods. Products were characterized by using Fourier Transform Infrared spectroscopy (FTIR), Raman spectroscopy; powder X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Energy-Dispersive Analytical X-ray (EDAX) spectroscopy, BET method (for surface area calculation), Thermal Gravimetric Analysis (TGA) and Differential Thermogravimetric (DTG) analysis (for thermal stability measurement). Then by using accurate back titration method in presence of pH meter control, PGO surface acidity has been measured. Characterization result and titration procedure revealed that; PGO poses distinct physical and chemical properties; such as solvent dispersity, acidity behavior, electrical bearing, cation exchange capability, altered morphology and *crystallinity, and also it poses better thermal stability;* in comparison with rare GO substrate.

Keywords: *Synthesis, Characterization, Graphene Oxide, Phosphorylation, Cation Exchange, Back Titration,*



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Cathodic Electrosynthesis of Nanostructured $Co(OH)_2$: Impact of Bath Temperature on the Crystal Structure and Morphology

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Abstract

Cathodic electrodeposition is an attractive technique due to its powerful control on the structural and morphological properties of metal oxides. In this technique, hydroxide of metal, as a precursor, is prepared by cathodic electrodeposition and then converted to the oxide *via* heat treatment process. Up now, various metal oxides and hydroxides such as ZrO_2 [1], Y_2O_3 [2], Nb_2O_5 [4], $La(OH)_3$ [5] and $Ni(OH)_2$ [6] have been synthesized using this technique. In this work, cobalt hydroxide was prepared *via* cathodic electrodeposition from cobalt nitrate bath at different temperatures of 10 25 and 60 °C. The deposition experiments were performed on galvanostat mode by applying the current density of 1 mA cm^{-2} using an electrochemical workstation system (potentiostat/galvanostat, Model: NCF-PGS 2012, Iran). The impact of the bath temperature on the crystal structure and morphology of the deposited products was evaluated by XRD and TEM techniques.

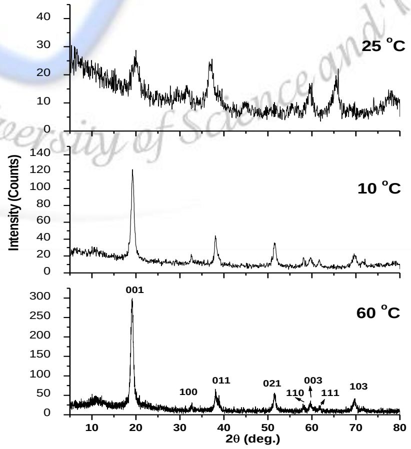

Fig.1. (a) XRD patterns of the prepared $Co(OH)_2$ samples at different bath temperatures.

The structural characterizations by XRD (Fig. 1) revealed that β phase of the $Co(OH)_2$ are the main product at all the applied bath temperatures (i.e. bath temperature change has no effect on the crystal phase of the electrodeposited hydroxide). But, the crystallinity of the product (i.e., XRD peak positions and their sharpness) are completely affected by bath temperature. In fact, well-crystallized hydroxide is obtained at elevated bath temperatures. The TEM observations (Fig. 2) showed that the morphology of prepared hydroxide has also affected by bath temperatures. As seen in TEM images, the prepared sample prepared at low temperature (10 ºC) has disc-like morphology (Fig. 2a). Also, the samples prepared at 25 and 60 ºC have plate and leaf-like morphology, respectively. So, it can be concluded that bath temperature is the main affecting factor in the cathodic electrodeposition of nanostructured $Co(OH)_2$.

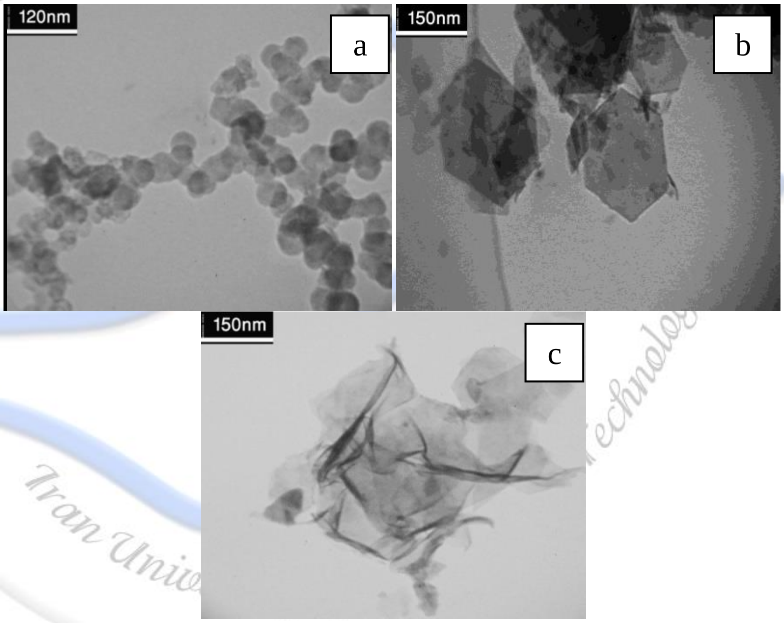

Fig. 2. TEM image of the prepared $C(OH)_2$ nanostructures at bath temperatures of (a) 10 ºC, (a) 25 ºC and (a) 60 ºC

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Keywords: Cobalt hydroxide; Cathodic electrodeposition; Bath temperature effect

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Electrochmical oxidation of 4,4'-biphenol in the presence of Arylsulfinic Acids

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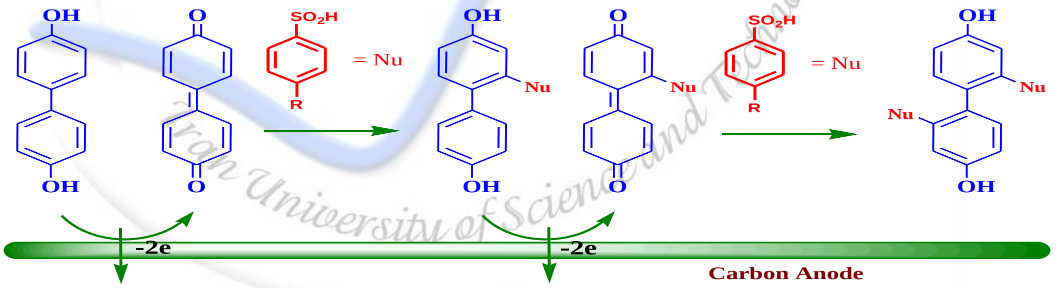
Abstract

Electrochemical methods are widely used for the study of electroactive compounds in pharmaceutical forms and physiological fluids due to their simple, rapid, and economical properties [1]. electrochemical synthesis of some new Arylsulfinic acids derivatives was carried out via the electrochemical oxidation of 4,4'-biphenol [2] in the presence of Arylsulfinic acids derivatives as a nucleophile using cyclic voltammetry and controlled-potential coulometry methods. Among the numerous methods to synthesize substituted 4,4'-biphenol, Michael-addition reactions play an important role. In this context we derived new 4,4'-biphenol derivatives in good yields based on controlled potential electrochemical oxidation at carbon electrode in a divided cell. On the basis of our results, depending on the applied potential, two different series of products are isolated [3].



Keywords: Electrochemical oxidation, 4,4'-biphenol , Michael addition reactions, Arylsulfinic acids.

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Electrochemical study of 4-methylaminophenol in the presence of arylsulfinic acids: Synthesis of new sulfone derivatives of 4-methylaminophenol

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Abstract

Aminophenols are interesting derivatives for chemical and electrochemical studies. Many aminophenol derivatives are known to be effective antioxidants and to be capable of modifying the direction of variousfree-radical processes(1). On the other hand, Aminophenol derivatives are important intermediate for the manufacture products and drug industries. In this research the electrochemical oxidation of 4-methylaminophenol has been studied in the presence of arylsulfinic acids as nucleophiles using cyclic voltammetry and controlled-potential coulometry methods (3). It is known that cyclic voltammetry is a powerfull technique for investigation of electrochemical reactions that are coupled with chemical reactions (1). The results indicate that the arylsulfinic acids participate in Michael type addition reaction with the oxidized form of 4-methylaminophenol, converts it to the corresponding new sulfone derivatives of 4-methylaminophenol. On the basis of our results, depending on the applied potential, two different series of products are isolated (3).

Keywords: Electrochemical oxidation, 4-Methylaminophenol, Michael addition reactions, Arylsulfinic acids,

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Preparation of Palladium Cluster-modified Nanoelectrode and Investigation of Its Electrocatalytic Property Towards CO_2 Electroreduction

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Abstract

Present research is dealing with preparation of Pd@C_8SH-modified nanoelectrode through physical dropping of cluster slurry in acetonitrile on the surface of conditioned glassy carbon electrode (GCE). As-prepared Palladium-thiol nanocluster has been dispersed in organic solvent and used for slurry preparation. Finally, nanoelectrode has been checked under nitrogen and carbon dioxide purge, respectively within optimized electrochemical window. CVs in aqueous KCl and different purging atmospheres at various scan rates showed increased reductive diffusion control current under CO_2 atmosphere and CO_2 electroreduction has been approved practically which is attributed to electrocatalytic activity of Palladium nanocluster as an efficient nanoelectrocatalyst. To the best of our knowledge, this is the first time report in this regard.

Keywords: *Cluster-modified Nanoelectrode, CO_2 Electroreduction, nanoelectrocatalyst*

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Electrochemical Synthesis Of Phosphonium-based Ionic Liquid Supported/MWCNT/Platinum Nanocomposite as an Efficient Nanoelectrocatalyst

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Abstract

Synergistic effect of different ingredients into the nanocomposites caused to intensive concentration on them. As an efficient nanoelectrocatalyst, Platinum-based nanocomposite has been electrochemically synthesized using Multi-Walled Carbon Nanotube (MWCNTs) in the presence of phosphonium-based ionic liquid **[P14,6,6,6][N(TFMS)$_2$A]** (Trihexyl Tetradecyl-phosphonium bis (trifluoromethylsulfonyl) amide as linker. Applying an appropriate reducing potential or differential current pulse in the quaternary phosphonium ionic liquid and MWCNTs caused the Pt/MWCNT/RTIL nanocomposite to be deposited on Glassy Carbon Electrode (GCE). The comparison of CVs with and without the noble metal, confirms the reduction of noble metal ions to zerovalent metallic species deposited on RTIL on GCE. Finally, electro-catalytic behavior of nanocomposite-modified electrode is investigated for methanol electro-oxidation.

Keywords: *Noble Metal Nanocomposite, nanoelectrocatalyst, PtNP/MWCNT/RTIL*

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Construction of novel fluoride potentiometric sensors based on conducting polypyrrole doped with different anions

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Absrtact

Fluoride (F^-) is an important and reactive anion, present in water, mineral, many plants, air and food.Obviously, this element is an important tool in the prevention of tooth decay and caries [1], butexcess fluoride can cause dental and skeletal flourosis, kidney failure and nephrolithiasis[2].This diversity of characteristic, both beneficial and destructive aspects, makes the sensing and measurement of fluoride one of considerable current interest for environmental, biomedical, industrial-process monitoring. Numerous methods have been exploited to measurement of fluoride in different sample matrices[3-5] of which the most important and interesting is using offluoride ion selective.In this research, we haveinvestigated the potentiometric behavior ofelectrodes based on polypyrrole doped with four different kinds of dopants, i.e., polypyrrole/perchlorate (Ppy-ClO_4) and polypyrrole/chloride (Ppy-Cl), polypyrrole/fluoride (PPy-F), and polypyrrole/nafion (Ppy-Nafion), towards fluoride ion.

*Keywords:*Flouride, Polypyrrole, Potentiometry, Sensor

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Current Density Effect on the Structural, Morphological and Electrochemical Properties of $Ni(OH)_2$ Prepared by Cathodic Electrodeposition

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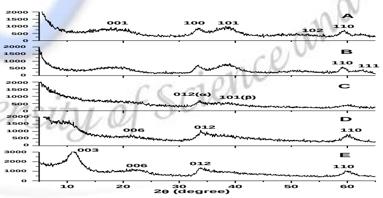
Abstract

Cathodic electrodeposition is an attractive technique due to its powerful control on the structural and morphological properties of metal oxides [1,2]. In this work, $Ni(OH)_2$ was prepared *via* cathodic electrodeposition from $Ni(NO_3)_2$ bath at different current densities are listed in Table 1.

Table 1. Electrodeposition conditions and obtained results

Sample name	i (mA/cm^{-2})	Deposition time (min)	Crystal phase
A	5	15	β
B	2	30	β
C	1	60	α,β
D	0.5	120	α,β
E	0.1	600	α

The impact of current density on the crystal structure and morphology of the deposited products was evaluated by XRD and SEM techniques.



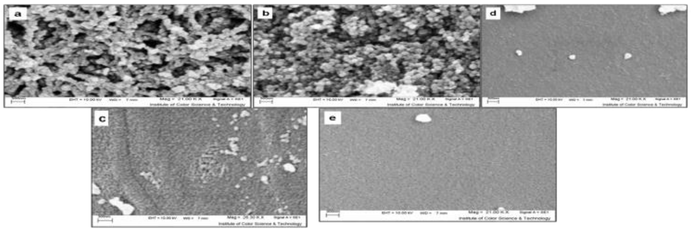


Fig. 1. XRD patterns of the prepared $Ni(OH)_2$

Fig. 2. SEM images of the prepared $Ni(OH)_2$ at different samples at different current densities

As seen from XRD patterns in Fig. 1, the prepared hydroxides at elevated current densities (*i*= 5 and 2 mA cm^{-2}) have pure β-$Ni(OH)_2$, while a pure α-$Ni(OH)_2$ is obtained at lower current density (*i*= 0.1 mA cm^{-2}). It is interesting that a mixture of α and β phases are formed at middle applied current densities (*i*= 1 and 0.5 mA cm^{-2}). The SEM observations (Fig. 2) showed that the size of $Ni(OH)_2$ particles has also affected by current density. The supercapacitive performance of the prepared sample was evaluated by CV and charge-discharge tests and the results are shown in Table 2. As seen, this performance are completely affected by crystal phase and particle size where this two parameter are dedicated by applied current in the deposition process of each sample. So, current density is the main factor in the electrodeposition of $Ni(OH)_2$ *via* base generation.

Table 2. Calculated capacitances from CV and charge-discharge tests

Sample name	**Calculated capacitances from CV curves (F/g)**					**Calculated capacitances from charge-discharge curves (F/g)**			**Theoretical capacitances (F/g)**
	Scan rate (mV s^{-1})								
	5	**10**	**25**	**50**	**100**	**1 th cycle**	**250 th cycle**	**Capacity decay (%)**	
A	634.9	542.	425.9	375.3	305.6	535.4	497.8	7.1	1150
B	704.2	619.	475.4	395.6	365.4	586.3	559.9	4.6	
C	1015.	924.	842.8	732	682.4	908.5	900.3	0.9	
D	1895.	1790	1622.	1521.	1305.	1808.	1773.	1.9	2602
E	2019.2	1870	1765	1540.7	1408.5	1854.3	1812	2.3	

Keywords: *Nickel hydroxide; Cathodic electrodeposition; Current densities effect*

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Fabrication and electrochemical investigations of the sensors based on metal nano-particles composite modified carbon electrodes and their applications in simultaneous trace determinations of Epinephrine, Indomethacin, Acetaminophen and some other compounds

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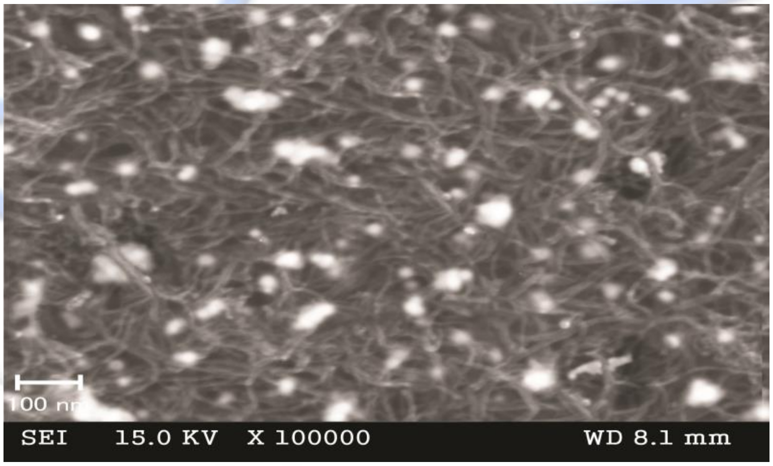
Abstract

In this report new application of a simple sensor based on multiwalled carbon nanotube and nickel hydroxide nanoparticles composite modified-glassy carbon electrode (MWCNTs-NHNPs /GCE) is introduced [1].



SEM image of the MWNTs and NHNPs nanoscale on glassy carbon.

For the first time The glassy carbon electrode modified with multi-walled carbon nanotubes/ nickel hydroxide nano particles was used for simultaneous measurement of small amounts of epinephrine- indomethacin –acetaminophen. The electrochemical investigations were carried out by application of cyclic voltammetry (CV), differential pulse voltammetry (DPV) and chronoamperometry (CA). Under the optimum conditions (buffer type, pH solution, accumulation time,..) electrode provides a linear response versus EPI concentrations in the range of 3-40 and 40-600 µM, for AC concentrations in the range of 0.1-25 and 25-145 µM, for IND concentrations in the range of 0.5-55 µM respectively using the DPV method. The electrode provides a linear response versus EPI concentrations in the range of 1-400 µM, for AC concentrations in the range of 1-70 and 70-300 µM, for IND concentrations in the range of 1-100 µM respectively using the CA method. The combination of NHNPs to MWCNTs composite leads to high sensitivity and low detection limit for the simultaneous determination of EPI, AC and IND. The electrode also shows high stability in repetitive experiments. The interfering study of some species showed no significant interference with determination of EPI, AC and IND. The results suggest that the proposed sensor is an attractive candidate for practical applications.

***Keywords*:** Epinephrine, Indomethacin, Acetaminophen, Multi-Walled Carbon Nanotubes, Nickel Hydroxide Nano-particles

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Cathodic Electrosynthesis of Nanostructured La(OH)$_3$: Effect of bath Temperature

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Abstract

Cathodic electrodeposition is an attractive technique due to its powerful control on the structural and morphological properties of metal oxides [1,2]. In this work, La(OH)$_3$ was prepared *via* cathodic electrodeposition from nitrate bath at different bath temperature as listed in Table 1.

Table 1. Electrodeposition conditions and obtained results

Sample name	*i* (mA/cm^{-2})	Bath temperature (^{o}C)	Deposition time (min)	Current efficiency(%)	Microstructure
LaH-1	1	10	30	85	Nanocapsules
LaH-2	1	25	30	80	Nanoparticles
LaH-3	1	40	30	71	Nanospindles
LaH-4	1	80	30	62	Nanorods

The impact of bath temperature on the crystal structure and morphology of the deposited products was evaluated by XRD and SEM techniques.

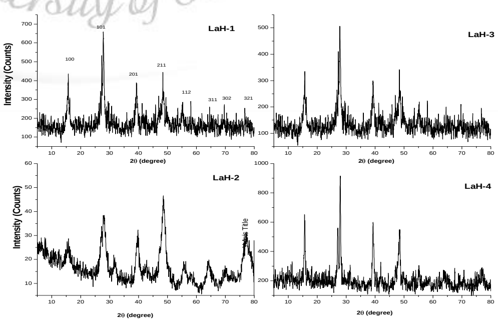

Fig. 1. XRD patterns of the prepared La(OH)$_3$ samples at different bath temperatures.

All diffraction peaks (in Fig. 1) can be indexed as the hexagonal $La(OH)_3$ with the lattice constants of a = 6.528 A° and c = 3.858 A°, which are very consistent with the values in the standard card (JCPDS 41-4019). So, it can be said that bath temperature has no effect on the crystal phase of deposited hydroxide. The SEM observations (Fig. 2) showed that the morphology of prepared hydroxide has affected by bath temperature as listed in Table 1. So, it can be said that bath temperature as an affecting factor dedicated the morphology of the deposited hydroxide in the cathodic electrodeposition of $La(OH)_3$.

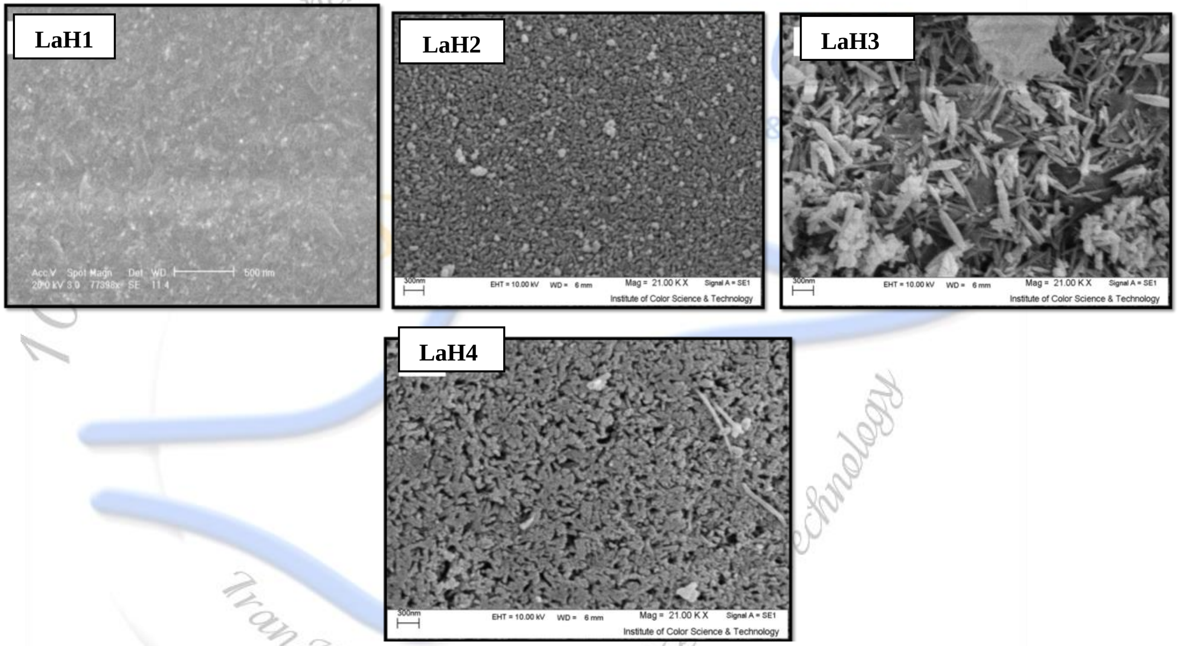

Fig. 2. SEM images of the prepared $La(OH)_3$ samples at different bath temperatures.

Keywords: *Lanthanum hydroxide; Cathodic electrodeposition; Bath temperature effect*

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The Verification of Hydrothermal Method along with the Electrochemical Performance of $LiCoPO_4$

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Abstract

Lithium-ion batteries are used widely as mobile devices like cellphone and notebook. Recently, researchers are actively devoted into the lithium-ion battery research for high energy conversion system, such as electric vehicle.$LiCoPO_4$ with olivine structure which is the promising candidate for high voltage cathode material was synthesized by hydrothermal method. In order to synthesize high purity and well-defined $LiCoPO_4$, several precursors for Li, Co, and P sources and hydrothermal reaction parameters including temperature and $[H_2O]/[Co]$ value are optimized. By analyzing the structure, Co valence, morphology, and chemical ratio via XRD, XPS, Raman, SEM, and ICP $LiCoPO_4$ synthesized from manganese acetate tetrahydrate have single phase of $LiCoPO_4$ without impurity and showed charge and discharge reaction caused by Co redox. Specific capacity of synthesized $LiCoPO_4$ grew up during cycling. In other phrases, when hydrothermal temperature was set at 150^{0}C and $[H_2O]/[Co]$ value was set at 15, discharge capacity as high as 70 mAh/g was obtained at 1/20 C rate.

Keywords**:** *hydrothermal , lithium-ion battery , electrochemical, SEM*

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Synthesis of nano-structured cobalt oxide by pulsed electrodeposition and further calcination

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Abstract

Nano-structured cobalt hydroxide was deposited on stainless steel using pulsed electrodeposition in a cobalt sulphate ($CoSO_4·7H_2O$) solution. Deposited cobalt hydroxide then converted to cobalt oxide by calcination in air at 450°C. The characteristics of cobalt hydroxide and cobalt oxide films were examined with X-ray diffraction (XRD), energy dispersive X-ray spectroscopy (EDS) and field emission scanning electron microscopy (FESEM) techniques. The FESEM images showed that as-deposited $Co(OH)_2$ has a interlaced nanosheet morphology. The thickness of nanosheets was 17 nm. The XRD and EDS analysis proved successfully conversion of cobalt hydroxide to cobalt oxide during calcination.

Keywords*: *Cobalt oxide,Pulsed electrodeposition, Thermal decomposition,Interlacednanosheets;

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Electrochemical adsorption and oxidation of thiophene on the surface of platinum electrode

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Abstract

Electrochemical desulfurization of aqueous solution of thiophene was performed via a combined adsorption/oxidation method. The best thiophene adsorption potential was determined to be 0.2 V (respect to Ag/AgCl reference electrode). The best frequency for thiophene oxidation was determined to be 50 Hz.

Keywords: *Electrochemical adsorption, Electrochemical oxidation, Electrochemical desulfurization, Cyclic voltammetry, Square wave potentiometery, Thiophene*.

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Cathodic Electrodeposition and Morphological Characterization of $Y(OH)_3$ Nanostructures From Chloride Bath: Effect of Current Density

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Abstract

Cathodic electrodeposition is an attractive technique due to its powerful control on the structural and morphological properties of metal oxides [1,2]. In this work, yttrium hydroxide was prepared *via* cathodic electrodeposition from YCl_3 bath at different current densities as listed in Table 1.

Table 1. Electrodeposition conditions of $Y(OH)_3$ and its obtained morphology

Sample name	*i* (mA/cm^{-2})	Deposition time (min)	Morphology	Estimated particle size (nm)
a	2	15	Nanospheres	500
b	1	30	Nanoparticles	300
c	5	60	Nanoparticles	300
d	0.25	120	Nanoparticles	100
e	0.1	600	Nanoparticles	50

The impact of current density on the morphology of the deposited products was evaluated by SEM technique. SEM images of the prepared samples are shown in Fig. 1. As seen from these images, sphere morphology is seen for the sample prepared at high current density (*i*=2mA cm^{-2}). In fact, sample ***a*** is composed of well-defined spheres with diameter up to 500 nm (Fig. 1a). for both **b** and **c** samples, the particle texture are seen in the SEM images (Figs. 1b and c). For these samples, the particle size was estimated in range of 300-400 nm. For the samples prepared at low current densities (d and e), the smooth and uniform surface composed of fine particles are seen (Figs. 1d and e). In fact, a compact thin film of $Y(OH)_3$ is achievable at current densities of 0.25 and 0.1 mA cm^{-2}. Overall, it was seen that the nanospheres of $Y(OH)_3$ are prepared at high applied current densities while its fine particles are achievable at low applied current densities. In final, it can be concluded that particle size of the deposited hydroxide us dedicated by applied current density.

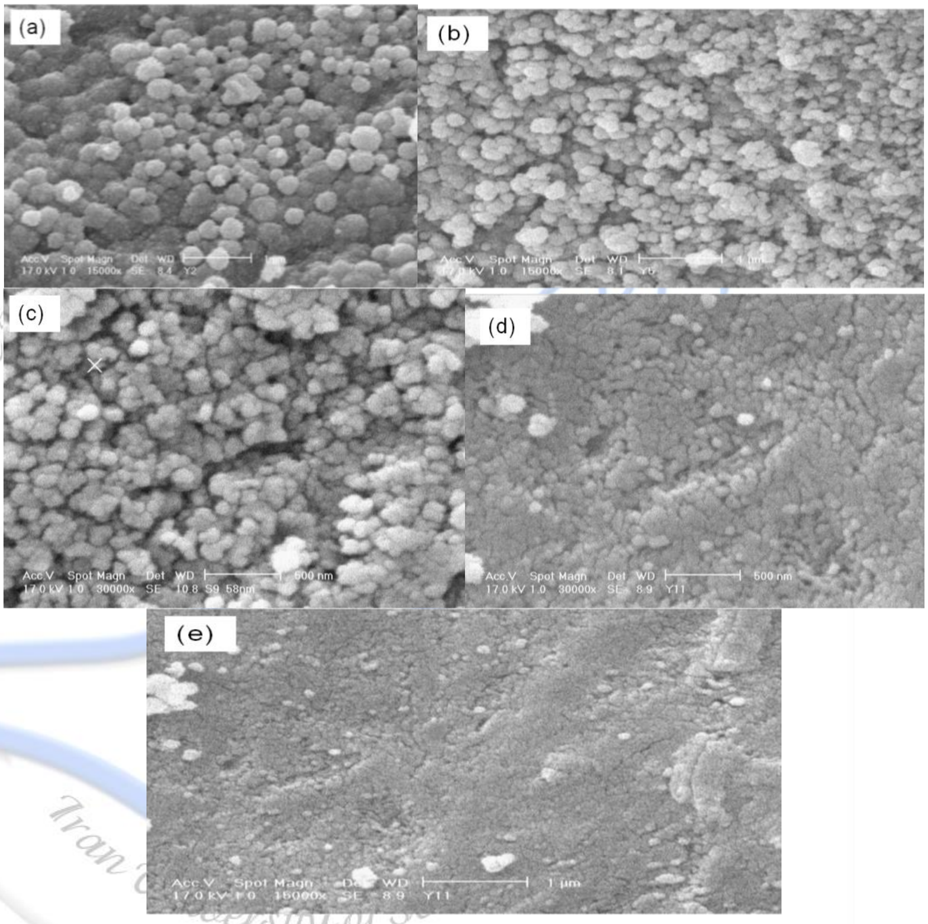

Fig. 1. SEM images of the prepared $Y(OH)_3$ at different current densities.

Keywords: *Yttrium hydroxide; Cathodic electrodeposition; Current density impact*

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Preparation of Modified Electrode by Molecularly Imprinted Polymer for Determination of Metyle Viologene

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Abstract

The goal of this project is Preparation of modified electrode by molecularly imprinted polymer for measuring the Metyle Viologene. (Metyle Viologene) is one of the pesticides which is consuming in agriculture division in various parts of our country due to its wide spectrum of herb killing effect and approximately low price. The poisoning amount of this Pesticide is 129-157 mg/l for mammals and 5.2-32 mg/l for fishes. Paraquat is extremely toxic to humans (LD50. 35 mg/kg) [1].

The method of measurement in this project is differential pulse voltammetry[2]. in which two positively charged quaternary nitrogen atoms of paraquat cation has been reduced by applying negative potential and cationic current[3], considered as the base of measurement, will be resulted from. A conventional three electrode system was used in this work, a glassy carbon, was used as working electrode,Poly Pyrrole in addition(Metyle Viologene) is an appropriate matrix for modifying the surface of electrode.

In order to creating this surface Cyclic voltammetry method was used[4], parameters such as scan rate, template concentrations in addition, measurement conditions consist of pH and support electrolyte and elusion method have been optimized. In optimized conditionLimit of Detectionis0.22µM

***Keywords*: :** *Poly Pyrrol, Differential Pulse Voltammetry , Molecularly Imprinted Polymer , Cyclic voltammetry.*

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Synthesis of hydride phases on the titanium surface by electrochemical hydriding method

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Abstract

In order to studythe effect of hydrideformation onthe corrosion behaviorandmechanical properties, the development of an appropriate hydrogen charging method is required.In this study the electrochemical hydriding is used for synthesis of hydride phases on the surface of titanium sample, and then confirmed by XRD analysis.

Keywords:*Electrochemical hydriding, Titanium hydride,*

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Dual activity of electrocatalytic activated CO_2 toward pyridine for synthesis of isonicotinic acid: An EC'C'C mechanism

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Abstract

The transformation of CO_2 as ideal C1 source to useful organic compounds is of great interest [1]. The present study demonstrates indirect electrocatalytic synthesis of isonicotinic acid using a Ni complex, $[Ni^{II}(Me_4\text{-}(NO_2Bzo)_2[14]tetraeneN_4)]$, in acetonitrile solution at room temperature.. The complex was used as an excellent electrocatalyst for the reduction of carbon dioxide [2]. The results indicate that the electrocatalytic reduction product of CO_2 ($CO_2^{\bullet-}$) has a dual role in the electrosynthesis of isonicotinic acid. The dual activity of $CO_2^{\bullet-}$ involved indirect electrocatalytic reduction of pyridine as well as its radical reaction with pyridine radical anion to formation isonicotinic acid. Finally, EC'C'C mechanism was proposed for synthesis of isonicotinic acid. In contrast, the reaction of pyridine with CO_2 in the absence of the complex follows an EC'C mechanism and the final product is 4,4'-bipyridine [3].

Keywords: CO_2, Pyridine, Isonicotinic acid, Bipyridine, Nikel (II) complex

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Thermodynamic study of the (NaCl +NaAsp+Water) system using potentiometric measurements

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Abstract

The thermodynamic properties of mixtures are important in the fields of chemistry, biology, industrial processes and solvent interaction [1]. Some experimental thermodynamic data on aminoacid and protein solutions exist in literatures. But there is still a need for more data in order to increase the basis for appropriate modeling of biosystems. Aspartate has an important role in biosynthesis of amino acids and also biochemical roles such as metabolite in the urea cycle and participates in gluconeogenesis. In this study, the determination of thermodynamic properties for (NaCl+ NaAsp + water) system for different series of salt molal ratios r ($r= m_1/m_2=5$ and 10) and pure NaCl solution are reported over total ionic strength ranging from 0.001 to 3 $mol.kg^{-1}$ using potentiometric measurements at 310.2 K. The electromotive force (emf) measurements were performed on the galvanic cell of type: Ag-AgCl|NaCl(m_1), NaAsp (m_2), water |Na-ISE. The selective electrode Na-ISE and Ag-AgCl electrode used in this study were prepared in our laboratory and illustrated a reasonably Nernst response. All of the potentiometric measurements were made using a digital multimeter whose resolution was 0.1 mV. The output of the multimeter was connected to a personal computer with Mi 5200 for data acquisition [2].Nernst equation was used to determine the experimental activity coefficients. The Pitzer ion interaction model was applied for experimental data correlation. Unknown mixing parameters (were evaluated using Pitzer graphical method. The obtained parameters were used to calculate the values of thermodynamic properties such as mean activity coefficients of sodium aspartate, osmotic coefficients and excess Gibbs free energy for the whole series of the studied mixed electrolyte system.

Keywords: *Activity coefficient, NaCl, NaAsp, Ion selective electrode, Potentiometry, Pitzer model*

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Electrochemical Synthesis of Polythiophene on Graphite and Stainless Steel electrodes for Application in Artificial Muscles

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Abstract

Recently, much attention has been focused on soft materialsthat can directly convert electrical energy into mechanical forces. Conductingpolymers (CPs) are a type of Electroactive polymers(EAP) that are considered as soft smart materials since they can sense external stimuli and respond accordingly.These polymers can be applied as base materials to fabricate electromechanical actuators which are able to generate force. Designing actuators based on CPs possesses advantages over traditional smart materials such as piezoelectrics, dielectric elastomers, and ferroelectric polymers;including lower operation voltage (~3 V) [1], larger mechanical stress, sufficient strain values, high reversibility, good safetyproperties and the possibility of precise control [2]. The ionic and elecronic conductivity of CPs play a key role in the performance of the electromechanical actuators fabricated based on these polymers. Many attempts have been made toimprove the conductivity of CPs. Researches have proved that the working electrode material and its structure and also the solvent and electrolyte applied in the electrochemical synthesis of CPs have a great effect on the quality and physical properties of the synthesized polymer [3-5]. In current work, polythiophene was synthesized on a graphite and Stainless Steel electrodes in anhydrous CH_3CN and in the presence of $LiClO_4$ as supporting electrolyte to study the effect of electrode type on the morphology and conductivity of the resulting polymers. This was carried out by cyclic voltammetrymethod in the potential range of

1-2 V. The synthesized polymerswas characterized by FTIR, scanning electron microscopy and its conductivity was measured.

Keywords**:** *Polythiophene, Electroactive polymers, Smart Materials, Cyclic Voltametry*

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Pulse electrodeposition of silicon-doped hydroxyapatite on AZ31 magnesium alloy, characterization &investigation ondegradation behavior

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Abstract:

Magnesium and its alloys have earned significant interest for their potential applications as biodegradablemetallic implants due to their degradability (no further need to do a second surgery for extracting the implant), similar mechanical properties to cortical bone and excellent biocompatibility. However, a high corrosion rate of magnesium alloys result in gas formation & a too fast loss of mechanical stability.Therefore, different kinds of alloying elements and coatings have been proposed to control the corrosion rate.

Calcium phosphate which has variety of phases,is a conventional coating used on orthopedic implants.Hydroxyapatite which is a form of calcium phosphate, has a similar chemicalcomposition and crystallographic structure to that of bonemineral. Though it has the ability to allow new boneformation, the number of biomedical applications for hydroxyapatiteis limited due to its relatively slow rate of osseointegration. Nowadays, the scientific community widely accepts the statement that silicon-doped calcium phosphates have better biological properties compared to pure calcium phosphates. For instance, studies by Carlisle suggested that the presence of silicon significantly facilitated bone formation and calcification process, thus preventing early loading on newly formed bone.

In the present research, a silicon-doped calcium phosphate coating was obtained successfully on AZ31 alloy substrate via pulse electrodeposition.$Ca(NO_3)_2$ and $NH_4H_2PO_4$ were used for generating calcium phosphate and Tetraethoxysilane (TEOS) was used as the silicon source.

EDS results showed that silicon was successfully doped tocalcium phosphate. On the other hand, XRD results indicated that preliminary coat was consisted of DCPD (Dicalcium phosphate dihydrate) and low amount of hydroxyapatite. Alkaline treatment was then used to transform DCPD into hydroxyapatite.

Short-term degradation behavior was investigated bypotential dynamic polarization curve. Results showed that Si-doped hydroxyapatite coated samples had much better corrosion resistance as compared with bare substrate.

Key words:*Silicon-doped,hydroxyapatite, coating,pulse electrodeposition, magnesium alloy*

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Pulse Electrosynthesis of Nanostructured Zinc powder as Anodic Active Material of Zn-Air Batteries

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Abstract:

Zinc is widely used as anode material in primary and secondary batteries like Zn- MnO_2, Zn-AgO, Ni- Zn, Zn- HgO, Zn- Polyaniline, Zn- air etc due to relatively high electrode potential and low equivalent weight [1]. Zinc is environmentally safer than other anode materials besides having high rate discharge performance [2]. Various deposition methods employed for the synthesis of zinc powder include physical vapor deposition, chemical vapor deposition, zinc oxide deposition/ reduction and Electrodeposition [3]. Electrodeposition method is mostly preferred as it achieves better control over morphology, porosity and surface area of the electrode. Electrosynthesis methods are preferred as they are cheap and have better control due to variations in temperature, solution concentrations and current density etc. Both acidic and alkaline baths have been used for the Electrodeposition of zinc but alkaline baths are preferred due to better control over the deposition distribution [4]. We previously showed that the pulsed galvanostatic method is the highest performance electrochemical method to synthesize metal and metal oxide nanoparticles with high surface area [5]. In this work, we synthesized nanostructured zinc powder via pulse galvanostatic method in alkaline media. Zinc oxide as zinc ion source was dissolved in potassium hydroxide solution. Three cylindrical graphite electrodes in linear arrangement (anode-cathode-anode) with 1 cm diameters and 3 cm lengths were immerged in the obtained solution as pulse electrosynthesis bath. The pulse electrosynthesis method included some chemical and instrumental parameters such as zinc oxide concentration, potassium hydroxide concentration, bath temperature, pulsed current density (pulse amplitude), pulse time (t_{on}) and relaxation time (t_{off}). The effects of these parameters were investigated and optimized by "one at a time method". Scanning electron microscopy (SEM), transmission electron

miscroscopy (TEM), dynamic light scattering (DLS) and X-ray diffraction (XRD) methods were used to characterize the zinc nanostructures samples. The results showed that the morphology and particle size of the electrodeposited zinc samples varied by changing the synthesis conditions. Based on the experimental data, the optimum amounts were obtained 20 g L^{-1} ZnO, 400 g L^{-1} KOH, 25 ºC bath temperature, 6mAcm^{2} pulsed current, 0.5 s pulse time is 0.5 seconds and 1.5 s relaxation time. Figure 1 shows the SEM images of the zinc electrodeposited nanoleafs under the optimum conditions.

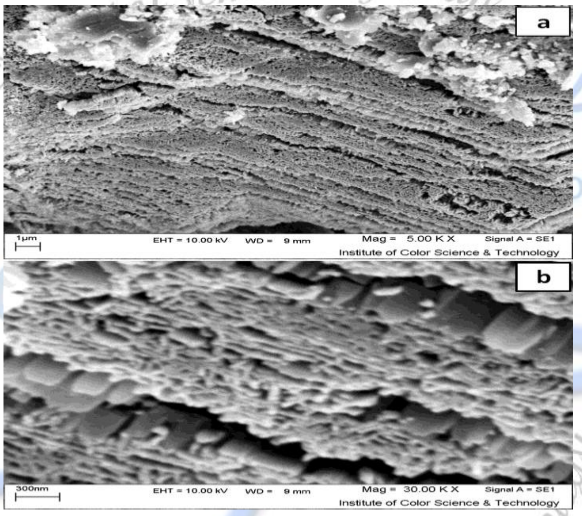

Fig. 1. SEM images of the zinc nanosheets electrosynthesized under the optimum conditions in two magnifications 5000 (a) and 30000 (b).

The obtained results confirmed that the pulse galvanostatic method can be used as a confident and controllable method to synthesize different nanostructures of zinc powder.

Keywords : Zinc Nanoparticles, Pulse Galvanostatic Method, Electrosynthesis, Zn- Air Batteries

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Preparation of PAn/Al_2O_3 nanocomposite using various surfactants

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Abstract

Polyaniline/aluminium oxide (PAn/Al_2O_3) nanocomposite was prepared successfully in aqueous media by the chemical polymerization of aniline using ammonium peroxydisulfate as an oxidant in the presence of hydroxypropylcellulose (HPC) and sodium dodecylbenzenesulfonate (DBSNa) as a stabilizer.The results show that the intensity of peaks related to the type of stabilizer.

Keywords: *Nanocomposite, Polyaniline, Surfactant, Morphology, Chemical structure*

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A Complete Survey upon Electrochemical and Spectroscopic Behavior of Gallium tetraphenylporphyrin Complexes

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Abstract

The field of the macrocyclic chemistry of transition metals is developing very rapidly because of its applications and importance in the area of coordination chemistry. Among the various macrocyclic systems surveyed, metalloporphyrins constitute an important class. Metalloporphyrins and their complexes with various ligands, which play an important role in biological processes and exhibit catalytic properties, are continuing to remain the subject of systematic experimental and theoretical studies. A series of Gallium-p-methyl-meso-tetraphenylporphyrin (p-CH_3TPP-Ga) containing axially coordinated salicylate anion [p-CH_3TPP-Ga-X)], where X= salicylate (SA), 4-chlorosalicylate (4-CSA), 5-chlorosalicylate (5-CSA), 5-flourosalicylate (5-FSA), 4-aminosalicylate (4-ASA), 5-aminosalicylate (5-ASA), 5-nitrosalicylate (5-NSA), and 5-sulfosalicylate (5-SSA), have been synthesized and characterized by various spectroscopic techniques including ultraviolet-visible (UV-VIS), infrared (IR) spectroscopy, proton nuclear magnetic resonance (^{1}HNMR) spectroscopy, ^{13}CNMR, and elemental analysis. A detailed study of electrochemistry of all the synthesized compounds has been done to compare their oxidation and reduction mechanisms and to explain the effect of axial coordination on their redox properties.

Keywords*: *macrocyclic chemistry, electrochemical, complex, coordination chemistry

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Electrochemical polymerizationof a novel bithiazolecompound

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Abstract

Electronically conducting polymers are still a verypopular research field among the scientists due to their usein a wide range of marketable applications such as electrochromicdevices, polymer light-emitting iodes(LEDs), thin film transistors, sensors, and conductingpolymer electrodes in charge storage devices.Among the great number of conducting polymersand its derivatives unquestionably are one of themost studied monomers due to their structural versatility,high environmental stability of its doped and undopedstates and suitability to applications like electrode materialsand conductors.Recently,considerable research effort has focused onstacking of p-conjugated polymers. Polymers witha structure of the repeating five membered heteroatomic rings readily constitute stacked structure.

Bithiazoles are very well known for their stacking properties,n-doping capability and usage in light-emitting diode construction. This new class of conjugated polymer exhibits interesting thermochromic and electrochemical behavior especially nonyl-derivative shows unusual optical properties as a result of its crystallinity and π–π stacking behavior.Because of their good polarization, high surface area, processability,low cost, chemical inertness, good thermal

andmechanical stability, carbon fibers constitute a class of electrodematerials for several applications.

This paper describes the synthesis, electrochemistry, and electronic properties of a novel 2,2′-diamino- 5,5′-dimethyle-4,4′-bithiazole, and their complexes with metals and electrochemically prepared polymer films of these free and complexed ligands.

The uncomplexed ligands and their polymers have electrochemical and electronic properties.The metal complexes exhibit reversible M(III/II) electrochemistry and ligand based reductions, and can be electrochemically polymerized under suitably anhydrous conditions.The resulting metallopolymers exhibit reversible M(III/II) electrochemistry with no indication of electronic coupling between metal sites. Oxidation of the polymer backbone results in a rapid loss of conjugation, but does not significantly affect the metal based electrochemistry, or the reductive electrochemistry of the backbone.

Keywords: Electrochemical, bithiazole, polymerization,film

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Studying the influence of carbon nanotube bed on the size and magnetic properties of $NiFe_2O_4$ nanoparticles

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Abstract:

In the present work, Nickel ferrite ($NiFe_2O_4$) nanoparticles were synthesized on the carbon nanotubes by the direct precipitating method, in order to investigating the influence of carbon nanotubes on the magnetite properties of these nanotubes. Structure, size and magnetic properties of these samples by XRD, SEM and VSM were identified.. The results characterized the nanoparticles assisted detection system above show that application of carbon nanotubes as a bed, could considerably influence of sizes, morphology and the magnetite properties of nanoparticles and prepared nanocomposite powder.

***Keywords**: Nickel Ferrite Nanoparticles, Carbon Nanotubes, Morphology, Direct Precipitating.*

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Effect of carbon nanotubes on size and optical properties of $NiFe_2O_4$ nanoparticles

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Abstract:

In this paper The effect of different concentrations of carbon nanotubes on the size and optical properties of nickel ferrite $NiFe_2O_4$nanoparticles have been investigated. The synthesis of Nickel ferrite nanoparticles performed by direct precipitation method in aqueous solution containing carbon nanotubes in ambient atmosphere. The prepared samples were analyzed by X-ray diffraction spectra (XRD), scaning electron microscopy (SEM) and UV–visibel spectroscopy (Uv-Visibie). Results obtained indicated with the *increased* concentrations carbon nanotube In addition to reducing the size of nanoparticles $NiFe_2O_4$ and nanocomposite powder $NiFe_2O_4$/ CNTs, the energy gap decreases.

Keywords: *Nickel Ferrite Nanoparticles, Carbon Nanotubes, Morphology, Direct Precipitating.*

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(1) Dhananjaya P.;Duryodhan S.;Harihara P.; Dhananjay K. Macromol. Chem. Phys. **2011,** 212, 1960–1970

Synthesis of $CuMgFe_2O_4$ nanoparticle by chemical precipition method and considering the effect of calcinat temperature on optical properties of these nanoparticles.

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Abstract

In this research the effect of calcinate temperature on behavior of $CuMgFe_2O_4$ nanoparticle considered .Synthesis of $CuMgFe_2O_4$ nanoparticle optimize in laboratory condition.Calcinated powder phases was determined by X-ray diffraction method and crystal size mean was computed by debby sherer formula. The surface morphologies and structures of the nanoparticle were characterized byscanning electron microscopy SEM.Optical properties was measured by UV-Visible spectroscopy in the range of200-1000nm.Increasing calsinate temperitute can leads to bigger nanoparticle and by increasing temperature the emount of energy band gap is reduced.

Keyword: Nanoparticle, Ferrite, chemical precipition, Band gap, Optical properties

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Electrosynthesis of strongly adherent nanocomposite of polypyrrole and γ-Al_2O_3 nanoparticles as a coating on carbon steel from a surfactant solution

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Abstract:

Conducting polymers are interesting materials for fundamental research and technological applications. These compounds are organic materials that generally possess an extended conjugated π- electron system along a polymer backbone. There has been an increasing interest in the use of conducting polymer/inorganic nanocomposites for protection of oxidisable metals against corrosion. Polypyrrole (Ppy) and its derivatives are among the most frequently investigated conducting polymers due to their facial synthesis, good environmental and excellent thermal stability. This polymer and its nanocomposites can be easily prepared by either an oxidatively chemical or electrochemical polymerization. The electropolymerization parameters such as the solvent, the size and nature of the dopant counter-anions have a strong impact on all the properties of nanocomposites including conductivity, mechanical properties, structure and morphology. It has been demonstrated that surfactants influence the morphology and redox behavior of conducting polymers. In this project, the electropolymerization of Ppy/ γ-Al_2O_3 nanocomposite onto carbon steel in the presence of sodium dodecylsulfate (SDS) with different concentrations (0.01, 0.02 and 0.03 M) as surfactant and dopant was investigated via cyclic voltammetry (CV) and scanning electron microscopy (SEM).

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A new method for electrochemical exfoliation of Graphite to Graphene Nano sheets in organic solvent and its application for Oxygen Reduction Reaction

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Abstract

A novel electrochemical method is demonstrated to prepare high yield of few-layer graphene in a single-step, one-pot process. Potential-controlled catholic reduction is used to intercalate graphite electrodes to produce Graphene Nano sheets in organic solvent (DMSO) in presence of $LiClO_4$ and surfactant TX100.

Scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-Ray Diffraction (XRD), infrared spectroscopy (FTIR) and Raman spectroscopy applied for characterization of synthesized Graphene.Cyclic voltammetry used to compare activity of synthesized graphene with Volcun X-72 R and Carbon Nano tube in $[Fe(CN)6]^{3-/4-}$ oxidation/reduction reaction

Furthermore, the graphene/TX100 composite film could be directly used for oxygen reduction reaction(ORR).

Keywords: *Graphene, Electrochemical exfoliation, Oxygen reduction reaction, Electrochemical exfoliation, surfactant*

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A novel platform base on NiFe$_2$O$_4$/graphene Nano composite film and its application for H$_2$O$_2$ biosensor

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Abstract

Electrochemical method applied for synthesis of graphene oxide in SDS surfactant and water in anodic potential. GN/NiFe2O4 Nano composites were prepared with chemical routs.

The structures of the synthesized NiFe2O4/graphene Nano composite and the electrode composition were confirmed by X-ray diffraction (XRD) spectrometry, Fourier transform infrared (FT-IR) spectrometry and scanning electron microscopy(SEM).

Finally, this Nano composite applied for H2O2 biosensor.Comparing with Ni nano particle modified glassy carbon electrode(NiNPs/GCE), the RGO-NiNPs/GCE showed better sensitivity and stability.

Long term stability and facile preparation method made this novel Nano composite electrode promising for H2O2 sensor.

Keywords**:** Reduced graphene oxide, Nickel nanoparticles, Nonenzymatic sensor,sodium dodecyl sulfate (SDS)

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A new method for electrochemical exfoliation of Graphite to Graphene Nano sheets in organic solvent and its application for Oxygen Reduction Reaction

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Abstract

A novel electrochemical method is demonstrated to prepare high yield of few-layer graphene in a single-step, one-pot process. Potential-controlled catholic reduction is used to intercalate graphite electrodes to produce Graphene Nano sheets in organic solvent (DMSO) in presence of $LiClO_4$ and surfactant TX100.

Scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-Ray Diffraction (XRD), infrared spectroscopy (FTIR) and Raman spectroscopy applied for characterization of synthesized Graphene.Cyclic voltammetry used to compare activity of synthesized graphene with Volcun X-72 R and Carbon Nano tube in $[Fe(CN)6]^{3-/4-}$ oxidation/reduction reaction

Furthermore, the graphene/TX100 composite film could be directly used for oxygen reduction reaction(ORR).

Keywords: *Graphene, Electrochemical exfoliation, Oxygen reduction reaction, Electrochemical exfoliation, surfactant*

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Synthesis of new graphene/Ni as a high-performance multifunctional electrocatalyst and its application in direct methanol fuel cell

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Abstract

Graphene synthesized with electrochemical method in organic solvent ,mixed wth LiClO4 and surfactant TX100.

Ni nano particles decorate on surface of graphene with electrodeposition. This Nanocomposite applied as catalyst for direct methanol fuel cell

The structures of the synthesized Ni/graphene Nanocomposite and the electrode composition were confirmed by X-ray diffraction (XRD) spectrometry, Fourier transform infrared (FT-IR) spectrometry and scanning electron microscopy (SEM).Cyclic voltammetry applied for Methanol Oxidation Reaction (MOR)

$[Fe(CN)_6]^{3-/4-}$ oxidation/reduction reaction test applied to compare activity of this composite Vs other common substrate for fuell cell like Volcun X72-R and CNT

Keywords**:** fuel cell, Graphene, Surfactant, Organic solvent, Electrocatalyst, Nanocomposite

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Aggregation Behavior of Cation-rich Catanionic Mixtures of Gemini Surfactants and Dodecyl Sulphate Sodium (SDS)

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Abstract

Physiochemical properties and aggregation behavior of cation-rich catanionic mixtures of ester-containing cationic gemini surfactants and dodecyl sulphate sodium (SDS) were investigated using surface tension, electrical conductivity and cyclic voltammetry. Different physicochemical properties such as the critical micelle concentration (CMC), degree of counterion dissociation (α^{diss}), interfacial properties, size of aggregates, and interparticle interaction parameters were determined. The interactions between two surfactants were analyzed on the basis of regular solution theory, both for mixed monolayers at the air/ liquid interface (β^{δ}) and for mixed micelles (β^{M}). The values of β^{M} and β^{δ} for all mixed systems were negative, which indicates that after mixing, the interaction between geminis and SDS is more attractive or less repulsive compared to before mixing. It was found that the surface activity of mixed surfactants is better than the individual surfactants. The results showed that the chemical structure of gemini surfactants have significant effect on the aggregation behavior and the thermodynamics of micellization. It was observed a phase transition with concentration for both mixed systems.

Keywords**:** Gemini Surfactants, Mixed surfactants, Aggregation**,** Diffusion Coefficient, Cyclic Voltammetry

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Measurement of Tyrosine using sol-gel/TiO2 electrode modified with over oxidized polypyrrole film

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Abstract:

Amino acids are essential building blocks of biological molecules,and the development of new technologies for their sensitive and universal quantitative determinations is of great interest [1] .
However, the determination of amino acids is not always simple given that these compounds lack natural chromophore or fluorophore for photometric and fluorometric detection. Over the past two decades, the significant analysis methods of amino acids have focused on UV–visible absorption, fluorescence, mass spectrometry, and the like, in which the investigated derivatives are formed mainly via the reactions between the primary amino group and o-phthalaldehyde in the presence of an alkyl thiol by pre- or postcolumn derivatization. But the derivatization products are usually unstable, and the above detection techniques have more or less suffered from diverse disadvantages with regard to the expensive equipment, insufficient selectivity, and time-consuming process of sample preparation. During this period, due to its obvious advantages of free derivatization, lower cost, better selectivity, and higher sensitivity, electrochemical detection has been widely employed to monitor a great variety of analytes of interest [2].

Sol-gel technology and using of silicated matrix that finally was crystallized as glassical crystals, has been used for analytical investigation since last century. Sol-gel electrochemistry has provided extensive research range in analytical chemistry in last fifty years. Sol-gel process has been done on the basis of hydrolysis and condensation of organometallic alkoxides following the

gel formation process by forming polymeric bonds with M (OR)X. In this research, carbon-ceramic electrode of tyrosine has been used for investigation of electrochemical behavior of tyrosine [3].

Effective parameters such as solution pH, supporting electrolyte concentration, optimizing percentage of TiO_2, modifying with polypyrole, scan rate, were investigated in this research. Amount of adsorbed Tyrosine on carbon-ceramic electrode was determined using cyclic voltammetry.

Keywords: Aminoacis, Tyrosin-solgel, cyclic voltametry, TiO_2-polypyrrole

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Simultaneous detection of ascorbic acid, dopamine and acetaminophen by modified gold electrode with polypyrrole/ gold nanoparticles film

Abstract:

The composite of gold nanoparticles and polypyrrole were electrochemically synthesized by applying gold nanoparticles as dopant ions, then the resulted composite was used as electrochemical sensor. The differential pulse voltammetric method was applied for simultaneous determination of ascorbic acid (AA), dopamine (DA) and acetaminophen (AC) using the Ppyox/GNPs/Au (poly overoxidizedpyrrole–gold nanoparticles–gold) modified electrode. The current of the oxidation peaks showed a linear dependent on the concentrations of AA, DA and AC in the range of 2.0×10^{-5} to8.0×10^{-4}mol L^{-1}, 1.0×10^{-7} to 8.0×10^{-6}mol L^{-1} and 3.9×10^{-6} to 1.4×10^{-4} for AA, DA and AC respectively. The detection limits (3σ) of 8.8×10^{-6}mol L^{-1}, 7.9×10^{-8}mol L^{-1} and 9.0×10^{-7} were obtained for AA, DA and AC, respectively. The modified electrode was used for determination ofAA, DA and AC in some real samples such as human serum and tablet samples.

Keywords:

gold nanoparticles, polypyrrole,electrochemical sensor, ascorbic acid,dopamine,acetaminophen.

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Construction of Rizatriptan benzoate nano-biosensor using bovine serum albumin

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Abstract

Rizatriptan benzoate (RB) belongs to a group of medicines known as serotonin agonists [1]. It is described chemically as: *N*, *N* dimethyl-5-(1*H*-1,2,4-triazol-1-ylmethyl)-1*H*-indole-3-ethanamine mono benzoate. It is used in the treatment of migraines. The literature reveals that various methods for the determination of rizatriptan benzoate are spectrophotometry, gas choromatography, high-performance liquid choromatography, liquid chromatography/tandem mass spectrometry, microemulsion electrokinetic capillary chromatography and reversed-phase liquid chromatographic [2].

The main target of this study is to develop sensitive and selective a new nano-biosensor for the voltammetric determination of Rizatriptan benzoate (RB). A new nano-biosensor consisting of multiwalled carbon nanotubes (MWCNTs) and bovine serum albumin (BSA) were prepared and utilized for electrode modification. The modified electrode was applied for electrochemical characterization and determination of RB in phosphate buffer solution (PBS, pH = 7) using cyclic voltammetry (CV) and differential pulse voltammetry (DPV). Experimental parameters for RB determination, such as scan rate, effect of pH and supporting electrolyte have been optimized. Under the optimum experimental conditions, RB could be linearly detected in the wide concentration range of 10^{-2} M to 10^{-4} M ($R^2 = 0.9946$). The detection limit was down to around 5×10^{-5} M and maximum current response was obtained at pH=7 phosphate buffer. Since

the prepared modified electrode exhibits a very good resolution between the DPV peaks of RB, Sumatriptan, Propranolol and Ergotamine, it can be applied for simultaneous detection of RB in the presence of these compounds in pharmaceutical preparations.

In this work, a chemically modified electrode using bovine serum albumin and multiwalled carbon nanotubes (BSA/NWCNTs) for the voltammetric determination of RB in solution was introduced. The results showed that the modified electrode exhibited excellent electrocatalytic activity to RB and showed great promise for simple, sensitive and quantitative detection and screening of RB. There is no voltammetric report using (BSA/NWCNTs) for construction of RB nano-biosensor in the accessible literature.

Keywords*: *nano-Biosensor*, *Voltammetry, Bovine Serum Albumin, multiwalled carbon nanotubes*, *Rizatriptan benzoate

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SiO_2 nanoparticles modified carbon paste electrode as a biosensor for determination of i-motif DNA / Tamoxifen interaction

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Abstract

Telomeres are the protective DNA-protein complexes that protect the ends of eukaryotes chromosomes and appear to play an important role in cellular ageing and cancer [1, 2]. Telomerase enzyme is a ribonucleic protein that maintains the lengths of chromosomal ends by synthesizing telomeric sequences and involved in around 85% of all cancers [3].Human telomeres are composed of tandem repeats of a double-stranded DNA sequence, (5-TTAGGG) :(5-CCCTAA) [4],Which the cytosine rich sequence can form i-motif structure. The stability of the i-motif depends on pH, c-rich telomeric repeats, the nature and concentration of cations[5]. It is believed that low pH stabilizes the folded i-motif structure of the C-rich strand, thus providing a competitor for duplex formation relative to the linear C-rich strand at neutral pH, that results in slow hybridization occurring and the formation of duplex. Tamoxifen is widely used as endocrine therapy for estrogen-receptor-positive breast cancer [6].In the current study, we designed an electrochemical biosensor by modifying a carbon paste electrode (CPE) with Sio$_2$ nanoparticle to investigate ligands which are able to interact with i-motif structure.The Tam drug was used as the model ligand and its ability for stabilizing i-motif structure was examined. The DNA oligonucleotides with following base sequences:d(5'- CCCTAACCCTAACCCTAACCC-3') were purchased from the MWG-BIOTECH, Germany and The stock solution of DNA (1.0µM) was prepared with phosphate buffered saline (PBS), (100mM phosphate, 1.5 M NaCl, 1.0mM MgCl$_2$, PH 4.5) and was kept frozen. In order to immobilize i-motif, 10 □L drops of 1.0 □mol L^{-1} DNA solutions was deposited on the freshly retreated modified electrodesurface,

followed by applying +0.50 V potential vs. Ag/AgCl/KCl (3 mol L^{-1}) for 5 minutes. The electrode was then rinsed with sterilized and deionized water. Then the interaction of i-motif with Tam was investigatedon the surface of working electrode.The square wave voltammetry (SW) was employed to ensure about i-motif DNA immobilization. This immobilization on the electrode surface was evaluated by SW measurement in 50 mM PBS buffer solution (pH 4.50). To investigate the interaction of i-motif DNA with Tam on the working electrode surface, i-motif DNA immobilized at the modified CPE and then the immobilized i-motif DNA modified CPE was immersed in ligand solution for 15 min without applying any potential to the working electrode. Then, the electrode was rinsed carefully with distilled water and SW measurements were recorded between +0.5 and +1.3 V vs. Ag/AgCl/KCl (3M) in PBS buffer These results demonstrate that after the i-motif DNA deposition on the modified electrode surface, Tam can interact with this structure and its oxidation signal can be seen after the i-motif immobilization and the oxidation signals of Tam increase by increasing its concentration.The mechanism of i-motif/Tam interaction has been studied using cyclic and SW voltammetry. The advantages of the proposed biosensor are rapid detection and the ability to distinguish i-motif DNA-binding ligands. Reports from our laboratory are in progress toward the usage of this ligand for antitumor activity in extracted DNA genome as real sample.

***Keywords:** i-motif DNA, Tamoxifen, Anti-cancer, Electrochemical biosensor*

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Design and construction of graphite electrode modified with liquid membrane based on an ionic liquid for the determination of Pb (II) ions

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Abstract

A new poly (vinyl chloride) (PVC) membrane electrode based on an ionic liquid, 1-hexyl 3-methylimidazolium hexafluorophosphate, and oleic acid (OA) as a good lipophilic additive for highly selective determination of Pb^{2+} ion has been developed. The electrode exhibits a Nernstian slope of 30.9 mV decade^{-1} over wide Pb^{2+} concentration range from 1×10^{-6} to 1×10^{-2} M and low detection limit 1.58×10^{-7} M. The electrode possesses a fast response time of ∼20 s, relatively long lifetime (at least 3 months). The proposed electrode revealed excellent selectivity for Pb^{2+}over a wide variety of alkali, alkaline earth, some transitions and heavy metal ions. The electrode could be used in a pH range of 4.0 to 10.

Keywords: *Lead, Lliquid Membrane, Potentiometry, Ionic Liquid.*

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Application of a novel ion-selective electrode based on a new ionophore for the determination of Pb (II) ion in Urmia and miyandoab water samples

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Abstract

Heavy metals are toxic and hazardous pollutants in the environment due to their non-biodegradability and persistence which can cause serious threat to living organisms, for example, the accumulation of lead in the human body exhibits severe deleterious effects on neurobehavioral development in children, increases blood pressure, and causes kidneyinjury and anemia. In this paper, we reported an ion selective electrode for the determination of lead ion based on 1-hexyl 3-methylimidazolium hexafluorophosphate as a new carrier (ionophore). The proposed sensor revealed important characteristics such as high selectivity, low detection limit, low cost, wide concentration range, low detection limit, fast response time and Nernstian response. In the present work, we used this sensor as indicator electrode for the determination of Pb (II) ion in Urmia and miyandoab water samples. The obtained results showed good agreement with data from atomic absorption spectroscopy.

***Keywords**: Lead, ionophore, ion selective electrode, liquid membrane.*

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Determination of copper (II) ion in Ahar and Tabriz water samples using liquid membrane electrode based on a new chitosan

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Abstract

The need for the determination of cu2+ and other heavy matales increased during the last years because their environmental problems are growing.Several methods were used for this purpose.Potentiometericion selective electrodes (ISEs) areknowentoofferanexellen low cost tool for the selective, sensitive and rapid determination of a vast variety of analytes in different fields of application. In this work, anovel cu2+ ion selective sensor using a new ionophore for potentiometric monitoring of low amounts of cu2+ ion was studied. The optimized PVC based membrane was contained of specific contents of ionophore, plasticizer and additive. Finally, the sensor was applied for the determination of cu2+ ion in Aharand Tabriz drinking and industrial sewage waters. The results showed good agreement with those from atomicabsorption spectroscopy.

Keywords: *potentiometry; ion selective electrode; carboxy methyl chitosan; sewage waters.*

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Design and construction of liquid membrane selective electrode based onTan(1-(2-thiazolylazo)-2-naphthol)for the determination of Pb^{2+} ions

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Abstract

In this work, a PVC membrane ion selective electrodefor Pb(II) ion based on an ionic liquid and TAN (1-(2-thiazolylazo)-2-naphthol)as suitable ionophore, was reported.The electrode responds to Pb^{+2} in a linear range from 1×10^{-6} to 1×10^{-2} molL^{-1}with a slope of 30.25 mV per decade and detection limit of 8×10^{-7} molL^{-1}.The response time of the sensor isabout 15 s and the electrode can be used for more than four months without observing any deviation.During last decade, the potentiometric sensorsbased on the ionophores with high selectivity for specific metalionshave been developed.The proposed electrode could be used in a pH range of 4-10. The selectivity coefficients were determined by Separate Solution Method (SSM) and suggested that the proposed sensor responded without important interferences over the alkali, alkali earth and heavy metals.

***Keywords*:** Lead (II) Ion;PVCMembrane; Potentiometric Sensor; TAN.

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Determination of lead (II) ions in the Urmia well, river and drinking waters by a novel ion selective sensor based on new ionophore

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Abstract

Lead (II) ion is one of themost toxic pollutants which can severely affecthuman health and the environment.The Pb^{2+} ion accumulation can cause the substantial damage to the brain, central nervous system,muscles and renal systems. There are several methods which have been used for Pb^{2+} ion detection,and the most common techniques are inductively coupled plasmamass spectrometry, atomic absorbance spectrometry and capillary electrophoresis. In the present research, a new lead ion-selective electrode was developed based on an ionic liquid and TAN(1-(2-thiazolylazo)-2-naphthol)as ionophore.The proposed sensor revealedvarious advantages including simple instrumentation, low cost, rapid response,high selectivity and lower detection limit.With regard to mentioned advantages, the proposed sensor was applied in the determination oflead ions in water samples such as Urmia well, river and drinking waters. The obtained data showed a good agreement with results from atomic absorption spectroscopy.

Keywords**:** Lead ions;liquid membrane; ionophore; Water sample

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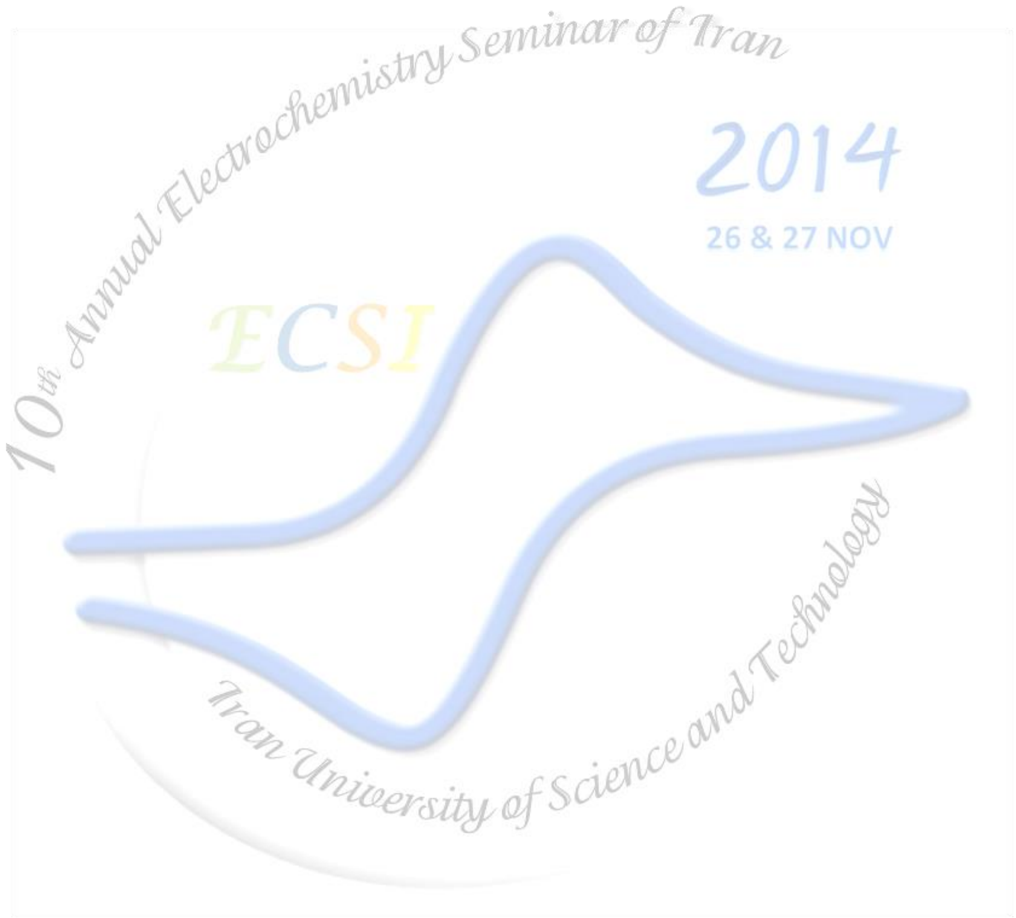

Development of a biosensor with alcohol oxidase and gold nanoparticles for ethanol detection

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Abstract

In the present age, the detection and quantification of components with high sensitivity, selectivity and accuracy is required in different areas. The measurement of alcohols, ethanol in particular, is an important option in medicine, biotechnology, environmental, food and fermentation industry, due to its toxicological and psychological effects. Classical methods are routinely used in industry. Although some of these methods are precise and reliable, there are relatively expensive and complex in performing; therefore, alternative approaches are desirable. Meanwhile, the devices such as biosensors, due to their potential advantages, are attracted more attention. A biosensor is an analytic device that uses specific biochemical reactions mediated by a biological recognition element immobilized on a signal transducer. The advantage of biosensors compared with electrochemical sensors is their high selectivity; it is because of the biological element that is used in biosensor. In the present work, this element is an enzyme. This work describes a new amperometric ethanol biosensor based on alcohol oxidase immobilization. Also optimization of variables affecting the system was performed and, for chronoamperometric measurements, a potential of 0.4 V versus reference electrode (Ag/AgCl) was chosen in 0.1 M phosphate buffer. The optimum pH was found to be pH 8.0 at 25°C. Also it was illustrated the use of gold nanoparticles could improve the biosensor response.

Keywords: *Alcohol oxidase, Biosensor, Ethanol, Gold nanoparticles*

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Nonenzymatic glucose sensor based on ternary NiO nanoparticles/polypyrrole/graphene oxide nanocomposite

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Abstract

The electrochemical biosensors based on nanomaterialsincludingmetal nanoparticles, carbon nanotubes, graphene and metal oxideshave recently been investigated intensively, due to their uniquechemical and physical properties [1-3]. The nanocomposites com-bining two or several different components are expected to furtherimprove the deficient characteristics of each component [4], lead-ing to promising application in biosensing.

In this work we report a simple, one-step method for direct electrochemical incorporation of graphene oxide (GO) into conducting polymer films without the use of any additional dopants. Polypyrrole (PPy) was successfully electropolymerized in as-prepared aqueous GO dispersions using potentiostatic polymerization. When dispersed in water, the GO flakes carry a negative surface charge which allows them to serve as counter ions and hence be incorporated into the polymer films during electropolymerization. Then CuO nanoparticles electrodeposited on the PPy/GO by cyclic voltammetry method. The morphology and structure of CuO/PPy/GO nanocomposites were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transform infrared (FT-IR). The incorporation of GO into PPy resulted in a distinctly different and more porous surface morphology than that observed in PPy films synthesized in the presence of conventional counter ions. The CuO/PPy/GO/GCE-based sensor exhibited excellent electrocatalytic activity and high stability for glucose oxidation. Under optimized conditions, the linearity between the current response and the glucose concentration was obtained in the range of 2μM to 4mM with a detection limit of 0.7μM (S/N=3). The proposed electrode showed a fast response time (less than 5s) and a good reproducibility. The as-

made sensor was applied to determine the glucose levels in clinic human serum samples with satisfactory results.

Keywords: *Polypyrrole, Graphene oxide, NiO nanoparticles, Nonenzymatic, Glucose*

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Graphene oxide/polyaniline/ZnO nanoparticles nanocomposite for determination of dopamine

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Abstract

Electrically conductingpolymers (ECPs) are unique since they are both ionicand electronic conductors. To further improve materialproperties like stability, conductivity, capacitance, and mechanicalstrength, ECPs have been fabricated as composites with a widevariety of materials like metal nanoparticles [1], conventionalpolymers [2], and carbon materials like nanotubes and fullerenes[3]. For the same reasons, the possibility to combine ECPs withgraphene and its derivatives has gained a lot of scientific groundduring the last few years, especially in the field of biosensors[4-6].

Here, we report a dopamine sensor based on graphene oxide/polyaniline/zinc oxide (ZnO) nanoparticlesnanocomposite modified glassy carbon electrode (GO/Pani/ZnO/GCE). In this case, the graphene sheetswere cast on the GCE directly. ZnO nanoparticles were obtained by oxidizing electrochemically deposited Cuon the graphene.Paniwas successfully electropolymerized in as-prepared aqueous GO dispersions using cyclic voltammetry. When dispersed in water, the GO flakes carry a negative surface charge which allows them to serve as counter ions and hence be incorporated into the polymer films during electropolymerization. Then ZnO nanoparticles electrodeposited on the Pani/GO by cyclic voltammetry method. The morphology and structure of GO/Pani/ZnOnanocomposites were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transform infrared (FT-IR). The GO/Pani/ZnO/GCE-based sensor exhibited excellent electrocatalytic activity and high stability for determination of dopamine. Under optimized conditions, the linearity between the current response and the dopamine concentration was obtained in the range of 0.5-200μM with a detection limit of 0.1μM

(S/N=3). The proposed electrode showed a fast response time and a good reproducibility. With good selectivity and sensitivity, the present method was applied to determination of DA in injectable medicine and UA in urine sample.

***Keywords**: Polyaniline, Graphene oxide, ZnO nanoparticles, Dopamine*

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Multivariate optimization of ion selective electrode based on a polymer membrane containing iodoquinol for determination of Cu^{2+} ions

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Abstract

The increasing use of ion sensors in the fields of environmental, agricultural and medicinal analysis is stimulating analytical chemists to develop new sensors for the fast, accurate, reproducible and selective determination of various species. In the past few decades, considerable efforts have led to the development of selective sensors for alkali and alkaline earth metals and for heavy metals [1]. A Plackett–Burman experimental design was used to evaluate the influence of several variables on the analytical response (Nernstian slope). A large number of factors could potentially affect the ion selective measurement. Therefore a Plackett–Burman design was used as a screening method to select the most statistically significant parameters for further optimization [2]. The main effects including concentraton of internal solution, amount of PVC, amount of plasticizer (NB), amount of additive (NaTPB), amount of ionophore, pH, time condition and stirring rate were studied. The evaluated factors were divided into four different sections including pH, amount of PVC, amount of plasticizer (NB) and amount of additive (NaTPB). The significant parameters (Fig. 1) were optimized using a central composite design.

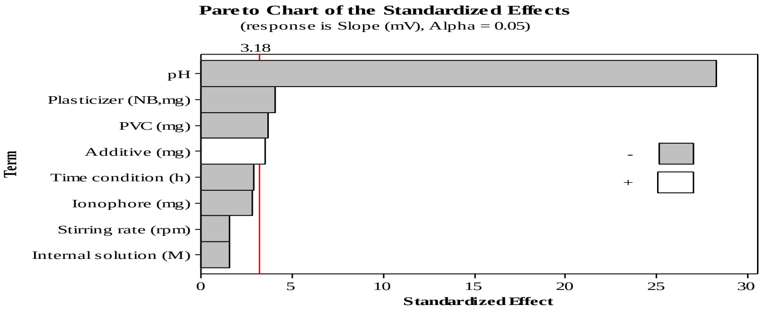

Fig. 1. The standardized main effect Pareto chart for Plackett–Burman design.

The electrode based on iodoquinol (5,7-diiodoquinolin-8-ol) exhibit Nernstian responses (29.2±0.3 mV) over a wide concentration ranges (1×10^{-6} to 1×10^{-2} M). The electrodes possess a fast response time of ~10s and can be used for at least 6 weeks without observing any deviation. The prepared sensor showed a suitable reproducibility and excellent selectivity for Cu^{2+} ions over a wide variety of alkali, alkaline earth, transition and heavy metal ions and could be used in a good pH range (5-9). To investigate the interfering effects Ag^{+}, Mn^{2+}, Cd^{2+}, Zn^{2+}, Ni^{2+}, Sr^{2+}, Mg^{2+}, Pb^{2+}, Ba^{2+}, Co^{2+}, Fe^{3+}, Al^{3+}, NH_4^{+} and Ce^{4+} cations were studied as interferents. In the most cases there was no interfering effect with the studied cations. It is suggested this new ion selective electrode would easily be used to determination of Cu^{2+} ions in the real samples.

Keywords:

Potentiometric, Copper(II) ion sensor, PVC membrane, 5,7-diiodo-8 hydroxyquinoline (iodoquinol).

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Optimization of a new polymeric copper (II) membrane electrode based on methimazole using experimental design

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Abstract

Ion selective sensors have been used for analytical determination of a wide variety of ions. One of the most important figures of merit for ion selective electrode (ISE) is the selectivity towards a specific analyte, which is generally limited by the interaction of ionophore within the membrane with other ions in solution. Ionophore plays a key role in the sensitivity of ion selective electrode [1]. It is familiar that the sensivity of cation selective electrode confirmly depend on the membrane composition and nature of plasticizer [2]. Thus the influence of plasticizers was studied and it was found that the best performance was obtained with dibutyl phthalate (DBP) as a suitable solvent mediator. Plackett–Burman and central composite designs were applied as experimental design strategies to screen and optimize the influence of membrane ingredients on the electrode performance. A new poly (vinyl) chloride (PVC) membrane sensor for Cu(II) based on methimazole as an ionophore was planned. The major variables to find a model for achieving the best Nernstian slope as response were: PVC, plasticizer, methimazole, additive, pH, stirring rate and internal solution concentration. Plackett–Burman design was used to screen the main factors (**Fig. 1**) and central composite response surface was led to find a model for optimizing the response.

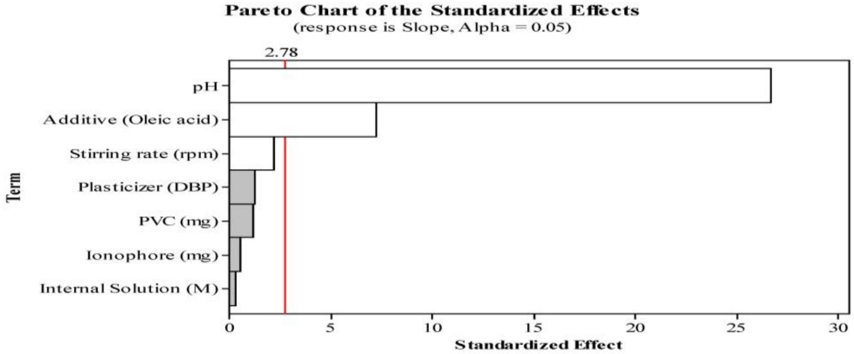

Fig. 1. The standardized main effect Pareto chart for Plackett-Burman design.

The optimized membrane electrode shows a Nernstian slope for Cu(II) ions over a wide linear range from 1×10^{-6} to 1×10^{-2} mol L^{-1} and a slope of 28.12 mVdecade^{-1} of activity.
The response time of the sensor is about 8 s and the membrane can be used for more than 6 weeks without any deviation. The electrode revealed comparatively good selectivity with respect to many cations including alkali earth, transition and heavy metal ions.

Keywords: *PVC membrane electrode, Copper (II) ion, Multivariate optimization, Methimazole*

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Electrochemical behavior of codeine and its sensitive determination on sammarium hexacyanoferrate–carbon nanotubes modified electrode

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Abstract

Codeine, i.e. methyl morphine, is a natural opiates alkaloid from poppy or prepared from morphine by methylation, has long been used as an effective analgesic and antitussive agent[1]. Its phosphate form is usually used for the treatment of gently or moderate pain in clinic medication. Metal hexacyanoferrate (MHCF) modified electrodes have been investigated intensively for a variety of application areas including electrocatalysis[2,3], ion selectivity, electrochromism, and solid-state batteries. The modification of electrode substrates with multi-walled carbon nanotubes (MWNTs) for use in analytical sensing is well documented to result in low detection limits, increased sensitivities, reduced over-potentials and resistance to surface fouling, and therefore MWNTs have been claimed as electrocatalyst[4].

In this work, a GC electrode modified with SmHCF/MWCNTs was prepared and that shows excellent electrocatalytic activity toward the codeine.Stable suspension of MWCNTs casting on glassy carbon electrode and dried in an oven at 50◦ C.Then, sammarium hexacyanoferrate deposited on the surface of the MWCNTs/GC electrode by potential cycling from +0.8 to -0.2 V at a sweep rate of 100 mV/s for 40 cycles[5].

Scanning electron microscopy was used to show the morphology of the synthesized SmHCF. The electrocatalytic oxidation of codeine was investigated using CV and compared modified electrode with bare GCelectrode in 0.1M phosphate buffer. Oxidation peak of codeine appear in 0.8 V and its indicate that modifier have electrocatalitic effect on oxidation of codeine.

CVs of 50 µM codeine on the SmHCF/MWCNTs/GCE was investigated with different scan rateand the results showed that the electrochemical oxidation is a typical adsorption-controlled

electrochemical process.CV investigated the electrochemical oxidation behaviors of codeine at electrode in buffer systems with different pH values. A linear relationship was observed between the E_{pa} and the pH values in the range from 5.5 to 8.5 as equation of with a slope of of approximately −62.8 mV per pH unit. This clearly indicates that equal numbers of electrons and protons are involved in the electrooxidation of codeine on the surface of the modified electrode. The determination of codeine was performed by employing DPVtechnique in 0.1 MPBS (pH 7.5). The results showed that a linear relationships between peak currents (I_p) and codeine concentration in two linear range of 2×10^{-7} -1×10^{-6}M and 1×10^{-6} -2×10^{-5} M. The LOQ and LOD were found 2×10^{-7} M and 6×10^{-8} M, respectively.

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Preparation of a molecularly imprinted polymer electrochemical sensor for 1,4-dihydroxyanthraquinone based on carbon nanotube/polypyrrole film

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Abstract

Molecular imprinting is a new technique that produces synthetic receptors that preferentially bind with a particular molecule (template). The principle of molecular imprinting is based on copolymerization of functional monomers and cross-linkers in the presence of template [1, 2]. An electrochemical sensor was developed by modifying multi-walled carbon nano tubes-molecularly imprinted polymer (MIP) on to a pencil graphite electrode (PGE). Preparation of MIP and quantitative measurements (**Fig. 1**) were performed by cyclic voltammetry (CV) and differential pulls voltammetry (DPV), respectively [3-5].

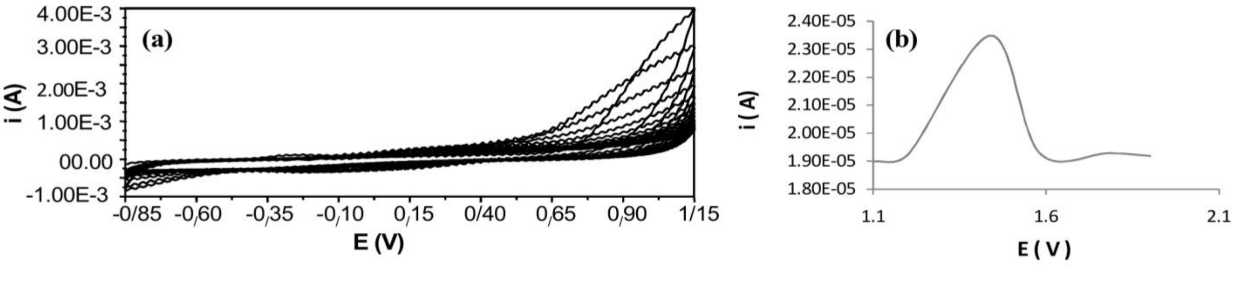

Fig. 1. The voltammetric cycles for the preparation of MIP (a) and DPV for measurements (b).

The influences of several parameters on the efficiency of sensor response were investigated using multivariate methods. Plackett-Burman design (PBD) for screening and central composite design (CCD) for optimization were carried out and optimum conditions were determined.

Pyrrole and acetonitrile were selected as functional monomer and polymerization solvent, respectively. The detection limit of 1,4-dihydroxyanthraquinone was obtained 4.15×10^{-9} M . The calibration curve demonstrated linearity over a concentration range of 10^{-8} -10^{-4}M with a correlation coefficient (R^2) of 0.992. The prepared sensor showed a suitable reproducibility (RSD % of 5, n = 3). The sensors showed good results for determination of 1,4-dihydroxyanthraquinone in serum and pelasma samples.

Keywords: *Molecularly imprinted, Experimental design, Carbon nano tubes, 1,4-dihydroxyanthraquinone* .

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Preparation of ion selective sensor using quinizarine as an ionophore based on multivarited optimization methods

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Abstract

Ion-selective potentiometry is one of the electro analytical methods. An ion-selective electrode (ISE), also known as a specific ion electrode (SIE), is a sensor that converts the activity of a specific ion dissolved in a solution into an electrical potential [1, 2]. In this work, a novel cadmium PVC-based membrane sensor using quinizarine as an ionophore is presented .The voltage is theoretically dependent on logarithm of the ionic activity, according to the Nernst equation [3, 4]. A Plackett–Burman experimental design was used to evaluate the influence of several variables on the analytical response (Nernstian slope). Then, the significant parameters (**Fig. 1**) were optimized using a central composite design, simultaneously [5].

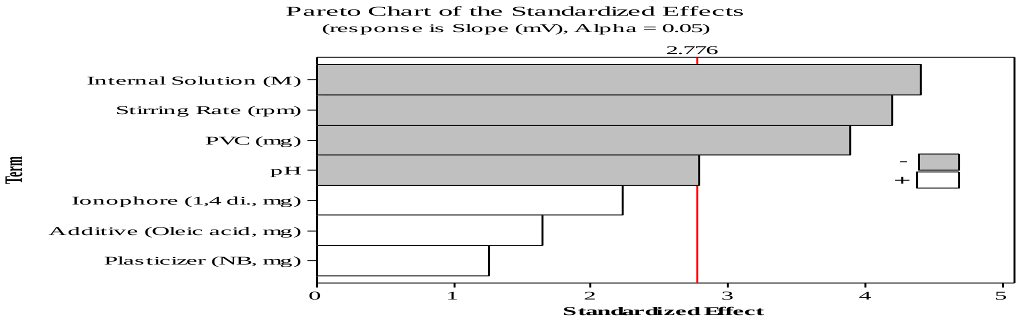

Fig.1. The standardized main effect Pareto chart for Plackett–Burman design.

The sensor showed liner dynamic range between 1×10^{-5} to 1×10^{-2} M, with a Nernstian slope of 27.5 mV per decade and detection limit of 1.9×10^{-7} M. The best performance was obtained with a membrane composition of 30 mg PVC, 70µl NB, 60 µl oleic acid and 1.2 mg quinizarine. The potentiometric response of the proposed electrode is independent of the pH of the solution in the range of 4.8-8.5. The development of potentiometric ion-selective electrodes is a very interesting field because it has a wide range of applications in determining ions in water and other mediums.

Keywords: *Potentiometry, PVC membrane, Quinizarine, Ion- selective electrode, Experimental design*

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Electrochemical behavior of codeine and its sensitive determination on sammarium hexacyanoferrate–carbon nanotubes modified electrode

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Abstract

Codeine, i.e. methyl morphine, is a natural opiates alkaloid from poppy or prepared from morphine by methylation, has long been used as an effective analgesic and antitussive agent[1]. Its phosphate form is usually used for the treatment of gently or moderate pain in clinic medication. Metal hexacyanoferrate (MHCF) modified electrodes have been investigated intensively for a variety of application areas including electrocatalysis[2,3], ion selectivity, electrochromism, and solid-state batteries. The modification of electrode substrates with multi-walled carbon nanotubes (MWNTs) for use in analytical sensing is well documented to result in low detection limits, increased sensitivities, reduced over-potentials and resistance to surface fouling, and therefore MWNTs have been claimed as electrocatalyst[4].

In this work, a GC electrode modified with SmHCF/MWCNTs was prepared and that shows excellent electrocatalytic activity toward the codeine.Stable suspension of MWCNTs casting on glassy carbon electrode and dried in an oven at 50◦ C.Then, sammarium hexacyanoferrate deposited on the surface of the MWCNTs/GC electrode by potential cycling from +0.8 to -0.2 V at a sweep rate of 100 mV/s for 40 cycles[5].

Scanning electron microscopy was used to show the morphology of the synthesized SmHCF. The electrocatalytic oxidation of codeine was investigated using CV and compared modified electrode with bare GC electrode in 0.1M phosphate buffer. Oxidation peak of codeine appear in 0.8 V and its indicate that modifier have electrocatalitic effect on oxidation of codeine.

CVs of 50 µM codeine on the SmHCF/MWCNTs/GCE was investigated with different scan rateand the results showed that the electrochemical oxidation is a typical adsorption-controlled electrochemical process. CV investigated the electrochemical oxidation behaviors of codeine at electrode in buffer systems with different pH values. A linear relationship was observed between the E_{pa} and the pH values in the range from 5.5 to 8.5 as equation of with a slope of of approximately −62.8 mV per pH unit. This clearly indicates that equal numbers of electrons and protons are involved in the electrooxidation of codeine on the surface of the modified electrode. The determination of codeine was performed by employing DPVtechnique in 0.1 MPBS (pH 7.5). The results showed that a linear relationships between peak currents (I_P) and codeine concentration in two linear range of 2×10^{-7} -1×10^{-6}M and 1×10^{-6} -2×10^{-5} M. The LOQ and LOD were found 2×10^{-7} M and 6×10^{-8} M, respectively.

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Nonenzymatic glucose sensor based on ternary NiO nanoparticles/polypyrrole/graphene oxide nanocomposite

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Abstract

The electrochemical biosensors based on nanomaterialsincludingmetal nanoparticles, carbon nanotubes, graphene and metal oxideshave recently been investigated intensively, due to their uniquechemical and physical properties [1-3]. The nanocomposites com-bining two or several different components are expected to furtherimprove the deficient characteristics of each component [4], lead-ing to promising application in biosensing.

In this work we report a simple, one-step method for direct electrochemical incorporation of graphene oxide (GO) into conducting polymer films without the use of any additional dopants. Polypyrrole (PPy) was successfully electropolymerized in as-prepared aqueous GO dispersions using potentiostatic polymerization. When dispersed in water, the GO flakes carry a negative surface charge which allows them to serve as counter ions and hence be incorporated into the polymer films during electropolymerization. Then CuO nanoparticles electrodeposited on the PPy/GO by cyclic voltammetry method. The morphology and structure of CuO/PPy/GO nanocomposites were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transform infrared (FT-IR). The incorporation of GO into PPy resulted in a distinctly different and more porous surface morphology than that observed in PPy films synthesized in the presence of conventional counter ions. The CuO/PPy/GO/GCE-based sensor exhibited excellent electrocatalytic activity and high stability for glucose oxidation. Under optimized conditions, the linearity between the current response and the glucose concentration was obtained in the range of 2μM to 4mM with a detection limit of 0.7μM (S/N=3). The proposed electrode showed a fast response time (less than 5s) and a good reproducibility. The as-

made sensor was applied to determine the glucose levels in clinic human serum samples with satisfactory results.

Keywords: *Polypyrrole, Graphene oxide, NiO nanoparticles, Nonenzymatic, Glucose*

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Modification of glassy carbon electrode using electrodeposition of zn-Al layered double hydroxide and its application in the determination of hydrazine

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Abstract

In this project, the immobilization possibility of layered double hydroxides (LDHs) based on Aluminium-zinc modified with hexacyanoferrate (HCF) as a thin film has been studied[1]. At first step, a thin film of Zn-Al-LDH-HCF was immobilized on the electrode surface. Then a nafion layer was used as a suitable coating to keep the electroactive modifier on the surface electrode[2]. The modifier, Zn-Al-LDH-HCF were prepared with direct interaction between LDHs and a solution of HCF. The electrochemical behavior of glassy carbon electrode modified with Zn-Al-LDH-HCF was studied and their ability in electrocatalytic oxidation of hydrazine was evaluated. This modified electrode showed characteristics such as good reproducibily they response, stability and suitable sensor for the determination of hydrazine.

Keywords: hydrazine; electrocatalytic oxidation; layered double hydroxides; glassy carbon electrode.

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Electrochemical characterization of new dye sensitized solar cell fabricated by sonochemical synthesized ZnO nanoparticles

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Abstract

Recently, synthesis of nanostructured compounds with various techniques has extensively fascinated a great deal of attention in scientific researchers. Among the variety of approaches, sonochemical methods have been extensively examined in this field [1], whereas sonochemical method is utilized as routine methods in synthesis of variety nanostructured material [2]. Among various nanomaterials, zinc oxide nanostructures with wide band gap (3.37 eV) have drawn considerable interest as a good candidate for solar cell applications [3, 4].

In this study a new type of ZnO based DSSC was fabricated using sonochemical synthesis of ZnO nanoparticles. Nano-sized ZnO supramolecular compound prepared by a self-assembling system containing pyridine ligand in both water and methanol solvents. *For revealing the structure and morphology of ZnO, field emission scanning electron microscopy (FE-SEM), FTIR spectroscopy and* thermal gravimetric analysis (TGA) *were carried out. Finally,* ZnO *DSSC was fabricated using N719 Ruthenium dye and all photovoltaic* such as short circuit current density (J_{SC}), open circuit voltage (V_{OC}), fill factor (FF) and conversion efficiency (η) were measured as well. *The electrochemical impedance spectroscopy was employed to study the properties of ZnO/electrolyte interfaces [5]. An appropriate circuit equivalent was considered for obtaining* the electron lifetime, charge transfer and transport resistances values to exhibit the performance of the new ZnO photoanode. The results demonstrated the overall efficiency about 1.3% for cell performance.

***Keywords*: *ZnO photoanode; Dye sensitized solar cell*, *Sonochemical synthesis, Electrochemical impedance spectroscopy*.**

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Determination of hydrazine in the water samples by electrocatalaticoxidationon surface LDH-modified carbon glassy electrode

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Abstract

Hydrazine (HZ), N_2H_4 is a colorless liquid with an ammonical odor and is the simplest unique diamine in its class because of the N-N bond. It was first prepared in 1887 by Curtius as the sulfate salt, from dizaoacetic ester [1]. Although HZ has simple structure but chemically it is reducing, decomposable, basic and bifunctional. HZ is a toxic material which must be treated with care. Harmful effect may result from injection, inhalation of vapors, or contact with the skin. In this work, a stable electroactive thin film of hybride zinc-Aluminum-layered double hydroxides (LDHs)-hexacyanoferrate (Zn-Al-LDH-HCF) was electrodeposited on a carbon glassy electrode. The proposed modified electrode exhibited several attractive features, such as simple preparation, fast response, good stability and repeatability, good electrocatalytic activity, overpotential reducing and high sensitivity in the wide concentration range of hydrazine. Finally, the proposed electrode was used successfully for the determination of hydrazine in Hashtrood and Tabriz well and river water samples and the results showed good agreements with data obtained by spectroscopic methods.

Keywords: *hydrazine; Layered double hydroxides; electrocatalytic oxidation; glassy carbon electrode*

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Experimental and numerical investigation on the heat transfer characteristics of alumina nanofluids under the laminar flow regime

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Abstract

This study aims to investigate the effect of particle agglomeration on the convective heat transfer performance of Al2O3/water nanofluids. Moreover, experiments were performed using Al2O3 nanofluids inside a straight circular tube under uniform heat flux and in the laminar flow regime. The cluster size distribution due to particle agglomeration was analyzed and used for the numerical modeling. The single-phase model with constant (CP-SP) and variable (VP-SP) physical properties and also the discrete particle two-phase model with particle agglomeration and clustering were considered. A commercial CFD codewas employed to solve the governing equations.

Recently, numerous theoretical investigations [1-3] by different researchers on nanofluid convective heat transfer were carried out, but all of them did not consider the van der Walls interaction and agglomeration phenomena of the nanoparticles.In order to consider the particle agglomeration in the nanofluid during the time of the experiments, the particle size distribution was measured using the dynamic light scattering (DLS) method and the size distribution data were fitted to the Rosin-Rammler equation,$Y_d = \exp(-(d/\bar{d})^n)$. In this study, by fitting the DLS data with equation 18, the value of $\bar{d}$ and n obtained were equal to 0.996008 µm and 1.175, respectively.Figure 1 show the stability results after 26 days. The results clearly show that the stability period for the same concentration of alumina nanofluids varies with the pH value and the period of stability at low pH is greater than at high pH. Reasonably good agreement can be observed in Figure 2 between the Shah equation and the experimental measurements with the average discrepancies about 4.1 % and 4.8% for the Reynolds numbers of 1724 and 1137, respectively.

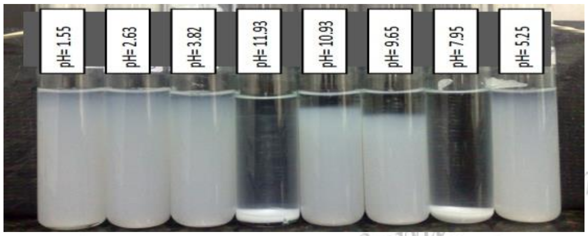

Figure 1. Stability analysis of 0.5 vol.% alumina nanofluids at different pH after 26 days

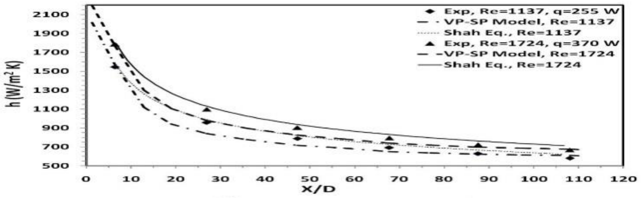

Figure 2. Measured heat transfer coefficient versus dimensionless distance for de-ionized water

Keywords**:** *Nanofluids, Heat transfer coefficient, Single-phase model, Two-phase model.*

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A new amperometric sensor for bromateions determination: Silver nanoparticles/carbon mesoporousnanocompositemodified GCE

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Abstract

In this wrok, we report the *synthesis* and characterization of a nanohybrid composed of mesoporous carbon and silver nanoparticles (MC/AgNPs) to use in amperometric sensing of bromate ions (BrO_3^-). In this process, the MC was synthesized by using the mesoporous silica as a template and glucose as a carbon source. The AgNPs were produced by reduction of silver nitrate through glucose as a reducing and stabilizing agent to give the desired MC/AgNPsnanohybrid. The obtained nanohybrid was used to modify a glassy carbon electrode and to fabricate an amperometric sensor for BrO_3^- determination at a working potential of -1.25 mV vssilver/silver chloride electrode in aqueous 0.2 M phosphate buffer solution (pH 4.0). The resulted sensor can detect BrO_3^- in the concentration range of 0.6-31.6mM with a detection of limit 0.397 mM at a signal-to-noise ratio of 3.

***Keywords*:**Bromate,Silver nanoparticles, Carbon mesoporous, Nanocomposite.

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Preparation and electrocatalytic application of novel Pd nanoparticle/polyoxometalate/Graphene nanohybrids

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Abstract

Fuel cells are widely considered to be an important power source due to their high energy conversion, efficiency and low pollution. The direct ethanol fuel cell (DEFC) has been proposed as a possible replacement for batteries and direct methanol fuel cell (DMFC) because ethanol has no toxicity compared to methanol and can be easily produced in great quantities by fermentation of sugar-containing raw materials: and the Pd-based catalysts toward ethanol oxidation exhibit a higher initial activity due to being free of CO poisoning compared to Pt, and also at a lower cost [1]. Furthermore, to maximize the electrocatalytic activity of NPs, a suitable carbon support is required to disperse these NPs. Graphene has received considerable attention due to its good chemical and physical properties[2]. There are various methods to load metal NPs on GNSs. Recently, polyoxometalates (POMs), the early transition metal oxygen anionic clusters with remarkably rich redox and photo-electrochemical properties[3], have been used as a sole agent to build metal NPs@POM[4-7]. Herein, we report an alternative, in situ, easy and green strategy for the synthesis of Pd NPs@POM-GNSs nanohybrids using solely polyoxometalates (POMs) as reducing, stabilizing and bridging molecules and investigate their electrocatalytic activity toward ethanol.

$PdCl_2$ and Graphite powder were purchased from merck Co., phosphomolybdic acid $H_3[PMo_{12}O_{40}]$ (PMo_{12}) was purchased from Aldrich Chemical Company.

Graphene oxide (GO) was oxidize from graphite powder by a modified Hummers method using H_2SO_4, $NaNO_3$ and $KMnO_4$ in an ice bath as reported in great detail elsewhere. For preparation of Pd NPs@POM-GNSs nanohybrids, PMo_{12} was firstly reduced by UV photo-reduction. In a typical synthesis PMo_{12}, isopropanol, $PdCl_2$ and GO were mixed under UV irradiation. Characterization using transmission electron microscopy, fourier transform infrared spectroscopy (FT-IR), X-ray diffraction analysis (XRD), cyclic voltammetry (CV), etc. was performed and verified the structure of the prepared nanohybrids of Pd NPs@POM-GNSs. Cyclic voltammetry was done under a conventional three compartment cell with a glassy carbon working electrode, a Ag/AgCl reference electrode and a Pt wire for counter electrode.

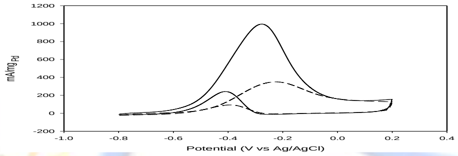

Fig1.Shows the catalytic activity of as prepare catalyst is higher than other composite.

So, the surface methodology of novel Pd NPs@POM-GNSs tri-component nanohybrids have been examined by different analysis. This synthesis is simple and environmentally friendly. The reaction can be performed at room temperature without any other organic templates or surfactants, which is beneficial for its electro-catalytic activities. The obtained nanohybrids exhibited exciting electrocatalytic activity towards ethanol electrooxidation reaction.

Keywords: *Palladium nanoparticle,Graphene oxide, Polyoxometalates, Electrocatalytic activity, Ethanol electrooxidation.*

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$Ni_{0.5}Zn_{0.5}Fe_2O_4$nanocomposite modified carbon paste electrode for determination of trace amounts of selenium(IV)

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Abstract

Selenium is an essential micronutrient for humansand animals. It has antioxidant properties, stimulatesthe formation of antibodies, and thus enhances the protection of the organism from infections. It is a trace element that is both essential and toxic, with essentiality being confined to a narrowconcentration range. Among the known methods for determining trace selenium, stripping voltammetry finds increasingapplication because of its high sensitivity, simplicity, and inexpensive equipment.

A new chemically modified carbon paste electrode (CPE) was constructed and used for rapid, simple,accurate, highly sensitive, and selective determination of selenium(IV) using square waveanodic stripping voltammetry.The electrode was preparedusing magnetic nickel zinc ferrite nanocomposite, as the modifier, in CPE.

This method is based on formation of mercury selenide and decreasing the current of mercury peak, this followed by square-wave anodic stripping voltammetry. Operational parameters such as pH, deposition potential, and deposition time were optimized. Compared with CPE, the stripping peak currents had a significant increase at the modified electrode. Under the optimal conditions, the limit of detection, based on three times the background noise, was 0.05mol L^{-1} with a 120s preconcentration. The effects of different cations and anions on the determination of selenium(IV) were investigated.

The results indicated that the electrode is highly selective. Furthermore, the present method was applied to the determination of se(IV) in several foodstuff samples.

Keywords:
Selenium determination , Stripping analysis, Carbon paste modified electrode,Magnetic nickel zinc ferrite nanocomposite.

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Dynamic Light Scattering of Mixed SDS-Hemin-Imidazole in Different Ionic Strength: As Structural Feature of Artificial Peroxidase

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Abstract

Artificial enzymes can be considered a part of biomimetic chemistry. An alternative approach to the preparation of robust biocatalysts consists in the encapsulation of metalloporphyrins into water-soluble hydrophobic pocket, as Micelles, vesicles[1], that mimic the polypeptide envelope, which protects the catalytic center into inactive complexes. So these studies also can be classified into colloid chemistry as part of interfaces in solutions. The electronic properties and biochemical functions of heme prosthetic group as an active-site of horseradish peroxidase (HRP) is strongly depended on the nature of the protein environment surrounding the heme group. To gain more quantitative insights to study of structural feature of heme-imidazole in SDS micelle (as artificial peroxidase enzyme) at different ionic strength dynamic light scattering (DLS) was used. The distributions of different sizes in each sample indicate that ionic strength has large effect on the biocatalyst's shape and structure. Data has shown that sizes of particles have grown by increasing of ionic strength. Zeta potentials of heme-imidazole-SDS in various phosphate buffer concentrations (pH=7.4) also confirm different structure via different charged SDS aggregation in various buffer concentrations. The structure of peroxidase-like nano biocatalyst system containing heme-SDS micelle and heme-imidazole-SDS micelle were found to be dependent on the environmental electronic properties or ionic strength. The different

formation of SDS micelle in various ionic strengths may produce different position for heme moiety as a peroxidase active site via inter and intra molecular interactions. This study indicates that the evolution of biocatalyst efficiency towards native peroxidase is relative to the enzyme structure.

Keywords**:** *artificial Peroxidase enzyme, Ionic strength, DLS, SDS, Heme, Imidazol*

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Investigation of Dopamine encapsulation in liposome and its electrochemical determination

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Abstract

Liposomes are artificial microscopic vesicles composed of a lipid bilayer in which the hydrophobic chains of the lipids are forming the bilayer, and the polar head groups of the lipids orienting towards the extra vesicular solution and inner cavity. Liposomes have been widely used in drug delivery successfully [1]. In a similar way to their application as a carrier for drugs, liposomes can act as a carrier for a wide range of signaling molecules especially in electrochemistry. The inner cavity and or space between bilayer can be used for encapsulating hydrophilic and hydrophobic compounds, respectively [2]. In this study we investigated the encapsulation of dopamine hydrochloride in liposomes composed of lecithin and cholesterol. The liposomes were prepared from lecithin: cholesterol (10:1 molar ratio) through thin film hydration method [3]. Dopamine hydrochloride as hydrophilic compound was successfully encapsulated during liposome formation step and the encapsulation efficiency was investigated using λ_{max} of dopamine at 280 nm. The electrochemical studies were carried out in Sama 500 electroanalyser system using cyclic voltammetry (CV) and differential pulse voltammetry (DPV) techniques

with a Multi Wall Carbon nano Tube modified Glassy Carbone Electrode (MWCNTs@GCE) as the working electrode and saturated calomel electrode and platinum wire as reference and counter electrodes, respectively. Spiking study was also done. For the releasing of encapsulated dopamine, two methods were investigated: releasing by Triton-x-100 and methanol. The encapsulation efficiency of liposome was calculated as $\%eff = \frac{C_{in} - C_f}{C_{in}} \times 100$ in which C_{in} is initial concentration of dopamine used for encapsulation and C_f is the final concentration of dopamine in outer solution after encapsulation. Based on the absorbance of dopamine at λ_{max}= 280 nm, a calibration curve was developed and the concentration of dopamine and the encapsulation efficiency were calculated. With increasing the total lipid and cholesterol from 30 mg to 60 mg the % eff was increased from %33 .to % 80. The mean size of liposomes was obtained 127 nm by dynamic light scattering (DLS). The MWCNTs@GCE has remarkable signal for dopamine in compared to bare GCE duo to active surface enhancement and electrocatalytic effect of MWCNTs. A calibration curve for determination of dopamine with MWCNTs@GCE was also developed using DPV and the limit of detection and linear range were obtained 88 nm and 3-20 µM, respectively. For releasing of encapsulated dopamine two methods were investigated: Triton-x-100 and and methanol. Triton x-100 caused the reduction of signal in which the signal of released dopamine cannot be measured but with using methanol the measurement was done successfully. The results of spiking showed good recovery values that showed the developed method can be used for electrochemical signal enhancing in applications such as biosensors.

***Keywords*:** Liposome, Encapsulation, Dopamine, Electrochemical signal enhancing

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Application of hemoglobin modified pencil lead electrode for the electrocatalytic reduction of persulfate

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Abstract:

Utilization of the direct electrochemistry of redox proteins has attracted much interest in recent years. Because of its known structure and commercial availability, hemoglobin (Hb) is considered as an ideal model molecule for such study. Hb has been shown to possess enzyme-like catalytic activity [1].

On the other hand persulfate (peroxydisulfate) is a strong oxidant and has been used for many applications such as water and soil decontaminants and cosmetics. It has been reported that persulfate may either cause or intensify diseases such as asthma and skin reactions [2]. Because of a gradual increase in application of persulfate, finding a simple and convenient measurement of persulfate is desired. Therefore, many studies have been performed for the quantitative determination of persulfate. However, electrochemical methods have received considerable interest due to its simplicity and cost-effectiveness when compared with other methods [3].

In our previous study, the modification of pencil lead electrode by a thin film of hemoglobin(Hb/PLE) is emphasized [4]. In this study, the mechanism of catalytic reduction of persulfate at Hb/PLE was studied. The obtained biosensor is exploited for the hydrodynamic amperometry of persulfate. It is found that the calibration graph is linear in the $S_2O_8^{2-}$ concentration range 2.5 to 50 µM and the detection limit of 0.6 µM. Developed biosensor was successfully used for the determination of $S_2O_8^{2-}$ in decolorizing powders.

Keywords: *Hemoglobin, pencil lead electrode, biosensor, persulfate*

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Electrosynthesis of molecularly imprinted polymer sensor for extraction and determination of naphazoline using multivariate optimization methods

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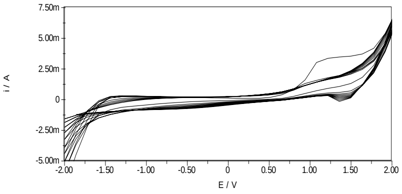
Abstract

Molecular Imprinting Technology (MIT) is a technique to design artificial receptors with a predetermined selectivity and specificity for a given analyte, which can be used as ideal materials in various application fields. Molecularly Imprinted Polymers (MIPs), the polymeric matrices obtained using the imprinting technology, are robust molecular recognition elements able to mimic natural recognition entities, such as antibodies and biological receptors, useful to separate and analyze complicated samples such as biological fluids and environmental samples [1, 2].In this work, an electrochemical sensor for naphazoline(NPZ) was prepared by electropolymerizing of pyrrole at the pencil graphite electrode (PGE) surface in the presence of template NPZvia cyclic voltammetry.The electrochemical response of NPZ at the NPZ-imprinted polypyrrole (PPY) modified PGE (PPY/PGE) electrode was investigated by differential pulls voltammetry (DPV). DPV response of NPZ at the NPZ-imprinted PPY/PGE electrode was significantly higher than that at non-imprinted PPY/PGE electrode.



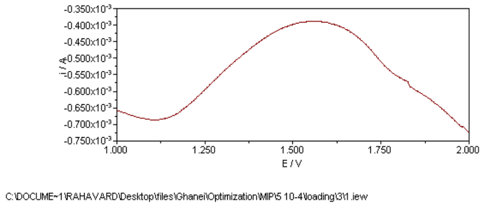


Fig. 1. The voltammetric cycles for the preparation of MIP (a) and DPV for measurements(b)

Multivariate optimization methods were applied to find a model foroptimizing the technique [3, 4]. A Plackett–Burman experimental design was used to evaluate the influence of several variables on theanalytical response (current). Then, the significant parameters were optimized using a central compositedesign, simultaneously. Under the optimized conditions, the detection limit (3sb, n = 3) was found to be1.28 × 10^{-8}M. The calibration curve showed two dynamic linear ranges including 5 × $10^{-8}$to 1.99 × 10^{-5}Mand 1.99 × $10^{-5}$to 1 × 10^{-2}M with correlation coefficients (r^2) of 0.989 and 0.993, respectively. The prepared sensor showed a suitable reproducibility (RSD % of4.16, n = 3) and regeneration capacity.Finally, the electrochemical sensor was successfully applied to determination of NPZ in pharmaceutical and biological samples with satisfactory results.

Keywords : Molecularly imprinted, Experimental design , Electroelectrochemical sensor, electropolymerization, cyclic voltammetry , polypyrrol, naphazoline.

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Studying the influence of carbon nanotube bed on the size and magnetic properties of $NiFe_2O_4$ nanoparticles

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Abstract:

In the present work, Nickel ferrite ($NiFe_2O_4$) nanoparticles were synthesized on the carbon nanotubes by the direct precipitating method, in order to investigating the influence of carbon nanotubes on the magnetite properties of these nanotubes. Structure, size and magnetic properties of these samples by XRD, SEM and VSM were identified.. The results characterized the nanoparticles assisted detection system above show that application of carbon nanotubes as a bed, could considerably influence of sizes, morphology and the magnetite properties of nanoparticles and prepared nanocomposite powder.

Keywords: *Nickel Ferrite Nanoparticles, Carbon Nanotubes, Morphology, Direct Precipitating.*

Investigation of Dopamine encapsulation in liposome and its electrochemical determination

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Abstract

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Keywords: Liposome, Encapsulation, Dopamine, Electrochemical signal enhancing

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A new electrochemical sensor based onnanoparticles of molecularly imprinted polymer for determination of metoclopramide drug

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Abstract

The use of artificial host materials in chemical/biological detections has become increasingly attractive, because the synthetic recognition systems such as molecularly imprinted polymers (MIPs) usually have lower costs, higher physical/chemical stability ,easier preparation and better engineering possibility than biological receptors. [1]

The technique of molecular imprinting creates specific molecular recognition sites in solid materials with features such as mechanical/chemical stability, low cost, and ease of preparation and hence have attracted extensive research interest. Nevertheless traditional imprinting techniques most often produce the polymer materials exhibiting high selectivity but low binding capacity, poor site accessibility, and slow binding kinetics [2].

Nanostructured, imprinted materials have a smalldimension with extremely high surface-to-volume ratio, so that most of the imprinted sites are situatedat the surface or in the proximity of surface. Therefore, the forms of imprinted materials are expectedto greatly improve the binding capacity and kinetics and site accessibility of imprinted materials. Thisis against the conventional bulky MIP particles which usually suffer from low rebinding kinetics [3].

In this research a new molecularly imprinted electrochemical sensor is prepared for selective and sensitive determination of a specific dopamine blocker, metoclopramide (MCP).

The nanoparticles of metoclopramide-imprinted polymers (MIP) were synthesized by the suspension polymerization in silicon oil. The MIP particles were then used for modification of graphene-carbon paste electrode(GCPE) composition in order to prepare the MIP (nano)-GCP

sensor. Cyclic voltammetry (CV) and square wave voltammetry (SWV) methods were applied to electrochemical measurements. Theresultsshowed that the graphene-carbon paste electrode modified by MIP nanoparticles (MIP-GCPE) have much higher adsorption ability to metoclopramide than the GCPE based non-imprinted polymer (NIP-GCPE).

Different parameters including the ratio of materials in the electrode composition, extraction pH, extraction time and pH of supporting electrolyte were optimized.According to the electrochemical studies the proposed electrode has two linear ranges includes 5×10^{-11} - 5×10^{-9} and 5×10^{-9} - 5×10^{-7} with adetection limit of 3.2×10^{-11} M .This modified electrode was successfully used for determination of MCP in a real samples.

Keywords: Metoclopramide,*Carbon paste electrode, Graphene*,*Molecularly imprinted polymer nanoparticles*, *Electrochemical sensor*.

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Electrochemical sensor for determination of diazepam based on carbon paste electrode modified with molecularly imprinted polymer-MWCNT composites

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Abstract

Molecular imprinting has become an efective way to prepare polymer materials that show a “memory efect” towardtheir templates. Compared to other recognition systems, MIPs possess many promising characteristics, such as low cost and easy synthesis,high stability to harsh chemical and physical conditions, and excellent reusability [1].Despite the application of MIPs as sensor matrices or separation materials, theysuffer from basic limitations associated with the limited concentration of imprinted sites ,and the bulk volume of the polymer matrices that requires long diffusion paths of theimprinted host molecules. These limitations lead to inefficient sensing or separationprocesses. MIP nanomaterials are proposed as a pain reliever for headache by improving theaccessibility and the homogeneity of the binding sites. In particular, with high strength, theextremely large surface area and unique chemical properties, Carbon nanotubes (CNTs)could serve as the reinforcing element or core in fabricating core–shell structural MIPs[2].

In this study molecularly imprinted polymers(MIP) were grafted on the surface of functionalized Multiwalled carbon nanotubes (MWCNT) using the diazepam as template molecules. The MWCNT-MIP were characterised by Fourier transform-infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM) and Then used for modification of carbon paste electrode(CPE). Cyclic voltammetry (CV) and square wave voltammetry (SWV) methods Were applied to study the binding event and electrochemical behavior of diazepam at the modified carbon paste electrodes. The diazepam binding expriments indicated that the carbon paste electrode modified by MWCNT-MIP have much higher adsorption ability than the MWCNT based non-imprinted polymer (MWCNT-NIP). Factors affecting the response of the sensor suchas compositionof carbonpaste, extraction and analysis pH, Preconcentration time ,

Stirring speed of extraction solution, and SWV parameters (Including Frequency and potential amplitude) were optimized. Under optimized condition the sensor modified by MWCNT-MIP exhibitedexcellent sensitivity(4.0×10^{7} µA L mol^{-1})fordiazepamewith a linear range of 8.0×10^{-9} to 1.0×10^{-6} mol L^{-1} ($R^2 = 0.9971$) and detection limit of 3.7×10^{-9} mol L^{-1}. The sensor was successfully applied for determination of diazepam in tablets and human serum samples with recovery values in the range of 91.7–100.2%

Keywords: Diazepame,Electrochemical sensor, Molecularly imprinted polymer, Multiwalled carbon nanotubes, Modified carbon paste electrode

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Unique effects of ultrasound on anticorrosive performance of electrolss Ni-P coating on the mild steel

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Abstract

Electroless Ni-P coating has been widely developed as a simple, low-cost and an easy technique.[1] In spite of the desirable properties of the binary Ni-P coatings such as high *corrosion* and wear *resistance*, good ductility and surface uniformity, improvement in their structure and corrosion protection has been studied by many scientists.[2] In the present research, for the first time, the specific effects of ultrasonic irradiation and its direction on the final morphology of coated layer and its anticorrosive performance have been subjucted. The resultant sonochemically electroless films on the mild steel have been also compared with the classical one which produced in the absence of ultrasound waves. The morphology of the final surfaces has been characterized by scanning electron microscopy (SEM) and the chemical composition has been determined by energy-dispersive X-ray spectroscopy (EDX). The corrosion behavior for the samples has been studied by electrochemical techniques including the *linear polarization resistance (LPR)*, *Tafel extrapolation* and *electrochemical impedance spectroscopy (EIS). The results* confirmed that the final characteristic of the fabricated surfaces was depended on two determining factors including the presence of ultrasonic waves during coating and the location of the plate with respect to the horn of ultrasonic apparatus. The analysis indicated that the Ni-P layer prepared by sonication has smoother surface with higher anticorrosive property in comparison with the classical one especially when the plate was situated in a perpendicular position with respect to the horn.

Keywords: *Ultrasound irradiation, direction, enhanced anticorrosion*

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Deposition of sonosynthesized ZnO nanoparticles on the electroless Ni-P coating to improve the corrosion protection

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Abstract

Different groups work on the production of the resistant thin films like Ni, Cu, Zn and Ni-P alloy through codeposition of the solid particles such as Al_2O_3, SiC, TiO_2, B_4C and diamond nanoparticles during the plating process.[1,2] In this research, For the first time, simultaneous synthesis and deposition of ZnO nanoparticles (NPs) have been carried out upon the surface of electroless Ni-P (EN) layer in order to improve the anticorrosive performance. Ni-P alloy coating has been produced by *electroless nickel* (EN) plating from the acid bath on the surface of mild steel then zinc oxide as an anticorrosive metal oxide has been deposited on the EN plated surface under ultrasonic irradiation. Transferring of the acoustic energy to the medium leads to more uniform distribution of the fabricated particles on the surface. The morphology and the chemical composition of the final surfaces have been characterized by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX) techniques. Electrochemical methods including the *linear polarization resistance* (LPR), *Tafel extrapolation* and *electrochemical impedance spectroscopy (EIS) have been applied to evaluate the* corrosion resistance of the Ni-P coatings with and without ZnO NPs. Our results confirmed that the deposition of zinc oxide nanoparticles on the surface of EN deposit improves significantly the corrosion resistance properties.

Keywords*: *Electroless Ni-P, ZnO NPs deposition, corrosion performance

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Malva sylvestris flower extracts as green corrosion inhibitor for mild steel in HCl solution

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Abstract

The Malva sylvestris is a cheap plant, which grows as a weed in the most parts of the world. In this study Malva sylvestris flower extracts (MFE) molecules was obtained by Soxhlet extraction. The inhibition of the corrosion of mild steel in 1 M HCl solution by the MFE was studied using potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) techniques[1]. These techniques showed that the inhibition efficiency increases with increasing MFE concentration[2]. The temperature effect between 298 to 338 K on the corrosion behavior of mild steel in 1 M HCl in the presence and absence of the inhibitor was studied, which the results show that in both cases the corrosion rate increases with temperature, but at all temperatures in the presence of MFE the corrosion rate was very slower[3].

Keywords*: *Greencorrosion inhibitor; Mild steel; Malva sylvestris flower extracts; Acid medium; EIS; Polarization

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N- Benzylidene : A new and effective corrosion inhibitor for copper in hydrochloric acid solution

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Abstract

Copper is widely used for industrial applications due toits excellent electrical and thermal conductivities and good mechanicalworkability [1]. Copper is resistant to the influence ofatmosphere and many chemicals.

To improve thecorrosion resistance properties of copper, great efforts have beengives to the investigations [2].One suitable approach to minimizing corrosion damage is to use corrosion inhibitors which are substance used in very low amounts that efficiently slow the rate of corrosion.

Heterocyclic organic compounds containing sulphur and/ornitrogen heteroatoms which are available for bonding with metalsurface are commonly used as inhibitors. N-benzylidenederivatives are illustrious due to their goodinhibitor efficiency in various media.

The inhibition effect of two N- Benzylidene derivatives namely N-(4,5 dicholoromethylbenzylidene) Pyridin – 2 amine amine and N-(4-choloromethylbenzylidene) Pyridin – 2 amine have been investigated against the corrosion of copper in 6.0 M HCl solution. Corrosion inhibition behavior were investigated by electrochemical impedance spectroscopy (EIS), electrochemical polarization measurement and quantum chemical studies. Among the studied compounds, N-(4-choloromethylbenzylidene) Pyridin – 2 amine exhibited the best inhibition efficiency 96% at 0.01 M.

The EIS results show that equivalent circuits of blankand inhibitors are fitted with theRQRW and RRQ modes, respectively. The results demonstrated that the investigated compoundsbehave as good inhibitors for copper corrosion in acidic solution.Their efficiency increases with increase in concentration from 0.0005 M to 0.01 M. The results of potentiodynamic polarization show that N-benzylidene are cathodic type inhibitor. Adsorption of these compoundsobeyed the Langmuir adsorption isotherm. The electronic properties obtained using quantumchemical approach, were correlated with the experimental results.

Key word: inhibitor, copper, acidic media,impedance

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Reducing the corrosion by superhydrophobic coating on electrical insulators

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Abstract

Electrical insulators which are subjecting to the corrosion are very important components of high voltage electric power networks. In this regard, composite polymeric insulators help to avoid erosion with hydrophobicity properties [1]. Superhydrophobic coating is a new technology and widely used in the industry and can cause some characteristics such as anti-wetting [2],self-cleaning [3], anti-icing [4] and also anti-corrosion [5] to the materials and finally replacing superhydrophobic coating with painting materials would be a very good alternative. In fact, superhydrophobic surface is highly hydrophobic and sliding angle of a water droplet is less than 10° [6]. Removing contamination from the surfaces and helping to reduce corrosion is a result of water droplets [7]. In this paper reducing the corrosion of electrical insulators by non-wetting coating has studied with salt fog testing and the contrasts between coated with superhydrophobic material and uncoatedsurfaces have shown by the scanning electron microscopy (SEM). This writing presents a type of polydimethylsiloxane (PDMS) coating to reduce electrical insulators corrosion.

Keywords: Corrosion, Superhydrophobic,Electrical insulators, Non-wetting,PDMS

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Corrosion Behavior of Nano Alkoxysilane Coating on Copper Substrates in 3.5% (w) NaCl solution

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Abstract

In this research, two alkoxysilanes, such as tetraethoxysilane (TEOS) and 3-Tri- methoxysilyl-1-propanethiol (TPS) were investigated to evaluate the influence of the silane molecule structure towards copper corrosion protection. The silane solution was prepared by dissolving silane agents in a mixture of distilled water and ethanol. The protective properties of covered and uncovered copper specimens in 3.5% NaCl solution was investigated by potentiodynamic polarization curves and electrochemical impedance spectroscopy (EIS). The Alkoxysilanes Coatings presented excellent inhibition effect to the copper corrosion and stability in water containing Cl^-. Furthermore, the surface morphological study by field emission gun scanning electron microscope showed the ball like silica particles distributed on the copper substrate with particle sizes ranging from 75 to 250 nm.

Keywords: *Corrosion, Copper, Alkoxysilanes, Nano coating, Electrochemical tests*

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A Study upon the Corrosion Behavior of MoC-Co-Os Alloys in The Chloride Media

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Abstract

It's known that hard metals are sintered composites of metal-ceramic powders. They consist of the mixtures of one or more finely divided hard carbides particles, such as molybdenum, molybdenum, titanium, tantalum, and vanadium, embedded in a matrix of soft and ductile binding materials such as cobalt, iron, or nickel. These materials are very hard and possess excellent wear resistance, and this make them suitable alloys in several industrial applications, such as cutting tools or seal rings, linings, valves, jet nozzles, saw blades, fluid mixers, and conveyor belt scrapers. A series of MoC-Co-Os alloys was evaluated in different chloride containing media to investigate their corrosion resistance. Standard electrochemical corrosion tests, chronoamperometric measurements, and surface analyses with Raman spectroscopy were conducted. An increasing amount of Os improves the corrosion resistance of all the alloys. The effect is not as dramatic as that observed with stainless steels containing Os in corrosive media. In both corrosive media Os decreased the cathodic Tafel constant and has a retarding influence on the cathodic part of the corrosion reaction. Raman analyses indicated the presence of molybdenum oxide, hydrated molybdenum oxide compounds, and CoO and Co_3O_4 formed on the alloy surfaces during the corrosion process.

Keywords: *corrosion ,alloy, electrochemical, SEM*

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Effect of surface nanocrystallization on inhibition behavior of mixed oxyanion inhibitors on protection of mild steel in sea water

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Abstract

Someproperties of materials are closely related to its surface structure, so that surface restructuring may change some properties like corrosion resistance, wear and etc [1]. It can also affect the formation of passive film on the surface [2].The corrosion behavior of an alloy in aggressive media is related to structural properties of metal surface and corrosivity of its surrounding environments. The use of a corrosion inhibitor is one of the most useful ways in decreasing the aggressiveness action of the environment on metals and alloys corrosion. Sodium molybdate has a good performance as anodic inhibitor that is incorporated into the metal surface forming a protective film.The presence of an oxide layer is essential for the corrosion inhibition action of molybdate [3] and in order to accelerate and stabilize the oxidized surface an oxidizing compound such as sodium phosphate is necessary. Phosphate ions in solution react with metal cations released from the surface and precipitate as a film with barrier properties at anodic areas [4]. The aim of this work is to investigate the effect of surface nanocrystallization on inhibition behavior of mixed oxyanion inhibitors(sodium molybdate, sodium phosphate) on protection of mild steel in artificial sea water. Near surface severe plastic deformation (NS-SPD) process by Wire-brushing treatment were used to create nanocrystalline surface[1]. X-Ray diffraction, weight loss, electrochemical polarization and impedance were used in this investigation. The obtained results demonstrate that NC-SPD can lead to form nanocrystalline surface. This surface treatment was changed corrosion and inhibition behavior by increasing preferential sites to adsorption of inhibitor and corrosive ions. Wire brushing process decreases the corrosion

resistance slightly which is due to increasing surface roughness. It is easier for electrons in the vicinity of a peak to escape than those in a valley, so that the peak would be corroded preferentially. The electron work function(EWF) fluctuation increased with an increase in roughness and may also promote the formation of corrosion cell that could further accelerate corrosion of a rough surface [5]. Presence of mixed inhibitor in corrosive media decreases the corrosivity of surrounding environments of mild steel by forming a protective film on the surface of alloy, which delays the anodic reactions. NS-SPD increases the high energy sites on the surface of mild steel which makes more intense competition between inhibitor and corrosive ions to occupy preferential sites. The results of polarization and impedance curves were shown that mixed inhibitor for wire-brushed surface has higher efficiency than that of nontreated surface. This surface has more preferential sites for adsorption of inhibitor. Therefore, the inhibitor coverage on surface is done faster than that of nontreated surface,Which promotes the passivation condition of surface by inhibitors. Eventually it may be concluded that surface structure has an important role in corrosion and inhibition behavior. Nanocrystallized surface done by NS-SPD treatment diminishes corrosion resistance slightly by increasing surface roughness. Nevertheless such treatment promotes the inhibition efficiency of oxyanions by increasing the adsorption of these inhibitors on the surface.

Keywords: Nanocrystallization, inhibition behavior, oxyanion, mild steel, sea water

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Corrosion inhibition of copper by Acoruscalamusas green corrosion inhibitor in 3 wt% NaCl solution

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Abstract

With witnessing the increase of marine industry, copper and its alloys are widely used in many marine-relative environments and engineering applications owing to their excellent properties, such as electrical and thermal conductivity, mechanical workability and its relatively noble properties. However, in the presence of the neutral chloride media, they are much susceptible to corrosion, leading to enormous economic losses and many potential safety problems. One of the most efficient approaches for protecting copper against aggressive attack is the use of the natural organic compounds to form tight films which contain electronegative functional groups and p-electron in triple or conjugated double bonds [1–4]. The adsorption and corrosion protection effect of Acoruscalamus**(AC)** on the copper surface in 3 wt% NaCl solution was investigated using potentiodynamic polarization and electrochemical impedance spectroscopy (EIS). Polarization curves indicate that AC is a mixed inhibitor, affecting both cathodic and anodic corrosion currents. The inhibition efficiency of AC reached 98% at an optimized condition.

Keywords: *Copper, EIS , Polarization , Neutral inhibition*

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Effect of pulse frequency and additive on microstructure and corrosion behavior of plasma electrolytic oxidation coating on Cp-Ti

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Abstract

The aim of this paper is to study the influence of frequency and additive concentration onsurface structure and corrosion properties of composite films fabricated by plasma electrolytic oxidation (PEO) on Cp-Ti in sodium zirconate containing electrolyte. The surface morphology, elemental distribution, composition and structural characteristics of the films were assessed by scanning electron microscope (SEM) equipped with energy dispersive spectroscopy (EDS) and X-ray diffraction (XRD) techniques.Electrochemical impedance spectroscopy wasemployed to study the corrosion behavior of plasma electrolytic oxidation (PEO) coating in different different applied frequencies and additives. The EIS analysis of the outer layer of the PEO coating provided insight into the structure of the coating, which was confirmed by SEM results.The process of PEO treatment involves reactions caused by electric breakdown on the metal surface, and the coating material in crystalline or amorphous phases, formed at breakdown sites, usually contains constituent species derived from the substrate and electrolyte.Frequency is one of the most important parameters for thepulsed PEO process.Corrosion protection performance of PEO coatings is directly dependent on uniformity and amount of porosity and other defects.During the PEO process, continuouschanges in the microdischarge as a result of breakdown affectsthe surfacestructure and consequently relative coating porosity. Evolution and mechanism of microdischarges can be regulated through the action duration and the action time of the energy pulse within one unit of time by changing the frequency.

The plasma electrolytic oxidation process was carried out using a pulsed DC electrical power source in a electrolyte containing 4 g of sodium dehydrogen phosphate and different amount of sodium zirconate additive in 1 l of distilled water. The coatings were obtained at two frequencies viz. 100 Hz and 1000 Hz, with a fixed on–off pulse-time ratio of ton/toff = 3:7 (i.e. 3 ms:7 ms and 0.3 ms:0.7 ms, respectively) for 7 min.

It was revealed that the porosity of the coating decrease with frequency but pore sizes was found to increase with additive concentration. EIS studies showed that the impedance values of the coating preparedat 100 Hz is extremely lower compared to impedance values of coating prepared at 1000 Hz. The reason is that coating porosity of coating at 100 Hz condition was higher than that of coating prepared at 1000 Hz due to influence of frequency on microdischarge characteristics.PEO processing at higher frequency (1000 Hz) results in a smooth surface with fine microstructure/surface morphologicalfeatures.

Keywords: *Plasma electrolytic oxidation*; *Titanium*; *EIS*; *Frequency*

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A Comparative Atmospheric Corrosion between Stainless Steel and Iron, Copper and Aluminum Alloys

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Abstract

Atmospheric corrosion has caused more and more losses and costs these years, so the world begin to pay much attention to this problem. Atmospheric that containing corrosive factors such as relative humidity, sulfur compounds, chloride ions, gaseous pollutants, can provide suitable environment for corrosion of metals and different alloys that uses in industry equipment. According to importance of using of steels and some metals such as iron, aluminum and copper, and with goal of choose a suitable metals for an corrosive environment, atmospheric corrosion had investigated for this metals and alloys and according to comparing between environment and corrosion conditions of each one and also comparative impedance diagrams and corrosion rate of metals, Strong alloys in different atmospheres has known and introduced.

Keywords: *Atmospheric corrosion, Corrosive factors, Resistance, steels*

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Production of ceramic coating on 5052 aluminum alloys by plasma electrolytic oxidation in aluminate-silicate mixture electrolytes

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Abstract

In this study, a plasma electrolytic oxidation process (PEO) was used to produce oxide coatings on 5052 aluminum alloy different concentrations of Aluminate–silicate mixture electrolytes. The phase composition, surface morphology and thickness of the films were evaluated by X-ray diffraction (XRD), scanning electron microscopy (SEM) techniques. Potentiodynamic polarizations and electrochemical impedance spectroscopy (EIS) have been made under static conditions in order to evaluate the corrosion performance of PEO coatings that coated under different concentration mixture electrolytes. When a mixture electrolyte with an optimum concentration ratio of aluminate to silicate (i.e. Al:Si = 80:20) is used, the corrosion resistance of PEO coatings is the highest.

Keywords: *Plasma electrolytic oxidation, Alumina, Aluminate, Silicate.*

Electrochemical study of $K_2Cr_2O_7$ concentration effect on improvement of corrosion resistance of Zr-1%Nb Alloys in alkaline media

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Abstract

In this work the effect of $K_2Cr_2O_7$ concentration in 2.0 M LiOH on the corrosion inhibition of the Zr-%1Nb alloys, was investigated by potentiodynamic polarization and EIS measurements. The results showed that potassium dichromate act as cathodic inhibitor andits optimumcontent to control the corrosion of the Zr alloy in the 2M LiOH media is 100 ppm.

Keywords:*Zr-1%Nb alloys, Corrosion, Inhibitors, potassium dichromate*n

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Electrochemical evaluation of a new BTA combination (gel) as corrosion inhibitor for historical bronze artifacts

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Abstract

Archeologists have long been trying to protect of ancient metal objects (artifacts corrosion control). Metallic cultural heritage are commonly treated with inhibitors and then exhibited or conserved in museums. NowadaysBenzotriazol (BTA) is almost common corrosion inhibitor for bronze artifacts. But many problems are there in using it for non-portable objects.

The study aims to evaluate the ability of new corrosion inhibitors (BTA gel) to protect archaeological bronze from corrosion. This inhibitorwas tested on bronze coupons. Electrochemical measurements were carried out to evaluatethe performances of the corrosion inhibitor solutions against aqueous corrosion, as well as the behavior of protected bronze samples in a corrosive electrolyte. Artificial aging in climatic chamber provedthe good performances of the treatments against atmospheric corrosion, and then we used this gel for treatment of the historical bronze sample and the efficacy of the changes on the Patina samples wasassessed. For this purpose, the digital loop and scanning electron microscopy were used.

The study indicates that the gel is efficient.

***Keywords*:**corrosion inhibitor, Electrochemical, historical bronze artifacts, BTA gel

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Investigation of self-healing ability of coatings based on microcapsules for corrosion protection of stainless steel in acid solution

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Abstract

One of the most significant types of smart coatings is self-healing coating, which has the ability to release encapsulated active agents in a controlled way [1]. They can be employed to develop a new family of smart multifunctional coatings. Incorporating microcapsules in coating matrix provides release of repairing agent rapidly after triggering due to crack propagation in coatings and gifts the self-healing to the coatings. The self-healing ability of coatings incorporated with microcapsules containing linseed oil was evaluated in this work. Urea–formaldehyde microcapsules containing linseed oil were synthesized by in-situ polymerization as a major procedure for fabrication of microcapsules [2]. The microcapsules were incorporated through epoxy coatings and the coatings were applied on stainless steel panels. In this study, the microcapsule concentration was chosen as 5, 10 and 20 wt%. Also a coating without microcapsules, called blank, was prepared as a control. After 6 days of curing at ambient temperature, cross-cuts were made on the coating samples by a razor blade. The scribed samples were immersed in 0.5 M H_2SO_4 solution at ambient temperature. The self-healing performance of the coatings was investigated by optical microscopic and electrochemical impedance spectroscopy (EIS) methods. The concentration of the embedded microcapsules affected the self-healing capability. According to the results it can be concluded that the weight fraction of microcapsules should not be lower than 10% in order to achieve good self-healing property. Fig. 1 shows the optical micrographs of the scratched area on the blank and coating sample

containing 10% microcapsules. It can be clearly seen from this figure that the 10% coating sample exhibited a reasonable self-healing behavior.

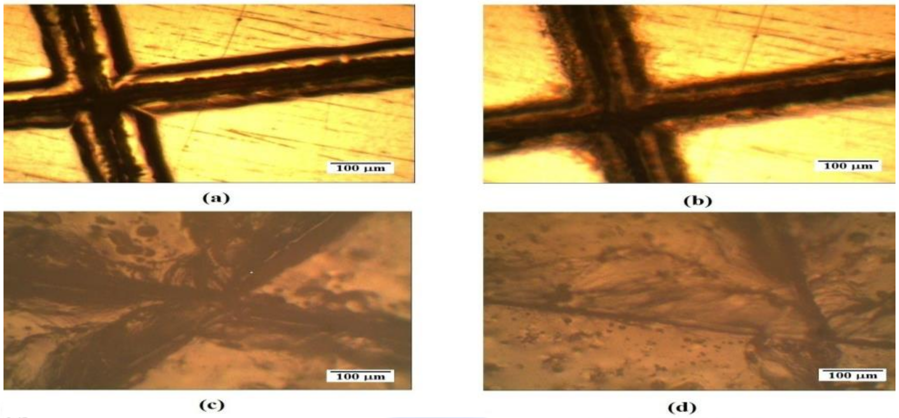

Fig. 1. The optical micrographs of the scratched area on: (a) blank coating just after scratching, (b) blank coating after exposure to 0.5 M H_2SO_4 solution for 1 h, (c) coating containing 10% microcapsules just after scratching and (d) after exposure to 0.5 M H_2SO_4 solution for 1 h.

Self-healing behavior of coatings based on microcapsules was studied by optical microscopy and EIS techniques. The microcapsule weight fractions higher than 10% showed the good self-healing ability.

***Keywords*:** Self-Healing Coating; Microcapsule; Optical Microscopy; Electrochemical Impedance Spectroscopy.

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Application of EIS and EN techniques to investigate the self-Healing ability of coatings based on microcapsules for corrosion protection of carbon steel

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Abstract

Polymeric coatings are always inevitably subjected to unexpected damages and cracks during their lifetime. Self-healing materials, including self-healing coatings, are a fast growing research area [1]. Effectiveness of linseed oil filled microcapsules has been investigated for healing of cracks generated in coatings. Microcapsules (Fig. 1) have been prepared by in situ polymerization of urea–formaldehyde resin to form shell over linseed oil droplets [2]. The microcapsules were incorporated through epoxy coatings and the coatings were applied on carbon steel panels. In this study, the microcapsule concentration was chosen between 5, 10 and 20 wt%. Also a coating without microcapsules, called blank, was prepared as a control. After 6 days of curing at ambient temperature, cross-cuts were made on the coating samples by a razor blade. The scribed samples were immersed in 0.5 M H_2SO_4 solution at ambient temperature.

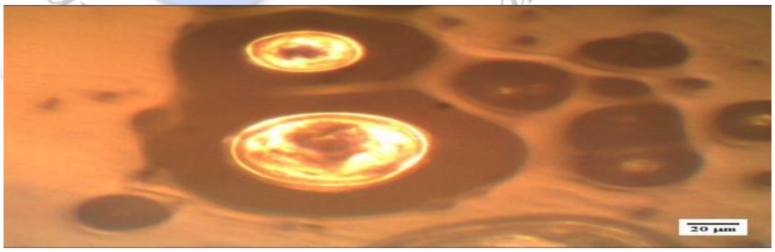

Fig. 1. Optical micrograph of prepared microcapsules.

The self-healing performance of the coatings was investigated by optical microscopic, electrochemical impedance spectroscopy (EIS) and electrochemical noise (EN) methods. The concentration of the embedded microcapsules affected the self-healing capability. Introducing

the parameter of self-healing efficiency (SHE) revealed that coating composed of 10% microcapsule showed optimum self-healing behavior. This work has employed the EN technique under open circuit conditions for the quantitative evaluation of self-healing performance of coatings. The SHE values resulting from EN technique showed a reasonable agreement with those obtained from EIS measurements.

Self-healing behavior of coatings based on microcapsules was studied by EIS and EN techniques. EN technique can be employed for quantitative evaluation of self-healing behavior. The coating composed of 10% microcapsule showed optimum self-healing behavior.

Keywords**:** Self-Healing Coating; Microcapsule; Self-Healing Efficiency; Electrochemical Noise.

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A comparative study on the direct and pulsed voltage electrodeposition of CNTs reinforcedhydroxyapatite coating on AZ31 Magnesium alloy

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Abstract

To control the degradation of Magnesium alloys, uniform CNTs reinforced HA coating was applied on AZ31 Magnesium alloy using direct and pulsed voltage electrodeposition method. 1 wt% CNTs were incorporated into the apatite coating by adding fuctionalized CNTs with COOH group into the electrolyte. The as-deposited specimen was then post-treated with hot alkali solution to improve the corrosion resistance for implant applications.X-ray diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM) equipped with energy dispersive X-ray analysis (EDX) was used to characterize the microstructure, morphology, and phase composition of the coatings. Furthermore, the corrosion resistance of the coatings was evaluated by electrochemical techniques in Hanks solution. Potentiodynamic polarization indicated that CNTs/HA composite coatings exhibited higher corrosion resistance in comparison with pure HA coatings.Also, the results indicated that the degradation of AZ31 Magnesium alloy substrate was decreased more after surface was modified by pulsed voltage electrodeposition in comparison with direct voltage electrodeposition.Electrochemical tests shows that the $E_{corr}$of Mg substrate significantlyincreased from -1.64 to -1.35 for direct HA+1% CNTs and -1.3 for pulsed HA+1%CNTs composite coatings.

Keywords**:** Hydroxyapatite, Carbon nanotubes, Magnesium alloy, Electrochemical deposition, Corrosion

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Application of 2-mercaptomenzoimidazole as corrosion inhibition of stainless steel in citric acid pickling process

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Abstract

Metals can be immersed into solution of acids to remove metal, metal oxides, heat-trate scale and foreign metals. Such treatments generally leave the surface chemically clean and ready for further processing. The usual solution for the removal of scale and from iron and steel products is hydrochloric or sulfuric acids. These are used in concentration ranges from a few ounces per gallon to very concentrated, depending on the type of work being processed [1]. Commercial inhibitors -amines and nitrates- are common and are optionally used in theses pickles to prevent overetching and to avoid pitting. In the other words, inhibitors are generally used in these processes to control the metal dissolution. Most well- known acid corrosion inhibitors are organic compounds containing nitrogen, sulfur and oxygen atoms; nitrogen-containing organic compounds are known to be efficient corrosion inhibitors in acid solutions. Among them, N-heterocyclic compounds are considered to be the most effective corrosion inhibitors for steel in acid media [2]. The use of 2-mercaptomenzoimidazole (2-MBI) inhibitor is one of the most practical methods for the protection of metals against corrosion during the pickling process and it takes more of more attention until now [3]. This paper discusses the pickling of stainless steel by the use of 2-MBI inhibitor in the 2-MBI inhibition use of citric acid. The use of citric acid is tested for the first time in the acidic pickling process of stainless steel in 25 ºC. The inhibitive activity of 2-MBI is examined successively via electrochemical techniques in the range of 100 to 1000 ppm. The metal samples were pre-trated prior to the experiments by grinding with emery papers (100-40-800-1000); rinsed with distilled water, degreased in alkaline solution for 45 s, washed again with distilled water and derided at room temperature before use. The 6 wt.% citric acid solution were prepared by the dissolving of citric acid solid with distilled water. Impedance

measurements were carried out at the open circuit potential (E_{ocp}), using a computer-controlled potentiostate (PAR EG&G Model 273A) and a frequency response analyzer. In the conventional three-electrode assembly, a Pt foil auxiliary electrode and a saturated calomel reference electrode (SCE) were used. The samples were immersed in the acidic media containing the different concentration of inhibitor for a time period of 24 h. The A.C. frequency range extended from 100 kHz to 10 mHz, a 5 mV peak-to-peak sine wave being the excitation signal. Data processing was based on a non-linear least squares fitting procedure as described elsewhere [4]. For this purpose, the Zview (II) software was used and for transforming constant phase element parameter values into values of idealized capacitances, a procedure outlined in the same reference was employed. The same equipment as for the impedance measurements was used leaving the frequency response analyzer out of consideration. The potentiostatic polarization curves were obtained using a sweep rate of 1 mV s^{-1}. Corrosion current densities were obtained from the polarization curves by Tafel curve simulation. The results showed that the anodic and cathodic reactions are affected by the addition of 2-MBI. So, the 2-MBI acts as a mixed controlled inhibitor in citric acid media. It could be observed that the inhibition efficiency increased with increasing the corrosion inhibitor concentration and the inhibition efficiency showed a maximum value of 93.2% at a concentration of 400 ppm. The EIS results confirmed well defined two time constant and were in good agreement with polarization method. In the case of 400ppm 2-MBI addition, the polarization resistance (R_p) and charge transfer resistance (R_{ct}) were the maximum amounts and obtained equal to 220 and 2618 Ω.cm^2, respectively.

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Influence of Single walled Carbon Nanotube Addition on the Zinc-Rich Paint Coating Corrosion in NaCl solution

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Abstract

Zinc-rich paints (ZRPs) are one of the most effective coatings used to protect steel from corrosion [1]. They are used in many aggressive medium: sea water, marine and industrial environments. For solvent-based zinc-rich paints, it seems to be established that, at least at the beginning of immersion, zinc particles provide a cathodic protection of the steel substrate [1,2]. Then, a long term protection develops due to the formation of zinc corrosion products, reinforcing the barrier affect of the paint [1, 3].

The effect of addition of conductive pigments like single walled carbon nanotubes on the corrosion behavior of zinc-rich paints (ZRP) coated steel in 3.5% NaCl solution was investigated. Open circuit potential measurements were used to characterize the cathodic protection ability and duration. Electrochemical Impedance spectroscopy and Tafel analysis was performed in order to identify the corrosion rate and to follow the corrosion mechanism. Also, the Scanning Electron Microscope (SEM) analysis was used for study the morphology changes in the coating due to corrosion. Two different effects were pointed out: increase of the porosity induced by single walled carbon nanotubes addition and a galvanic action between zinc and single walled carbon nanotubes.

Keywords**:** *zinc-rich paint; Corrosion; Electrochemical Impedance spectroscopy; single walled carbon nanotubes; Tafel.*

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The Effect of Mesoporous Silica Nanocontainers Incorporation in the Polymer Coatings on the Corrosion Behavior of Coated Steel

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Abstract

Protective coating was produced by dispersing mesoporous silica nanocontainers, loaded with corrosion inhibitor, sodium molybdate, in the epoxy layer. The corrosion properties of the composite coatings were assessed by electrochemical impedance spectroscopy and electrochemical noise. Results showed higher corrosion resistance of epoxy/mesoporous silica loaded inhibitor as well as self-healing ability of coating in NaCl media for eight weeks. Corrosion inhibitors released from nanocontainers in response of corrosion damage in the scratch zone. Besides, the analytical investigation of scratch zone showed that oxidation state of Mo was (Mo (VI)), which can be attributed to the formation of Fe_2(MoO4)$_3$ or molybdenum oxides.

***Keywords*:** Mesoporous Silica; Epoxy; Corrosion; EIS.

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Fabrication of ceramiccoatings on 5052 aluminum alloy by plasma electrolytic oxidation in different electrolytes

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Abstract

Ceramic coatings were deposited on 5052 aluminum alloy substrates by plasma electrolytic oxidation (PEO) in three different electrolytes i.e. phosphate, aluminate and silicate. Effects of electrolytes on the microstructural and corrosion properties of the PEO coatings were analyzed. Potentiodynamic polarizations and electrochemical impedance spectroscopy (EIS) was used in order to evaluate the corrosion performance of PEO coatings. The phase composition and surface morphology of the films were evaluated by X-ray diffraction (XRD), scanning electron microscopy (SEM) techniques. According toEIS and polarization tests,the PEO coatings prepared in aluminate electrolyte showed better corrosion properties in comparison to other electrolytes.

Keywords: *Plasma electrolytic oxidation, Alumina, Aluminate, Silicate, phosphate.*

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*CydoniaOblonga*Extract as Eco-Friendly Corrosion Inhibitor for Mild Steel in 2.0 M HCl Solution

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Abstract

By considering the practical applications of acidic solutions at various industrial processes such as acid pickling of steels, acid cleaning of boilers and oil-well acidizing, the special importance of corrosion inhibitors is more pronounced [1, 2].Nevertheless, the use of chemical inhibitors has been limited because of the environmental threat. In the 21st century, the research in the field of ‘‘green’’ or ‘‘eco-friendly’’ corrosion inhibitors has been addressed toward the goal of using cheap, effective compounds at low or ‘‘zero’’ environmental impact [3]. Plant extract is low-cost and eco-friendly, and can be obtained through simple extraction process as well as biodegradable [4-6]. This paper presents the inhibitory properties of *cydoniaoblonga* extracton the corrosion of mild steel in HCl solution. The inhibition performance is evaluated by open-circuit potential, weight loss, electrochemical polarization measurements and electrochemical impedance spectroscopy complemented with scanning electron microscopy.EIS measurements show an increase of the transfer resistance with increasing inhibitor concentration.Polarization measurements indicate that all the examined compounds act as a mixed inhibitor and inhibition efficiency increases with inhibitor concentration.The adsorption of this plant extract on the carbon steel surface obeys the Langmuir adsorption isotherm.Temperature studies revealed an increase in inhibition efficiency with rise in temperature and activation energies decreased in the presence of the extract.

Keywords**:** Corrosion inhibition; *Cydoniaoblonga*extract; Mild steel; HCl.

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Biocompatibility and Long Term Corrosion Studies of CNTs ReinforcedHydroxyapatite Coating on AZ31 Magnesium Alloy

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Abstract

Magnesium and its alloys have earned significant interest as temporary implantsdue to their degradability. The degradation product of Magnesium (Mg^{2+}) is not toxic to human physiology and the excess amounts of it can be naturally discarded by the body if necessary. Moreover Magnesium is similar to human bones in terms of density and elastic module. In spite of all the benefits, high corrosion and Hydrogen evolution rate of Magnesium in contact with human body fluids can limit the application.Therefore, different kinds of alloying elements and coatings have been proposed to control the corrosion rate. One of the most important methods for surface treatment is using Hydroxyapatites coatings, the most stable Ca-P phase, in order to improve corrosion resistance as well as better biocompatibility and bioactivity of implants.The main shortcomings of using HA coatings are their brittle nature and poor strength. One of the most suitable solutions to enhance the mechanical properties of the coatings and to provide better corrosion resistance is incorporating the reinforcing materials like carbon nanotubes (CNTs). Carbon nanotubes have excellent mechanical properties as a reinforcing material, such as extraordinary elastic modules (200-1000 GPa), high tensile strength (11-63 GPa), good corrosion resistance, chemical stability, and unique structural properties such as light weight, arising from the cylindrical graphite structure and small dimensions. It should be mentioned that non-activated CNTs have high affinity for agglomeration and bundling, and therefore functionalized CNTs are used for better dispersion and homogenization in the coating solution. In the present research, uniform CNTs reinforced HA coating was applied on AZ31 Magnesium alloy using direct voltage electrodeposition method at -3 V vs. Ag/AgCl reference electrode for 1 hour. 1 wt.% CNTs were incorporated into the apatite coating by adding functionalized CNTs with

COOH group into the electrolyte. XRD results indicated that preliminary coat was consisted of DCPD (Dicalcium phosphate dehydrate). Alkaline treatment was then used to transform DCPD into hydroxyapatite. Long-term degradation behavior was investigated by electrochemical impedance spectroscopy in hanks′ solution for 4 days. Results showed that HA/CNTs composite coatings exhibits higher corrosion resistance in comparison to pure HA coatings and AZ31 Magnesium alloy in the time mentioned. The bioactivity of an orthopedic material is characterized by its capability to show bone apatite growth in vitro or in vivo. In this paper apatite growth was studied by observing changes in morphologic features after immersing in Hanks′ solution for 4 days via FESEM. Generally, When coatings are immersed in Hanks′ solution (pH 7.4), ion exchange occurs between the surface layer of the coatings and the Hanks′ solution that results in dissolution of coatings into calcium and phosphate ions and nucleation of biomimetic hydroxyapatite from the Hanks′ solution. On the other hand, The FESEM images of HA/CNTs composite coatingsrevealed more apatite growth than single-phase HA coatingafter 4 days of immersion.This can be explained by the presence of carboxylic groups.The functionalized groups on the surface attract greater amount of calcium ions to the surface and subsequently phosphate ions are adsorbed. Thus,Functionalized CNTs improve the nucleation of hydroxyapatite due to negative charge of carboxylic groups of functionalized CNTs.

It can be concluded that HA/CNTs composite coating have better biocompatibility and bioactivity rather than single-phase HA.

Keywords: *Hydroxyapatite, Carbon nanotubes, Magnesium alloy, Biocompatibility, Corrosion*

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Effect of *F. gummosa*Boiss Leaf Extract on Corrosion Inhibition of Aluminium Surface in HCl Medium

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Abstract

Aluminium and its alloys are used extensively both in industrial and domestic applications.Al relies on the formation of a compact, adherent passive oxide film for its corrosion immunity in various environments. However, this film is amphoteric and can be dissolved substantially when it is exposed to either acid media (pH < 5) or alkaline media (pH > 9) [1].Hydrochloric acid solutions is one of the most currently used acids in the pickling and electrochemical etching of aluminium capacitor foil [2].The corrosion of aluminium in acid solutions can be inhibited by inhibitors, which may be synthetic or natural inhibitors [3-5].Ferula gummosaBoiss is a monocarp plant and a green annual herb of family Umbelliferrae (Apiaceae). It is found to contain phytochemical constituents like monoterpenes: β-pinene, α-pinene, δ-3-Carene, and limonene.The extract of this plant have been used successfully for the corrosion prevention of 304 stainless steel in HCl solution, and it has been found very effective [6].

Therefore, in the present work, an effort has been made to explore the inhibition characteristics of the *F. gummosa*Boissleafextract on Al corrosion in 0.5 M HCl.The inhibition effect of *F. gummosa*Boiss leafextract on the corrosion of aluminium in HCl solution was studied by weight loss, potentiodynamic polarization curves, electrochemical impedance spectroscopy (EIS), quantum chemical calculation and molecular dynamics simulation methods.The inhibition efficiency 97%was found for2000 ppm of *F. gummosa*Boiss leafextract in 0.5 M HCl.Tafel polarization studies reveal that *F. gummosa*Boiss leafextract acts as mixed typed inhibitor.The phenomenon of physical adsorption is proposed from the trend of decrease in inhibition efficiency with increase in temperature which is corroborated by the values of kinetic/ thermodynamic parameters obtained from the experimental data.

***Keywords*: *F. gummosa*Boissextraxt, Aluminium, Hydrochloric acid, Corrosion inhibition**

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Evaluating the corrosion protection properties of electrochemically synthesized polypyrrole/γ-Al_2O_3 nanocomposite coatings on carbon steel via electrochemical impedance spectroscopy

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Abstract

Carbon steel is used in large tonnages in marine applications, nuclear power and fossil fuel powerplants, transportation, petroleum production and refining, pipelines, construction and metalprocessing equipment. By the nature of limited alloying content, carbon steel is vulnerable to very high corrosion rates in aggressive solutions and atmosoheres. Organic coatings are widely used to prevent corrosion of metallic structures because they are easy to apply at a reasonable cost. Among organic coatings, conductive polymers are considered as the relevant alternatives with numerous advantages. Polypyrrole (Ppy) is one of the conductive polymers which has been attracted much attention due to its high conductivity, environmental stability and corrosion protection behavior. Ppy can be synthesized by either chemical or electrochemical methods. Aqueous electropolymerization has several advantages such as formation of the polymer and its deposition on the substrate in one process. Recently researches showed that incorporating of nanoparticles in Ppy matrix improve the mechanical and corrosion resistance of the coating. In the present study, the electrochemical synthesis of Ppy/ γ-Al_2O_3 (0.2, 1 and 2 g/l) nanocomposite coatings have been achieved on carbon steel via cyclic voltammetry. Synthesized nanocomposites were characterized by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and scanning electron microscopy (SEM). Then the corrosion behavior of

coated samples have been investigated using electrochemical impedance spectroscopy (EIS) in H_2SO_4 1 M solution.

Keywords**:** Polypyrrole, γ-Al_2O_3 nanoparticle, Carbon steel, Nanocomposite, EIS.

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Corrosion Prevention of Kovar Alloy by Inorganic Coatings

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Abstract

Kovar (54% Fe, 29% Ni & 17% Co) as an advanced alloy has a low coefficient of thermal expansion (CTE); so it is used in proximity of materials with high dimensional stability materials like ceramic and glass under high temperature conditions.This alloy is Iron based so it can be corroded and must be protected from corrosive species.In this research, corrosion prevention of Kovar by inorganic surface coatings with low CTE was investigated. Effects of four different protective coatings were studied. The coatings were: 1)electroless nickel, 2)electroless nickel/zinc double layer, 3)zinc rich ethyl silicate paint and 4)nickel/chromium double layer.Field emission scanning electron microscopy (FE-SEM) was used to characterize the microstructure of the coatings and alloy/coating interfaces. Adhesion test was used to measure the adhesion between substrate and coatings. Electrochemical polarization test and Tafel extrapolation were used to compare the corrosion behavior of each coated and non-coated specimen. 3.5% wt. sodium chloride solution was used as electrolyte (corrosive media) and the immersion time was about 64 days. Results showed that the ethyl silicate zinc rich paint had a good integrated structure (Figure 1) and it created a barrier protection with1.3×10^{-7}A/cm^2 in corrosion current density (i_{corr})after a cathodic protection was made.Cross-cut adhesion test result of this coating were matching with 5Baccording to ASTM D 3359. i_{corr} of electroless nickel coating on Kovar was 4.3×10^{-7}A/cm^2, and according to ASTM B 733 its adhesion was acceptable.Zinc layer of electroless nickel/zinc coating had some microscopic impurities and electrochemical tests represented that it doesnot protectKovar as an anti-corrosion coating.

Electroplated nickel/chromium coating had the lowest i_{corr}. It was about 1.3×10^{-8} A/cm^{2} after 46 days of immersion. According to ASTM B 571its adhesion was acceptable. It can be concluded that in order to protect Kovar from corrosion, the nickel/chromium coating can be one of the first choices. And if plating is not possible, painting by zinc rich ethyl silicate can provide an acceptable protection, even as a primer coating.

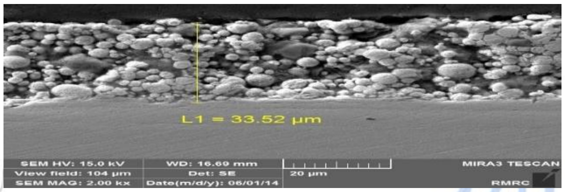

Figure1: FESEM image of Kovar section with zinc rich paint on top at 2000x

Keywords*:Corrosion, Coatings, Kovar Alloy, polarization test*

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Corrosion Prevention of Kovar Alloy by Inorganic Coatings

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Abstract

Kovar (54% Fe, 29% Ni & 17% Co) as an advanced alloy has a low coefficient of thermal expansion (CTE); so it is used in proximity of materials with high dimensional stability materials like ceramic and glass under high temperature conditions.This alloy is Iron based so it can be corroded and must be protected from corrosive species.In this research, corrosion prevention of Kovar by inorganic surface coatings with low CTE was investigated. Effects of four different protective coatings were studied. The coatings were: 1)electroless nickel, 2)electroless nickel/zinc double layer, 3)zinc rich ethyl silicate paint and 4)nickel/chromium double layer.Field emission scanning electron microscopy (FE-SEM) was used to characterize the microstructure of the coatings and alloy/coating interfaces. Adhesion test was used to measure the adhesion between substrate and coatings. Electrochemical polarization test and Tafel extrapolation were used to compare the corrosion behavior of each coated and non-coated specimen. 3.5% wt. sodium chloride solution was used as electrolyte (corrosive media) and the immersion time was about 64 days. Results showed that the ethyl silicate zinc rich paint had a good integrated structure (Figure 1) and it created a barrier protection with1.3×10^{-7}A/cm^2 in corrosion current density (i_{corr})after a cathodic protection was made.Cross-cut adhesion test result of this coating were matching with 5Baccording to ASTM D 3359. i_{corr} of electroless nickel coating on Kovar was 4.3×10^{-7}A/cm^2, and according to ASTM B 733 its adhesion was acceptable.Zinc layer of electroless nickel/zinc coating had some microscopic impurities and electrochemical tests represented that it doesnot protectKovar as an anti-corrosion coating.

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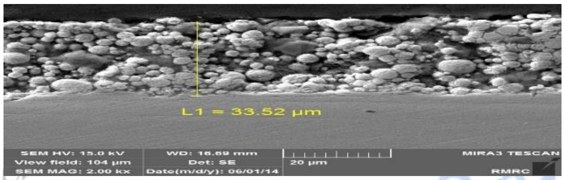

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A comparative study on long term corrosion resistance of direct and pulsed voltage electrodeposition of CNTs/HA compositecoating on AZ31 magnesium alloy

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Abstract

To control the degradation of Magnesium alloys, uniform CNTs reinforced HA coating was applied on AZ31 Magnesium alloy using direct and pulsed voltage electrodeposition method. 1 wt% CNTs were incorporated into the apatite coating by adding fuctionalized CNTs with COOH group into the electrolyte. The as-deposited specimen was then post-treated with hot alkali solution to improve the corrosion resistance for implant applications.

Long-term degradation behavior was investigated by electrochemical impedance spectroscopy in hanks′ solution for 4 days. Results showed that CNTs/HA composite coatings exhibits higher corrosion resistance in comparison to pure HA coatings and AZ31 Magnesium alloy in the time mentioned. It also indicated that the corrosion resistance of the coating increased in four days because of the biomimetic hydroxyapatite layer that formed in hanks′ solution. The sample that was modified by pulsed voltage electrodeposition showed higher corrosion resistance in comparison with direct voltage electrodeposition. The FESEM images after four days immersion showed that more compact layer formed on pulsed voltage electrodeposition rather than direct voltage electrodeposition**.**The reason can be attributed to the structure of pulsed voltage electrodepositioncoating that is finer than direct voltage electrodeposition and had more sites for nucleation of biomimetic hydroxyapatite in hanks′ solution. The hydrogen evolution was measured during the four days immersion in hanks′ solution. The results showed that HA/CNTs composite coatings exhibits lower hydrogen evolution in comparison to pure HA coatings and

AZ31 Magnesium alloy and also the sample that was modified by pulsed voltage electrodeposition showed lower hydrogen evolution in comparison with direct voltage electrodeposition.

Keywords: *Hydroxyapatite, Carbon nanotubes, Magnesium alloy, Immersion, Electrochemical impedance spectroscopy, Hydrogen evolution*.

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Electrochemical Impedance Spectroscopic Analysis of Dye Sensitized Solar Cells With Different Electrolyte

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Abstract

While Prof Grätzel invented dye-sensitized solar cells (DSSCs) in 1991, the research on different parts of this photovoltaic device for increasing efficiency has attracted great attention [1]. In performance of each DSSC, electrolyte has great role in electron transfer through the cell. Adding certain compounds like ion liquids to electrolyte can remarkably improve DSSC performance [2].The aim of this work is the evaluation of the effect of cetyltrimethylammonium bromide (CTAB) as liquid electrolyte additiveon performance of DSSC by electrochemical impedance spectroscopy (EIS). DSSCs fabricated in this work include, porous nano crystalline TiO_2 film sensitized by N719 dye on substrate of fluorine-doped SnO_2 as photoanode, I^- and I_3^- couple in acetonitrilewithout and with addition of CTAB as electrolyte and platinized FTO as cathode. Current density-voltage curve of the cell was obtained by potentiostatgalvanostat equipment under illumination of light intensity corresponding to $100\frac{W}{cm^2}$.Electrochemical impedance spectroscopyof DSSC was performed under dark and open-circuit conditions. Z-view software was used for fitting impedance data. Table 1 shows the J-V photovoltaic curve and impedance parameter of DSSC with and without addition of CTAB. CTAB is a cationic surfactant with high molecular weight,and the interaction of this substance with I^-/I^{3-} couple in electrolyte, slightly increase the electrolyte viscosity, thus diffusion of Iodide and Triiodide in electrolyte became more difficult and R_{ct2}increased consequently.$R_{ct1}$was related toelectron

transfer at the TiO_2/electrolyte interface, and the redox reaction at the platinum counter electrode [3], in the presence of CTAB, R_{ct1} was decreased so $J_{sc}$and efficiency increased consequently.

Table 1: The photovoltaic and EIS parameters of DSSC based on different electrolyte (Concentration of I^- is 0.2 M, I_2 is 0.013 M and CTAB 0.0055M)

Type of additive	V_{oc} (v)	J_{sc}(mA/cm^2)	FF	η (%)	R_{ct1}(Ω)	R_{ct2}(Ω)	R_s (Ω)
No additive	0.59	15.14	0.66	5.89	11.55	2.35	18.18
CTAB	0.62	16.24	0.61	6.14	11.47	3.82	10.96

Theaddition of CTAB as cationic surfactant to liquid electrolyte is effective in performance of DSSC. Electrochemical impedance spectroscopy showed the addition of CTAB facilitates the electron transfer at the TiO_2/electrolyte interface, and the redox reaction at the platinum counter electrode, therefore the addition of CTAB increases the performance of DSSC. This study introduce new route to useappropriate additives in order to fabricate DSSCs with higher efficiency.

Keywords: *Dye Sensitized Solar Cells, Electrochemical Impedance Spectroscopy, Electrolyte, Cationic Surfactant (CTAB).*

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A Structural Integrity & Electrochemical Behavior Research of $GaPO_4$-Coated MoO_2 Anode Material for Lithium-Ion Batteries

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Abstract

$GaPO_4$ nanoparticles used in this paper , were synthesized via chemical deposition method and used for the surface modification of MoO_2 to improve its structural stability and electrochemical performance. Structure and surface morphology of pristine and $GaPO_4$-coated MoO_2 anode material were characterized by electron microscopy imaging (SEM and TEM) and X-ray diffraction (XRD). $GaPO_4$ nanoparticles were observed, covering the surface of MoO_2 . The electrochemical properties of pristine and $GaPO_4$ -coated MoO_2 were characterized in the voltage range of 0.01–2.5 V versus Li/Li^+ . Cyclic voltammetry studies indicate that the improvement in electrochemical performance of the $GaPO_4$ -coated anode material was attributed to the stabilization of the lattice structure during lithiation. Galvanostatic charge/discharge and electrochemical impedance spectroscopy (EIS) studies reveal that the $GaPO_4$ nanoparticle coating improves the rate capability and cycle stability and contributes toward decreasing surface layer and charge-transfer resistances. These results suggest that surface modification with $GaPO_4$ nanoparticles suppresses the elimination of oxygen vacancies in the lattice structure during cycling, leading to a better rate performance and cycle life.

Keywords: *electrochemical, stabilization ,SEM, TEM*

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Synthesis and electrochemical performance nanoporousmicrobead hard carbon as high-power negative electrodes material oflithium-ion battery

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Abstract

With thegrowth ofenergy consumptioninhuman society, energystorageand use itwhen needed, on a daily basisincreases.Alsoto Thelimitationoffossil fuels and long periodfor the rehabilitation, humanFollowing theuseof newand renewableenergy sources, such as battery. Hollownanostructuredanodematerials forlithiumion batteriesin the heart ofthe investigation intotheneed forhigher capacity, higherspeed capabilityand high safetyarefollowed. In this study, a simple, low cost and reproducible synthesis strategy was developed to fabricate mesoporous micro bead hard carbon by using hydrothermal method.A series of nanoporousmicrobead hard carbons was prepared using phenolic resin as carbon precursors. The effects of the amount of the pore former on nanoporousand heat-treatment temperature in the range from $700^{\circ C}$ to $1000^{\circ C}$, on their electrochemical performance were systemically studied, including the reversible capacity, coulombic efficiency in the first cycle, the rate capability and cycling stability. Under the optimal condition, the carbon material obtained at $700^{\circ C}$ with 50 wt% pore former as negative material for lithium-ion batteries exhibits a reversible capacity of about 523mAh g^{-1} at a constant current density of 100mAhg^{-1} in first cycle with excellent rate capability and cycling stability.

Keywords: *lithium ion battery, Negative-electrode material, nano porous material, spherical carbon.*

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CdS-modified TiO_2 Nanotube Arrays forVisible Light Conversion

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Abstract

Titania nanotube arrays (TNAs) are important nanostructure materials because of their favorable surface chemistry, high surface area, optical and electrical properties. The application of these nanotubes has been considered in various fields includephotoelectrochemical [1] and sensing [2]. But, due to their high band gap energy, different methods have been developed to reduce it for a particular application [3] such ascadmium sulfide (CdS) for solar energy applications in visible region. In this investigation, we report the result of photoelectrochemical (PEC) property of CdS-modified TNA by sequential-chemical bath deposition (S-CBD) technique.

TNAs have been synthesized by two-step anodization (80 min + 120 min) of Ti sheets (99.5% purity, 0.5 mm thickness) in DI water and ethylene glycol solution with ratio 10/90 containing 0.1 M NH_4F and H_3PO_4 at optimum applied voltage (60 V). Crystalline TNAs were fabricated by annealing the deposited films in air at 500˚C for 80 minutes with heating rate of 10 ˚C min^{-1}. CdS nanoparticles were deposited on the external and internal surface of TNAs by (S-CBD) method for different cycles (n=10, 20, 30) [4]. Using 0.1 M $Cd(NO_3)_2$ and 0.1 M Na_2S as CdS precursors. The surface morphology was characterized by field emission-scanning electron microscopy (FE-SEM). PEC analysis was performed in 0.1 M Na_2SO_4 solution under visible light photo-irradiation using Auto lab system. Pt and Ag/AgCl electrodes were used as counter and reference electrodes, respectively. For the all PEC experiments, a bias voltage of 0.1 V was applied.

Figure 1a shows the surface morphology of the sample indicating that the diameter and the length of TNAs was about 125 nm and 3 μm, respectively. Assembling of CdS nanoparticles with average size of 30-50 nm did not change the surface morphology of the TNA and a small amount of CdS nanoparticles aggregated on them (Fig. 1b to 1d). Figure 2 shows the calculated electron life time (t_e) versus open circuit voltage of TNA/CdS-n (n represents number of the cycles) as compared to pure TNA sample (n=0). It is clear that for TNA/CdS-30 sample, we have calculated the highest t_e value (~24 ms at -0.8 V) as compared with others. Moreover, the maximum photocurrent density was obtained for n=20 of about 28 mA cm^{-2}. Hence, high concentration CdS nanoparticles increased the electron life time and simultaneously decreased the effective surface area for light absorption.

Keywords:TNA, cadmium sulfide, redox reactions, visible light.

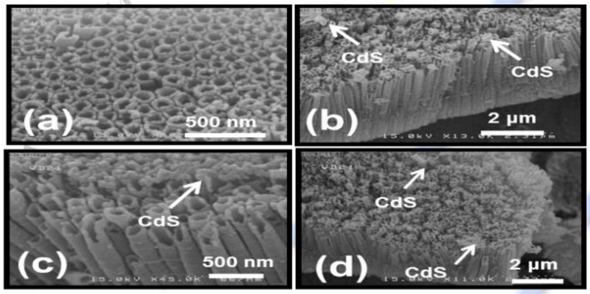
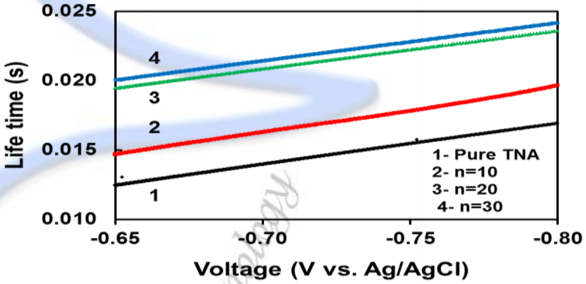


Figure 2.Photocurrent density response of pure TNA and TNA/CdS-n



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Electrochemical performance of α/β Nickel hydroxide nanoparticles prepared by cathodic electrodeposition

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Abstract

Nickel hydroxide, $Ni(OH)_2$, has been introduced as a promising candidate for electrode material of supercapacitors [1,2]. In this paper, nanoparticles of nickel hydroxide was deposited *via* cathodic electrodeposition from 0.005M $Ni(NO_3)_2$ bath under mild conditions. Deposition experiments were done at a constant current density of 0.1 mA cm^{-2} on the steel cathode for 1h. The prepared hydroxide powder was characterized by XRD, IR, DSC-TGA, CHN and SEM techniques. The XRD and IR analyses confirmed that the prepared hydroxide has a α/β phase of $Ni(OH)_2$ with intercalated nitrate ions in its structure. Morphological characterization by SEM revealed that the prepared deposit is composed of well–dispersed particles with size of about 30 nm (Fig. 1). The electrochemical properties of the prepared nanoparticles were analyzed by means of cyclic voltammetry (CV) and galvanostatic charge-discharge tests in 1 M KOH. The prepared α/β-$Ni(OH)_2$ nanoparticles showed an excellent capacitance behavior of 1210 F g^{-1} at the potential window of 0 to 0.55 V *vs.* Ag/AgCl. These results make the α/β-$Ni(OH)_2$ nanoparticles as a promising candidate for the supercapacitor electrodes.

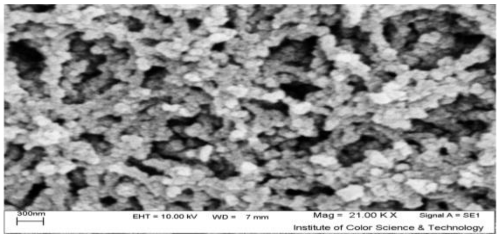

Fig. 1. SEM image of the prepared α/β-$Ni(OH)_2$ nanoparticles

Keywords**:** *α/β-$Ni(OH)_2$, Nanoparticles, Cathodic electrodeposition, Supercapacitive behavior*

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Electrochemical preparation and characterization of MnO_2 nanoworms

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Abstract

Well-defined worm-like nanostructures of MnO_2 were prepared *via* pulse electrochemical method. The electrochemical cell included a stainless steel cathode (316 L, 100 mm × 50 mm × 0.5 mm) centered between the two parallel graphite counter electrodes. The deposition experiments were conducted at the pulse current mode with a typical on-time and off-time (ton = 5 s and t_{off} = 10 s) and an average current density of 1 mA cm^{-2} (Ia = 1 mA cm^{-2}). The deposition time and bath temperature were 50 min and 80°C, respectively. The deposition experiments were conducted using an electrochemical workstation system (potentiostat/galvanostat, Model: NCF-PGS 2012, Iran). After deposition, the steel substrates were rinsed with water several times and dried at 50°C for 5 h. Then, the deposits were scraped from the substrates and subjected to further analyzes. To obtain oxide product, the prepared hydroxide powder was heat treated at 600°C for 3 h in dry air atmosphere. The products were characterized by XRD, FT-IR and SEM techniques. The results revealed that well-crystallized α,γ-MnO_2 with worm-like texture has been prepared (Fig. 1).

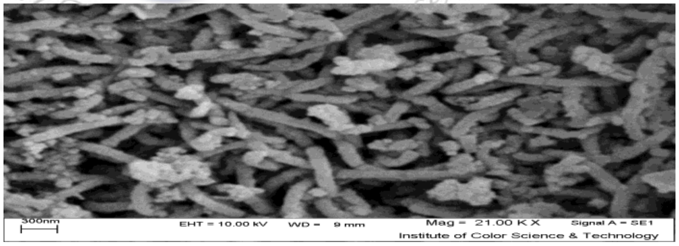

Fig.1. SEM image of the prepared MnO_2

The supercapacitive performance of the prepared nanoworms was analyzed by means of cyclic voltammetry (CV) and galvanostatic charge-discharge tests (Fig. 2).

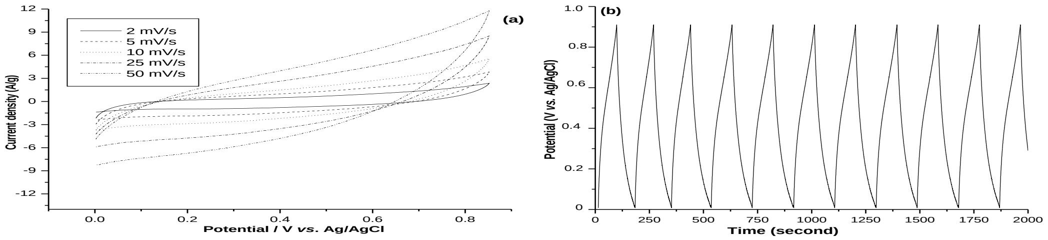

Fig. 2. (a) CV of MnO_2 electrode at various scan rates, and (b) its charge–discharge curves at the current density of 1 A g^{-1} in 1 M Na_2SO_4

The electrochemical measurements results are listed in Table 1. These results make the MnO_2 nanoworms as an excellent candidate for the pseudo-capacitor materials.

Table 1. Electrochemical measurements results

Calculated capacitances from CV curves (F/g)				**Calculated capacitances from charge-discharge curves (F/g)**		
Scan rate (mV s^{-1})						
2	**5**	**10**	**25**	**1 th cycle**	**250 th cycle**	**Capacity decay (%)**
205.9	181.2	144.3	102.5	198.4	180.1	9.2

Keywords: Nanostructured MnO_2; Pulse electrodeposition; Heat treatment; Microstructure; Supercapacitors

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Preparation of Ni-P & Ni-B modified electrodes by electroless method and its application for Oxidation of glucose

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Abstract

Electrocatalytic processes related to sugars oxidation are of great interest in many areas, as medical applications, wastewater treatment, biological fuel cells and food industry. Oxidizable metal electrodes Ni, Au, Pt and Cu provide simple way for the catalytic oxidation of carbohydrates at constant applied potentials. Non-enzymatic glucose fuel cells will probably replace by lithium batteries because of long-term stability and adequate power density. In these fuel cells of the common electrodes, which are expensive, and have current limited resource, in addition they show serious self-poisoning in the glucose oxidation. Pt electrodes replaced by Ni electrodes as well as by Ni compounds reducing these disadvantageous as reported by several[1]. Nowadays there are many bath solutions for electroless Nickel coating containing different Nickel sources, reducing agents, complexing agents, stabilizers, pH buffers and some additive which leads to pure or alloy nickel coatings with different properties [2, 3]. As reported before, electroless Ni-P and Ni-B coatings have phosphorus and boron as alloying element in their structure repectively. The crystallographic structure of the both depends on the amount of P or B. The purpose of the present work is to study the electrocatalytic oxidation of glucose using Ni-P & Ni-B modified graphite electrode in solution of 0.1 M NaOH.

***Keywords**: Fuel cell, Ni-P, Ni-B, Electrocatalyst ,Glucose*

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Synthesis and Electrochemical Performance of SiO_2 Modified $LiFePO_4/C$ Cathode Materials for Lithiumion Batteries

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Abstract

To improve the electrical conductivity of $LiFePO_4$ cathode materials, the SiO_2 modified $LiFePO_4/C$ cathode materials are synthesized by spray pyrolysis synthesis method, which is a simple, size controllable and continuous method, was used.The electrochemical performances are also characterized and analyzed with charge-discharge test, cyclic voltammetry and electrochemical impedance spectroscopy. The results show that the existence of SiO_2 improves the specific capacity,rate capability and cycling stability and lithium ion diffusion rate of $LiFePO_4$ cathode materials and reduces the charge transfer resistance of cell, and the one with 3wt% SiO_2 exhibits the best electrochemical performance including The initial discharge capacity is 148 mAh/g at 0.1C rate and 134 mAh/g at 1C rate, keeping a capacity retention ratio of 95% after 50 cycles.

Keywords: *lithium ion batteries, cathode materials, $LiFePO_4$, electrochemical performance, surface modification.*

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Synthesis and characterization of Palladium-Cobalt Alloy Nanoparticles as Polymer Electrolyte Fuel Cell Cathode Catalyst

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Abstract

Bimetallic catalysts surfaces are unstable under the operational electrochemical conditions of the proton exchange membrane fuel cells (PEMFCs). The less noble component tends to leach out, resulting in a phenomenon commonly referred to "de-alloying". Here, we conducted the potentio-static electrochemical corrosion of Pd-Co alloy nanoparticles (NPs) in the O_2 saturated 0.1 M H_2SO_4 solution close to the conditions of the cathode electrode in PEMFC. By the use of high resolution aberration-corrected STEM and EELS elemental maps, we examined the atomic-scale distribution of Pd and Co atoms in the de-alloyed NPs. Depending on the applied anodic potential, two types of nano arrangements were identified during the corrosion process: i) nano-porous evolution and ii) formation of a Pd shell around the Pd-Co alloy corewith various thicknesses and their corresponding formation mechanisms were discussed. Promisingly,the enhanced mass and specific activities of the de-alloyed Pd-Co catalysts toward the oxygen reduction reaction (ORR) were close to the state-of-the-art Pt/C catalyst. Moreover, these findings demonstrates a novel structure-control strategy to tune and optimize Pd-based alloy NP catalysts.

***Keywords*:**Palladium-Cobalt; De-alloying; Oxygen Reduction Reaction; Electrocatalysis.

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$BiVO_4/TiO_2/$GrapheneNanocompositePhotoanode for Enhanced Photoelectrochemical Performance

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Abstract

Growth of the world population and shortage of fossil fuels mandate our society to search for alternative clean energy using appropriate photocatalyst. TiO_2 has been proven to be the most active photoelectrode for photoelectrochemical (PEC) applications but its wide band gap limits its usage in UV region of solar spectrum [1]. To harvest the UV/visible portion of the solar spectrum and improve its carrier electrical conductivity, the photoanode can consist of TiO_2 accompanied with a visible active narrower band gap semiconductor such as $BiVO_4$ and Graphene as a material with high electron mobility and surface area. In this paper, we have used band energetic calculation to design visible active $BiVO_4/TiO_2/$Graphenenanocomposite thin film and then synthesized it as photoanode in PEC cell. The PEC performance of the $BiVO_4/TiO_2/$Graphenenanocomposite was compared with pure TiO_2 and $TiO_2/$Graphene photoelectrode under similar conditions. $TiO_2/$Graphene solution was prepared by coupling TiO_2 nanoparticles synthesized by sol-gel method on graphene oxide (GO) sheet via photocatalytic process and then it coated on transparent conducting oxide substrate (in here FTO) by spin coating and subsequently annealed under Argon gas at 350 °C. An efficient $BiVO_4$ layer was formed by dipping the deposited $TiO_2/$Graphene thin film electrode in an aqueous nitric acid solution of $Bi(NO_3)_3$ and NH_4VO_3. Surface analytical techniques such as SEM, AFM, XPS analysis and UV/Vis spectroscopy were used to determine chemical and physical properties of all investigated films. A three-electrode galvanostat/potentiostat (AutolabPGSTAT302) with a Platinum as counter electrode, Ag/AgCl as reference electrode and the prepared thin film samples as working electrode, 0.1M K_2SO_4 aqueous solution as electrolyte and a Xenon short arc lamp (OSRAM 5000W HBM/OFR as visible irradiation source with the intensity of about 1 Sun

were used to evaluate their PEC activity. Fig.1 depicts the photocurrent density of different samples obtained in the chopped I-t curves at constant applied potential of 0.8 V versus Ag/AgCl reference electrode. As seen, the $BiVO_4/TiO_2$/Graphenenanocompositephotoelectrode exhibits the hightestphotoactivity at about 3 A/m^2 as compared with the TiO_2 and TiO_2/Graphenephotoelectrodes. Visible light absorption of $BiVO_4$, high electron acceptance of the Graphene and the multistep electron transfer are believed to be responsible for the observed photoenhancement.

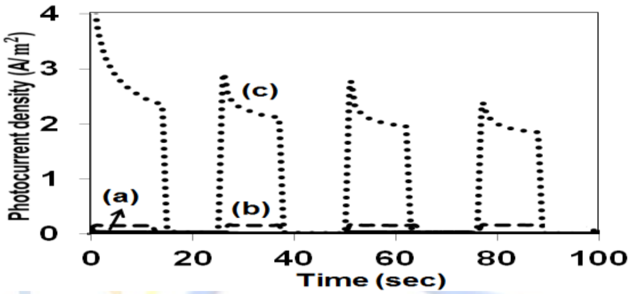

Fig. 1. Photocurrent density versus time at constant potential (0.8 V) for a) TiO_2, b) TiO_2/Graphene and c) $BiVO_4$/ TiO_2/Graphenephotoelectodesunder photoillumination

In summary, we have successfully synthesized the $BiVO_4/TiO_2$/Graphenenanocomposite thin film using a combined process. SEM, AFM, XPS analysis and UV/vis spectroscopy were used to characterize the films. Enhanced Photocurrent density of the $BiVO_4/TiO_2$/Graphene was measured under visible light as compared to other investigated systems.

Keywords:

Photocurrent density, visible activity, multiple electron transfer, Light harvesting

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α-$Co(OH)_2$ Nanoplates: Electrochemical Preparation and Characterization

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Abstract

Cobalt hydroxides have received increasing attention in recent years due to their many important technological applications such as electrode material for alkaline secondary batteries and supercapacitors [1,2]. The hydroxides of cobalt have a hexagonal layered structure and exist in two polymorphic forms, α and β [3]. The first form is isostructural with hydrotalcite-like compounds, while the second is brucite-like [$Mg(OH)_2$] and consists of hexagonally packed hydroxy ions with Co(II) ions occupying alternate rows of octahedral sites. α-$Co(OH)_2$ is a hydroxy deficient compound and consists of stacks of positively charged layers of composition $Co(OH)_{2-x}(H_2O)_x$, which intercalate anions and water molecules in the interlayer space to restore charge neutrality [2]. In this work, cobalt hydroxide nanoplates were prepared *via* cathodic electrodeposition and their electrochemical performance was investigated using cyclic voltammetry test. The deposition experiments were performed in the direct current mode with the applied current density of 0.1 mA cm^{-2}. Fig. 1a shows XRD pattern of the hydroxide product. The observed peaks in this pattern are fully matched with the corresponding crystalline α-$Co(OH)_2$ (JCPDS no. 42-1467). No β phase peaks were observed, demonstrating that α phase of cobalt hydroxide was successfully prepared at our applied conditions. Morphological observation by SEM revealed that the prepared α-$Co(OH)_2$ has nanoplates with the sizes in the range of 200–300 nm (Fig. 1b). Fig. 1c shows the CVs of the α-$Co(OH)_2$ electrode in 1M KOH at the different scan rates. A quasi-reversible electron transfer process observed in the CV curves, indicating that the measured capacitance is mainly based on the redox mechanism. Within the applied potential windows, the electrochemical reactions can be expressed as follows [2]:

$$\alpha\text{-}Co(OH)_2 + OH^- + H_2O \rightleftharpoons \gamma\text{-}CoOOH + e^- \quad (1)$$

$$\gamma\text{-}CoOOH + OH^- \rightleftharpoons CoO_2 + H_2O + e^- \quad (2)$$

The average specific capacitance of the prepared electrode was estimated from the CVs in Fig. 1c by integrating the area under the current–potential curve [3]:

$$C = \frac{1}{mv(V_a - V_c)} \int_{V_a}^{V_c} I(V)\, dV, \qquad (1)$$

where C is specific capacitance of α-$Co(OH)_2$ (F g^{-1}) measured in the potential range of V_a to V_c, *m* is the mass of $Co(OH)_2$ (g), *v* is the scan rate (V s^{-1}) and I(V) is a current response depending on sweep voltage. Using Eq. (1), the specific capacitance of α-$Co(OH)_2$ nanoplates was calculated to be 2263.1, 2105.8, 2000.5 and 1978.5 Fg^{-1} at scan rates of 2, 5, 10 and 25 mV s^{-1}, respectively. The values showed excellent supercapacitive performance of hydroxide nanoplates, which resulted from its α phase and plate morphology.

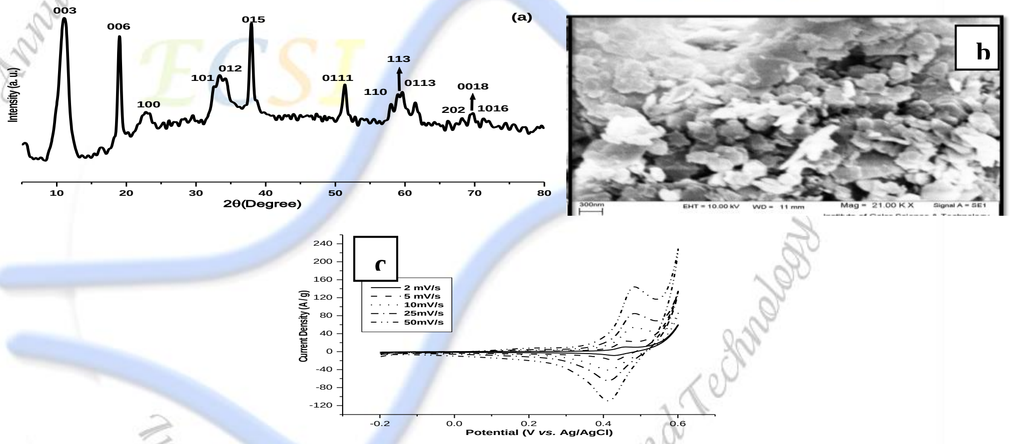

Fig. 1. (a) XRD pattern, (b) SEM image and CVs of the prepared $Co(OH)_2$ nanoplates.

Keywords: α-$Co(OH)_2$, Nanoplates, Electrosynthesis; Electrochemical Supercapacitors

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Promotion Effect of Pd and Ceria Nanocatalysts on ThePerformance of LSM Cathode of SOFCs

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Abstract

Due to the depletion of fossil fuel resources and serious global warming effects in the last few years, it is vital to replace present energy conversion technology and resources with a more sustainable/renewable energy system[1]. Solid oxide fuel cells (SOFCs) which are one of the cleanest and most efficient energy conversion technologies, have attracted a great deal of attention recently as a substitution for traditional fossil fuel conversion systems. A challenging issue in the development of SOFCs is to improve cathode performance by minimizing cathode polarization resistance to the oxygen reduction reaction[2-4]. In this study, small loading of ceria-based catalytic nanoparticlesalong with catalyticpalladium nanoparticles were co-infiltrated into the porous structure of $La_{0.8}Sr_{0.2}MnO_3$ (LSM) cathode backbone and the electrochemical performance of the cells was evaluated at intermediate temperature range of 600-800°C. Cathode performance was investigated by electrochemical impedance spectroscopy (EIS) and DC polarization technique (Chronopotentiometery) at dc bias of 200 mA/cm^{2}on cathode half cells. The results indicated that electrochemical performance of co-infiltrated cathode is significantly improved compared with that of LSM cathodes separately infiltrated with Pd and ceria-based nanoparticles.Scanning electron microscopy (SEM) studies show random distribution of discrete nano catalysts is formed in the vicinity of cathode interface which proves effectiveness of the infiltration technique for performance enhancement of cathode electrodes.Long term stability tests are in progress to evaluate agglomeration behavior of the Pd catalyst in the presence of ceria nanoparticles.

Keywords: *SOFC, LSM Cathode, Pd, Ceria, Infiltration, EIS*

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Study the effect of bimetallic electrocatalyst for ORR on cathode of PEMFC

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Abstract

The core- shell structure of catalyst is one of the effective ways that not only reducedPt loading but also raisedPt utilization for ORR on electrode[1-3]. In this research, bimetallic electrocatalyst (Ru@Pt) with core- shell structure were synthesizedby using the impregnation with hydrothermal methodstep by step and were characterized by physical and electrochemical techniques. Physical techniques (XRD, TEM and ICP) indicate that the Ru and Pt weresuccessfully reduced on Vulcan with different molar ratio (1:1, 2:1 and 3:1 Pt:Ru). The electrochemical techniques were done in three electrode system (LSV, CV, IES and chronoamperometery) and single cell. The resultsof half-cell studies illustrated that among 1:1, 2:1 and 3:1 for ORR, 1:1 of Pt:Rumolar ratio had the best performance, therefor, the MEA was prepared by using this electrocatalyst in cathode and commercial Pt/C as anode.electrode fabrication is similar to previouse work[4]. The XRD patterns show that the size of electrocatalyst particle was nanometer. Moreover, the TEM image indicates the good dispersion of catalyst in 11. Better performance of 1:1 molar ratio can attributed to well dispersionof catalyst on Vulcan and consequently increased three phase zone. The electrochemical results emphasis this idea (fig. 3 and 4). As it can see in table 1, exchange current density, electroactive surface area andcharge transfer resistance of 11(1:1 of Pt:Ru) are the best.The electrode area of MEA is 5 cm^2, and the catalyst loading is 0.3 mg.Cm^{-2}. The N-112 was used as membrane and activation process was 0.6V at 10h. The polarization curve and power density of single cell were obtained(fig. 5). Maximum power density of this cell is 547 mw.cm^{-2}. This result is comparable to other reported [1-3]. By applied different gas pressure and anode humidification can achieved the better results.

Keywords**:** core-shell, Electrocatalyst, ORR,PEM fuel cell, Pt, Ru.

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Electricity generation via phenol biodegradation in a microbial fuel cell

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Abstract

In the present work, bioacclimation of the mixed culture (activated sludge) was performed by introducing different concentrations of phenol (50-500 ppm) and decreasing the concentration of dissolved oxygen. Base on the objectives of the study, the acquiredmixed consortia from Arak petroleum refinery was used for enzymatic phenol degradation and electricity generation in a dual chamber microbial fuel cell (MFC).

The H-shaped MFC comprised two cylindrical compartments with 800 ml volume. The anode and cathode chambers were separated by a proton exchange membrane (PEM) (Nafion 117 with the cross sectional area of 15.9 cm^2). Two graphite rods as electrodes were positioned at a distance of 7cm on either side of PEM and copper wires were also used as contact with electrodes. Performance of MFC considering phenol biodegradation was evaluated by measuring cell voltage.

Keywords*: *Microbial fuel cell, Phenol biodegradation, Electricity generation, Two chamber, Mixed culture.

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Open Circuit Voltage in Passive Direct Methanol Alkaline Fuel Cell

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Abstract

Afunctionalized polymer electrolyte membrane for passive direct methanol alkaline fuel cell (DMAFC) was prepared by dipping Nafion117 membrane into NaOH solution.Membrane electrode assembly (MEA) was fabricated with carbon supported Platinum catalyst and Nafion117/NaOH treated membrane.MEA was tested in an alcohol fuel cell test station.The obtained MEA exhibited higher open circuit voltage (OCV) compared to traditional MEAs including Nafion117 treated with acid, reported in literatures. Single cell performance suggested that the OCV of passive DMAFC depends on fuel concentration which contains methanol and alkali solution. Cell performance tests also showed that the prepared MEA can deliverOCV about0.9 V.

***Keywords*: Passive, Nafion117membrane, Direct methanol, Fuel cell.**

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دهمین سمینار سالانه الکتروشیمی ایران

Design of Fuel Cell Test Station System Based on PLC Programming

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Abstract

This work consists of two section of software and hardware. In the software section, to control of test station system was performed using simatic software of siemens PLC programming. Also, HMI programming using PM-Designer software were done to communicate operator and PLC in order to reading the elements from PLC or entering the values to PLC. Hardware section, includes, cpu, analogue input cards, analogue output cards, digital input cards, and digital output cards. The analogue inputs, were used for reading the elements such as output temperatures of hydrogen and oxygen humidifier, values of hydrogen and oxygen moisture, flow of hydrogen and oxygen, voltage of cell, temperature of cell, pressure of hydrogen and oxygen outputs. Also, analogue outputs, used for sending commands of the gradual closing or opening to hydrogen and oxygen solenoid valves. Furthermore, digital inputs, used for status of hydrogen and oxygen solenoid valves, status of emergency and status of nitrogen solenoid valves. In this system, digital outputs, used for send closing command to hydrogen and oxygen solenoid valve, opening command to nitrogen solenoid valves in emergency status, closing or opening command to heater contact of hydrogen and oxygen humidifier, and closing or opening command to solenoid valve of cooling water.

Keywords*: *PLC, test station, fuel cell

Using of red lead as additive for positive paste to improve performance of lead-acid batteries

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Abstract

Recently, using of red lead has considered for the lead-acid battery manufactures because of its useful influences on battery performance, especially for VRLA batteries [1,2]. The formation process in formal lead-acid battery manufacturing is a long time and low efficiency process because of the low conductivity of the lead oxide, lead sulphate and basic lead sulphates in the battery plate. Red lead has a higher conductivity than that of lead oxides and sulphates [3]. When red lead is added in a positive paste, some amount of the lead oxide is converted directly to PbO_2 before the charging process is begun, and this helps in the formation process [4,5]. Using optimum amount of red lead in process of positive paste preparation from 8 to 10% by weight was explored in this paper. It has great effect in lead-acid batteries such as more efficient formation, higher first discharge capacity, increasing in cycle life and easier curing control.

In this research the batteries manufactured with red lead are compared with other standard batteries in different tests. Here, the significant benefits of red lead are shown using scanning electron microscopy and X-ray diffraction analysis and the results will be presented and discussed.

***Keywords*:** Red lead, Lead oxide, Lead-acid battery, Formation process

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Preparation and Characterization of Polysulfone Based Anion Exchange Membrane for Fuel Cell Application

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Abstract

In this study the anion exchange membranes with polysulfone backbone and quaternary ammonium cationic group were prepared and characterized by the ion exchange capacity and dimensional stability tests. These membranes were prepared by chloromethylation, amination and alkalization steps and trimethylamine with different amounts was used as amination agent. The ion exchange capacity and dimensional stability tests showed that these membranes can be good candidate for solid alkaline fuel cell application.

Keywords**:** Anion Exchange Membrane, Ion Exchange Capacity, Water Uptake, Swelling Degree, Ammonium Functional Group.

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Improving the ICR of SS316L as bipolar plates by coating AlN-TiN nanoparticles with APF

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Abstract

The polymer electrolytemembrane fuel cell (PEMFC) is promising in transportation applications and portable devices due toits high efficiency, cleanliness, and low operating temperature (70-90˚). The bipolar plate is a multi-functional component of the fuel cell. In most fuel cell setups, it separates the individual electrochemical cells and connecting the cathode side of one cell to the anode side of the other one with good conductivity. Hence, high electrical conductivity, high gas impermeability, good mechanical performance, good corrosion resistance, and low cost are required for practical applications of bipolar plate materials

The present work reports the results of double layer AlN and TiN-ions implantation onto the SS316L samples as bipolar plates by a 4 kJ Mather type Amirkabir Plasma Focus (APF) device operated with nitrogen gas for 5, 10 and 20 shots in order to improve the corrosion resistance and conductivity of samples, using AlSi11MgSr alloy and Ti anode tip for coating AlN and TiN layer respectively. Scanning Electron Microscopy (SEM) indicates changes in surface morphology before and after potentiostatic test. The interfacial contact resistance (ICR) of samples was measured, and the results show that the conductivity of samples increase after coating because of high electricalconductivity of AlN-TiN coating. The double layer coated SS316L samples show more reduction in ICR in comparison with the SS316L samples coated just with TiN, as it can be seen in.figure1. The ICR increases after the potentiostatic test because of change in passive layer composition.

Keywords: *Bipolar plate, Plasma focus,TiN-AlN, Interfacial contact resistance, Corrosion.*

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Study of the O-O bond breaking of molecular oxygen in the oxygen reduction reaction (ORR) in fuel cells based on DFT

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Abstract

PEM fuel cell performance depends on the oxygen reduction reaction. The O-O bond breaking of molecular oxygen is the most important part of this reaction. In this paper, it has been tried that condition of O-O bond breaking in cathode electrode is shown. First, GPt_9 as the electrodes are properly considered that it conclude Pt_9 as catalyst and graphene as platform and wereoptimized. Second, O_2 molecule is placed on the electrode and were optimized. Then, based on the presence or absence of proton (H^+), several structures in which O-O is separated, were optimized. Finally, the energy difference was calculated andproton impact on the break will be displayed.

Keywords*: *Oxygen reduction reaction, GPt_9, protonation, DFT.

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Tuning the Substrate to Enhance Electrocatalytic Activity of Co Nanoflakes for Water Oxidation

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Abstract

Alarming depletion rate of reserved fossil fuel associated with rapid increase in environmental pollutions has caused an urgent need to develop efficient clean and renewable energy resources. In this regard, many different approaches have been followed up including hydrogen generation from water splitting using photovoltaic systems as an electric energy resource. To reduce required overpotentials in this process developing earth abundant electrocatalysts for water oxidation/reduction is desired [1-3]. Here, a simple low cost method proposed to grow cobalt nanostructures as an efficient electrocatalyst for oxygen evolution and studied how the substrate can effect on their performance.

Co nanoflakes have synthesized using electrodeposition techniques on different four subtrate: copper sheet, titanium sheet, Ni foam and steel mesh with pore size of ~ 20 µm. For all substrates galvanostat mode in a conventional three-electrode cell configuration was used. The solutions contained 0.5 M $CoCl_2$ and 0.5 M H_3BO_3.The applied current density and the electrodeposition time were 20 mAcm^{-2} and 800 s, respectively. The counter and reference electrodes were platinum (Pt, 99.99 %) and Ag/AgCl, respectively. As can be seen in the figure 1, Co nanoflakes were grown on each substrate while the geometry and density of the flakes depended on the substrate. Tablet like structure was formed on the metallic Cu and Ti sheets while a wrinkled surface was observed for Co deposited on mesh like structure with higher

surface area. Electrochemical study of the water oxidation reaction on the surface of these Co based electrodes revealed that the least overpotential can be obtained by electrodeposition of Co nanoflakes on the steel mesh as the substrate which caused the also the lowest value for charge transport resistance on the surface (figures 1 and 2).

Keywords: Electroctalyst, Cobalt oxide/hydroxide, Water oxidation, Double layer.

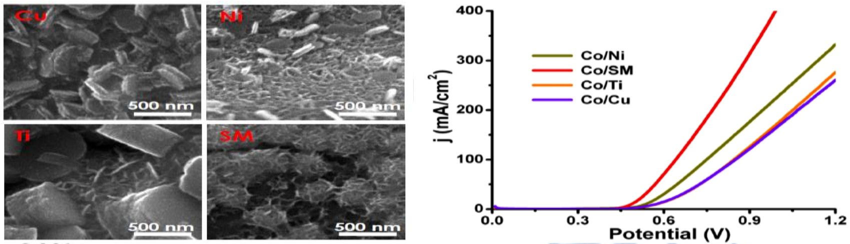

Figure 1. left: SEM images of the grown Co nanoflakes on different substrates and right: I-V characteristics of the prepared electrodes for water oxidation reaction.

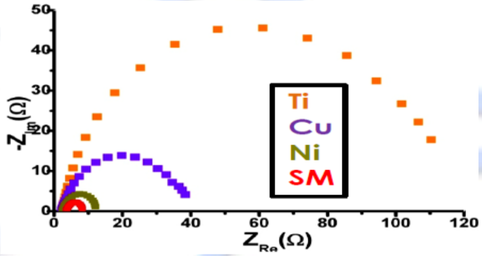

Figure 2. Niquist plots of the Co based electrodes on various substrates.

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Electrochemical Capacitive Properties of CdO Nanostructured Prepared by Cathodic Electrodeposition-Heat Treatment Method

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Abstract

Solar cells [1], photo-transistors and diodes [2], transparent electrodes [3], gas sensors [4], etc. are some of the known applications of cadmium oxide (CdO) but, the direct use of CdO electrode in electrochemical supercapacitors (EC) application seems to be novel. Because the electrodeposition is characterized by the convenience of processing, low temperature process and low cost of raw materials and equipment, it is expected to find wide applications among the processes commonly used for the preparation of metal oxides. In the present work, nanostructured CdO was prepared *via* cathodic electrodeposition-heat treatment method, and its electrochemical performance was investigated using cyclic voltammetry technique. The deposition experiments were performed in the pulse current mode (t_{on}=10s and t_{off}=10s) with the applied current density of 1 mA cm^{-2}. To prepared oxide sample, the obtained hydroxide was then heat-treated at 600 ^{o}C for 3h. Fig. 1a shows XRD pattern of the oxide product. The observed peaks in this pattern are fully matched with the hexagonal phase of CdO (JCPDS no. 05-0640). Morphological observation by SEM revealed that the prepared CdO has plate-like structure with the sizes in the range of 200–300 nm (Fig. 1b). Fig. 1c shows the CVs of the CdO electrode in 1M KOH at the different scan rates. A quasi-reversible electron transfer process observed in the CV curves, indicating that the measured capacitance is mainly based on the redox mechanism. Proposed mechanism for the charge storage in CdO electrode is based on the concept of intercalation of cations in the electrode during reduction and deintercalation due to oxidation phenomenon [5]

Keywords: *CdO, Nanoplates, Electrosynthesis; Supercapacitive behavior*

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Uniform β-Co(OH)$_2$ Nanodiscs Prepared by Low-temperature Electrochemical Method as a Electrode Material for Supercapacitor Materials

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Abstract

Cobalt hydroxides have received increasing attention in recent years due to their many important technological applications such as electrode material for alkaline secondary batteries and supercapacitors [1,2]. The hydroxides of cobalt have a hexagonal layered structure and exist in two polymorphic forms, α and β [3]. The β form is isostructural with hydrotalcite-like compounds, while the second is brucite-like [Mg(OH)$_2$] and consists of hexagonally packed hydroxyl ions with Co(II) ions occupying alternate rows of octahedral sites [2].

In this work, uniform nanostructures of cobalt hydroxide were successfully prepared by a low-temperature electrochemical method *via* galvanostatically electrodeposition from a 0.005 M Co(NO$_3$)$_3$ bath at 10 ^{o}C. The XRD (Fig. 1a) and FT-IR (Fig. 1b) analyses showed that the prepared sample has a single phase of the hexagonal brucite-like β-Co(OH)$_2$. Morphological characterization by SEM (Fig. 1c) and TEM (Fig. 1d) revealed that the prepared β-Co(OH)$_2$ was composed of uniform compact disc-like nanostructures with diameter of 40-50 nm. The electrochemical performance of the prepared β-Co(OH)$_2$ was evaluated using cyclic voltammetry (Fig. 2a) and charge-discharge tests (Fig. 2b). A maximum specific capacitance of 736.5 F g^{-1} was obtained in aqueous 1 M KOH with the potential range of -0.2–0.5 V (*vs*. Ag/AgCl) at the scan rate of 10 mV s^{-1}, suggesting the potential application of the prepared nanostructures as a electrode material in electrochemical supercapacitors. The results of this work showed that the low-temperature cathodic electrodeposition method can be recognized as a new and facile method for the synthesis of cobalt hydroxide nanodiscs which are promising candidate for the electrochemical supercapacitors.

Keywords: *β-Co(OH)$_2$, Cathodic Electrodeposition, Nanodiscs, Supercapacitors*

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High Performance Supercapacitive Behavior of Nanostructured Co_3O_4 Prepared by Cathodic Electrodeposition−Heat-treatment method

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Abstract

Among the transition oxides, cobalt oxide (Co_3O_4) has been widely used in many fields, such as pigment for glasses and ceramics, solid-state sensors, heterogeneous catalysts and electrochromic devices [1,2]. Co_3O_4 is a promising electrode material for electrochemical supercapacitors [3,4]. Herein, we report on the high surface area nanostructured Co_3O_4 prepared *via* a two−step method; cathodic electrodeposition of cobalt hydroxide from additive free nitrate bath followed by heat treatment at 400 ^{o}C for 3h. The XRD pattern of the prepared oxide sample is shown in Fig. 1a. All diffraction peaks in this pattern can be indexed undisputedly to face-centered cubic (fcc) Co_3O_4 phase (JCPDS no. 43-1003). The FTIR spectrum of the prepared Co_3O_4 is shown in Fig. 1b. The bands at around 568 cm^{-1} and 664 cm^{-1} are associated with the OB_3 (B represents Co^{3+} in an octahedral hole) vibration and the ABO (A represents the Co^{2+} in a tetrahedral hole) vibration in the spinel lattice, respectively [3]. The morphology of the prepared Co_3O_4 was characterized by SEM and TEM. From Fig. 1c, one can see that the prepared Co_3O_4 has approximately plate-like morphology. The TEM image (Fig. 1d) shows that these plates are completely porous. CVs for Co_3O_4 electrode under different scan rates in 1 M KOH solution are presented in Fig. 2a. The specific capacitance of Co_3O_4 was calculated as 465.5, 410.4, 349.5 and 294.1 F g^{-1} at the scan rates of 5, 10, 25 and 50 mV s^{-1}, respectively. The prepared Co_3O_4 electrode was galvanostatically discharged at the current density of 1 A g^{-1} for 500 cycles (Fig. 2b). The calculated capacitance for the 10th cycle was as high as 393.6 F g^{-1}, which is very close to that calculated from the CV curves, confirming the high capacitance of the prepared Co_3O_4. For the 500th cycle, the calculated capacitance was 381.2 F g^{-1} which showed only 3 % capacity

decay compared with the 10th cycle (Fig. 2b). These characteristics indicate that the prepared Co_3O_4 can be promising electroactive materials for supercapacitors.

Keywords: Co_3O_4, *Cathodic Electrodeposition, Heat-treatment, Supercapacitors*

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Application of palladium nanoparticles supported on ethylenediamine-functionalized cellulose as catalysts for electrochemical hydrogen production

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Abstract

Hydrogen production from electrochemical water splitting has been considered as an ultimate solution to the energy and environmental issues. There are various methods for hydrogen production including steam reforming, gasification, electrolysis, hydrolysis, thermal catalysis, thermochemical, photocatalysis, and photoelectrocatalytic. In electrochemical method, platinum is regarded as an ideal catalyst for hydrogen production from aqueous solutions. Platinum is a suitable electrode for electrochemical production of hydrogen, but it is expensive and its resource availability is very limited. Therefore, the search for new methods to reduce loaded Pt or replace other materials in the hydrogen evolution reaction (HER) has been a topic of current interest.

In this study palladium nanoparticles supported on ethylenediamine-functionalized cellulose (PdNP@EDAC)was synthesized and carbon paste electrode was modified by this catalyst for hydrogen evolution reaction (HER). According to our knowledge, this is the first report which apply PdNP@EDAC for efficient electrochemical hydrogen production. Scanning electron microscopy (SEM), X-ray diffraction spectroscopy (XRD) and Fourier transform infrared spectroscopy (FT-IR) were used to study the morphology, structure and functional groups of PdNP@EDAC, respectively. For optimization of conditions some parameters including catalyst percent, binder amount and pH was changed and their effect on HER was evaluated. The electrochemical characterizations were performed using cyclic voltammetry (CV), linear sweep voltammetry (LSV), chronoamperometry (CA) and electrochemical impedance spectroscopy (EIS). The best performance was obtained for PdNP@EDAC modified CPE (25% catalyst, 20% binder) in 2 M H_2SO_4 solution. Comparison of the proposed electrode with the CPE, CPE

modified with functionalized cellulose (EDAC-CPE) and CPE modified with Pd (Pd-CPE) showed that PdNP@EDAC-CPE has the best performance. The proposed electrode with the very low loaded Pd includes several advantages such as using cellulose as a biodegradable polymer, low cost, very good performance and ease of preparation in a large scale that could be a perfect candidate for high-purity electrocatalytic hydrogen production.

Keywords: *Electrocatalytic hydrogen production, Carbon paste electrode, Palladium nanoparticles; Ethylenediamine functionalized cellulose, Biodegradable*

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Highly graphiticmesoporous carbon as electrode material for electrochemical supercapacitors

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Abstract

Porous carbon structures with outstanding properties, such as tunable pore channels, high surface area, uniform structure, chemical and mechanical stability has already been of considerable interest for gas separation, water purification, catalyst support, energy storage, electrodes of electrochemical double layer capacitors and fuel cells [1,2]. In the present work, a graphitic nanoporous carbon was synthesized via a nanocasting approach by using nano calcium carbonate as hard template; sucrose as carbon precursor, Nickel nitrate as graphitization catalyst and dilute acetic acid as template removing agent. The prepared material was characterized using nitrogen adsorption/desorption, small & wide angle X-ray diffraction and Fourier transform infrared techniques. Porous carbon materials andpolytetrafluoroethylene (PTFE)binder were thoroughly mixed in a massratio of 85:15 and then the mixture was sandwichedbetween two pieces of nickel foam to form a workingelectrode.The electrochemical performances of the asfabricatedsupercapacitor are investigated with cyclic voltammetry, galvanostatic charge/discharge andelectrochemical impedance spectroscopy.Our results show that a maximum capacitance of 220 F/gat a current density of 0.5 A/g can be achieved by the supercapacitor, which is significantlyhigher than most solid-state ones reported in the literature.

***Keywords*:** mesoporous carbon; Supercapacitor; synthesis; characterization

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Molecular orientation and dielectric anisotropy propertiesof E_{7CN5}–TiO_2liquid crystal composite

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Abstract

Composites based on liquid crystals (LCs) have attracted muchattention over a number of years because of their unique electro and magneto-optic properties and novel display applications[1]. The relationship between the static dielectric permittivity andthe molecular properties of nematic liquid crystals has long beenan objective of dielectric studies[2–4]. The static dielectric measurement has been shown to be a successful technique in characterizing molecular anisotropy and intermolecular ordering innematic liquid crystals. The dielectric permittivity of the nematicliquid crystals is anisotropic due to their long-range orientationalorder. The dielectric behavior of a nematic liquid crystal is described by two dielectric constants, $\varepsilon_{\parallel}$ and $\varepsilon_{\perp}$ the dielectricanisotropy $\Delta\varepsilon$, defined as $\Delta\varepsilon = \varepsilon_{\parallel} - \varepsilon_{\perp}$ [5], is an important parameter that determines the lower threshold voltage of a liquid crystaldisplay (LCD)[6]. The development of multimedia LCDs resulted ina strong demand for new liquid crystalline materials with highclearing temperatures, negative dielectric anisotropies and low viscosities. Liquid crystal mixtures with a positive dielectric anisotropy are currently used in most active matrix displays. Themixing of two or more components is of increasing importanceand interest because it can result in a composite with a valuable

practical application. Some of the properties of a blend can be different from those of the pure components, and it can behave asnew single phase material down to the micro-scale level.

Miscibility implies a homogeneous mixture, and pairs can exhibit completeor partial miscibility within a range of concentrations.

The molecular orientation and the dielectric anisotropy of the nematic liquid crystal (LC) $E_{7CN5}$and of TiO2-doped E_{7CN5} have been investigated. The dielectric properties of theLCs exhibit a relaxation peak that shifts to lower frequencies with increasing voltages. The relaxation frequencies of E_{7CN5} and E_{7CN5}/TiO_2liquid crystals were calculated and found to decrease as the bias voltageincreases. This is attributed to molecular reorientation. The dielectric anisotropy of the LCs changes fromthe positive type to negative type and the static electric permittivity and dielectric anisotropy valueswere found to be lower for the E_{7CN5}/TiO_2system (fig1).

***Keywords*:**Dielectric properties, relaxation, electricmodulus, Liquid crystals and molecular liquids

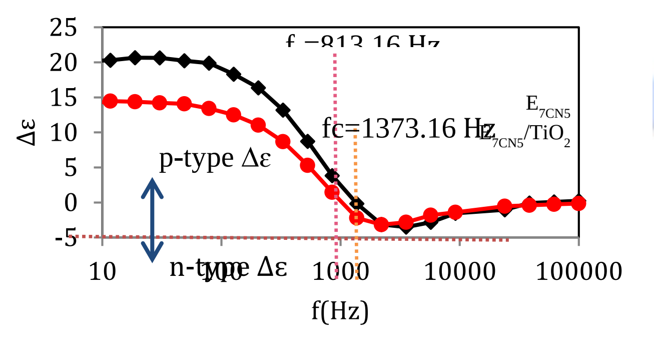

Figure1: Dielectric anisotropy on frequency (Δε–logf) plot of 7CB and E_{7CN5}/TiO_2LCs

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Comparison of Single-walled and Multi-walled Carbon Nano-tubes Durability as Pt Support in Gas Diffusion Electrodes

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Abstract

The durability of proton exchange membrane fuel cell (PEMFC) is a major barrier to the commercialization of these systems for stationary and transportation power applications [1]. Limiting the commercialization of PEMFCs, electrocatalyst durability is a factor for consideration [2-3]. Durability of single-walled (SWCNT) and multi-walled carbon nano-tubes (MWCNT) as Pt supports were studied using two accelerated durability tests (ADT), potential cycling and potentiostatic treatment. ADT of gas diffusion electrodes (GDEs) was once studied during the potential cycling. Pt surface area loss with increasing the potential cycling numbers for GDE using SWCNT was shown to be higher than that for GDE using MWCNT. In addition, equilibrium concentrations of dissolved Pt species from GDEs in 1.0 M H_2SO_4 was found to be increased with increasing the potential cycling numbers. Both findings suggest that Pt detachment from support surface plays an important role in Pt surface loss in proton exchange membrane fuel cell electrodes. ADT of GDEs was also studied following the potentiostatic treatments up to 24 h under the following conditions: argon purged, 1.0M H_2SO4, 60° C and a constant potential of 0.9 V. The subsequent electrochemical characterization suggests that GDE that use MWCNT/Pt is electrochemically more stable than other GDE using SWCNT/Pt. As a result of high corrosion resistance, GDE that use MWCNT/Pt shows lower loss of Pt surface area and oxygen reduction reaction activity when used as fuel cell catalyst. The results also showed that potential cycling accelerates the rate of surface area loss.

Keywords*: *Durability, Gas diffusion electrode, Nano-tube, Oxygen reduction reaction, Fuel Cell.

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Investigation of Anodic Activation Response of Pt/C Substrate toward Electro-reduction of Oxygen through a Gas Diffusion Layer

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Abstract

The electrochemical reduction of oxygen plays significant role in fuel cells, gas sensors and in the electro-synthesis of hydrogen peroxide. The oxygen reduction reaction (ORR) proceeds either as a direct four-electron process or a two-electron process [1, 2]. Production of water by a four-electron oxygen reduction is used both in fuel cells and gas sensors, while hydrogen peroxide is produced by a two-electron reduction of oxygen. Electro-catalytic reduction of oxygen on a Pt/C as catalytic layer with the weight ratio of 20/80 and loading value of 0.5 mg cm^{-2} through a gas diffusion electrode in sulfuric acid medium was studied by cyclic voltammetry (CV) and chronoamperometry (CA). Initially, Pt/C supported gas diffiusion electrode (PGDE) was previously undergone 15 consecutive cycles to guarantee the stability of the CV pattern. Inverse dependency of hydrogen adsorption quantity on potential sweep rate was shown for PGDE. The electro-reduction was verified in the form of an anodic shift of hydrogen evolution peak potential beginning from 200 mV vs. Ag/AgCl as well as the increment of current values in all stages of the cathodic direction. This feature as well as decrease of the current in all regions of the anodic direction unveils the mediated oxygen electro-reduction. To test the effect of electrochemical treatment on oxygen reduction, anodic activation was performed via stopping at the anodic potential 1500 mV. The main response of PGDE toward this pretreatment was gradual elimination of hydrogen adsorption peak of the voltammogram in the absence of oxygen. After anodizing within the various stopping times up to 100 seconds, 10 cycles were carried out to recover PGDE at each experiment. Thereafter, oxygen was bubbled through the back of PGDE till the saturation level. Interestingly, the more anodic activation times, the less over-potential of oxygen electro-reduction is resulted. This introduced the argument that the formed oxygen-

containing functional groups during the anodic activation play a key role on proton transfer towards the electro-catalyst layer. This approach was confirmed by employing chronoamperometric regime in dc-offset potential -300 mV. Accordingly, obtained CA patterns clearly validate the approaches of CV concerning oxygen electro-catalytic reduction.

Keywords: *Gas diffusion electrode, Oxygen reduction, Pt/C, Anodic activation*

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Application of CuBDCMetal Organic Framework as electrocatalyst for hydrogen production

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Abstract

There are several ways to produce hydrogen including hydrolysis, thermal catalysis and thermochemical, photocatalysis, photoelectrocatalysis, steam reforming, gasification and electrolysis. In the electrochemical production of hydrogen, platinum (Pt) is an excellent electrode for hydrogen generation, but it is expensive and its present resource is very limit. Therefore we should look for a suitable alternative to Pt.There are very rare report on using metal- organic framework (MOF) as electrocatalyst for hydrogen evolution reaction (HER). In this study CuBDCMOFwas used as a HER electrocatalystin carbon paste electrode (CPE). The performance of the proposed modified CPE for electrochemical hydrogen production was studied by cyclic voltammetry, linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS) and chronoamperometry techniques. For optimization of conditions some parameters including catalyst percent,paste binder amount and pH was changed and their effect on HER was evaluated. The best performance was obtained for 25% catalyst, 30% binder and 2 M H_2SO_4 solution. In addition, a promisingresult showed that by applying successive CVs the current density increases.

Keywords: *Carbon paste electrode, Electrocatalyst, Metal–organic framework, Hydrogen production*

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Advanced chlor-alkali cells: history, present status and further prospects

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Abstract

The development of the membrane chlor-alkali technology and its further optimization resulted in a significant cut of the energy consumption in chlor-alkali production [1]. State-of-the-art membrane reactors operate at voltages as low as 3.2 V at a typical current density of 4 kA m^{-2} (0.4 A cm^{-2}) [2]. In spite of the effort to reduce the energy use by the chlor-alkali industry, the brine electrolysis is still one of the most energy-intensive industrial operations. It is believed that the mature membrane technology reached the theoretical limit on energy consumption [3]. As a consequence, further optimization of this technology is not expected to result in meaningful energy savings. However, by replacing the hydrogen-evolving cathode in a membrane cell with an oxygen-depolarized cathode (ODC), the cell voltage and energy consumption can be reduced by as much as 30% at 4 kA m^{-2} [4]. This review article describes the historical development, present status and future prospects of advanced chlor-alkali electrolysis with oxygen depolarized cathodes. After a brief introduction to the relevance of chlorine production and the existing manufacturing processes, the principle of oxygen depolarized cathodes is described. Furthermore, reaction paths and catalysts for oxygen reduction in alkaline media are briefly reviewed. After intensive discussion on the chlor-alkali electrolysis by oxygen depolarized cathodes, advanced chlor alkali cell designing as a zero-gap ODC cell will be introduced to. This cell design comprises flow fields for oxygen transport and caustic removal. From these examples one can see that the zero-gap design has certain advantages such as a reduction of ohmic losses in the electrolyte and avoidance of pressure differences between liquid and gas.

On the other hand, the activated dimensionally stable anodes (DSA) and mixed metal oxide (MMO) coated cathodes are studied as anodes and cathodes of brine electrolysis by our

teamwork and the results of the electrochemical technique investigation show that these electrodes act as well as commercial ones. So, a brief discussion about these results will be introduced too.

Keywords**:** Advanced chlor-alkali electrolysis, Oxygen depolarized cathode, Dimensionally stable anode, zero-gap cell design

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Optimized growth parameters of electrophoretic deposited MoS_2few layer nanosheets for photoelectrochemical activity under sunlight irradiation

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Abstract

Ultra-thin MoS_2few layer nanosheets have attract many attentions during recent years [i]. Despite of its bulk, MoS_2 ultra-thin nanosheets show noticeable photo-activity.Mixed solvent strategy [ii]is one of the most important methods to produceultrathin isolated few layer nanosheets from MoS_2bulk. Herein, we have used this simple method to prepare MoS_2 few layer nanosheets. Then the electrophoretic deposition technique (EPD) was used to prepare MoS_2 thin films on Indium tin oxide (ITO) substrate. We have determined the optimum EPD growth parameters to obtain the maximum photo-current density fromtheMoS_2/ITO layers under visible light. MoS_2 powder (250mg,Aladdin Inc.) was added to 50 mL of ethanol/water =45/55 solution andsonicated for 15 h, then the dispersion was centrifuged at 3800 rpm for 45 min. Two cleaned ITO sheets were immersed in the prepared solution. By applying various voltages(4, 5 and 8V) and growth times (30s, 1, 2 and 3min), Few layer MoS_2 nanosheets were deposited on ITO cathode. The photo-current density of MoS_2/ITO thin films was investigatedwith CHI 660D electrochemical workstation (Shanghai Chenhua Co., China) by using Pt as counter electrode, SCE as reference and the MoS_2/ITO as working electrode in a 50 mMNa_2S aqueous solution.The UV-Visible spectrum of the exfoliated MoS_2 is shown in Figure 1(a) (PGENERAL T6

spectrophotometer). A and B excitonic peaks are clearly observable at 676 and 620 nm, respectively. These peaks arise from the K point of the Brillouin zone in 2H-MoS_2 crystal phase [iii].Based on TEM analysis (Tecnai-G2-F30, USA), the average sizeand thickness of the obtained flakes were about 60 and 5 nm respectively(Figure 1(b)). Based on Photo current-time curves (Figure 1(c), for the samples prepared under 4V, increasing deposition time reduced the photo-responsibility from 0.8 to 0.18 μA/cm^2. For the samples prepared under 5V, the highest photo-current density was3μA/cm^2 for 2min EPD time. The maximum photo-current densityof 5.6 μA/cm^{2}was measured for the MoS_2/ITO thin film prepared under 8V in 1min.

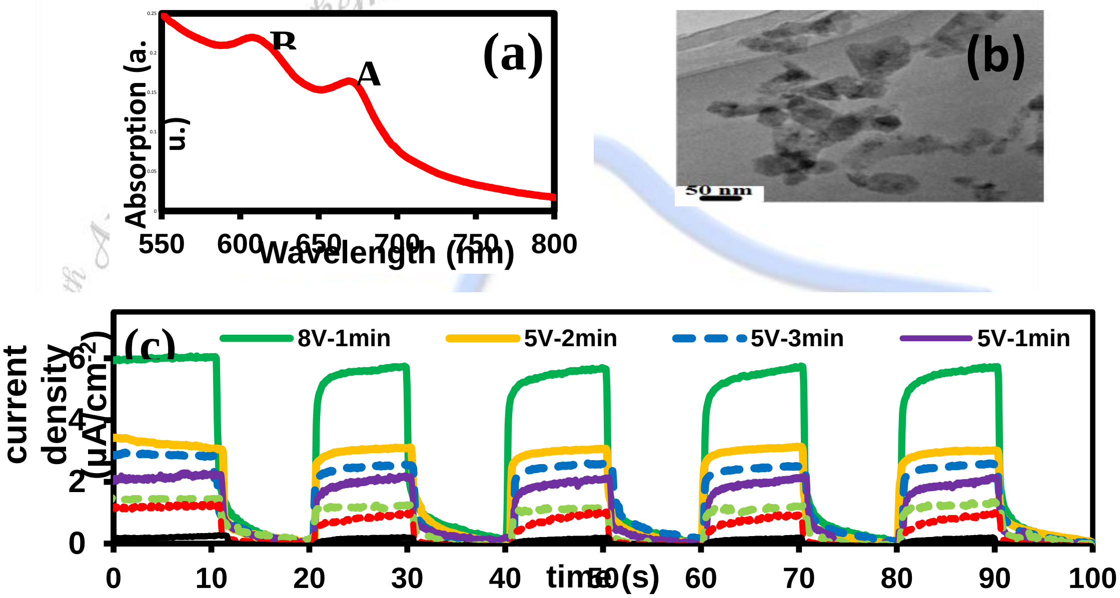

Figure 1: (a): UV-Visible absorption spectrum,(b) TEM images of the MoS_2few layers and (c) I-t curves of the MoS_2/ITO thin films prepared with various EPD experimental conditions under 500W Xe lamp.

Keywords: MoS_2 few layer, electrophoretic deposition, photoelectrochemical performance, visible light.

References

Preparation and evaluation of alkaline direct glucose fuel cell based on Pt free anode catalyst

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Abstract:

In this work, a direct glucose fuelcell that uses an anion-exchange membrane and non-platinum electrocatalysts in anode and cathode catalyst layer is developed.The resultsshow an open circuit voltage (OCV) of 0.917 V and a maximum power density(P_{max}) of 22mW cm^{-2} with 0.5 M glucose in1M of KOHat room temperature.

Keywords:*Glucose, Pt freeNanoelectrocatalyst,direct glucose fuel cell*

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TiO_2 Nanotube Arrays Grafted with Fe_2O_3 Nanoparticles as Integrated Electrodes for Lithium-Ion Batteries

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Abstract

Novel nano-heterostructures composed of Fe_2O_3 nano particle on both the outer and inner surface of the aligned TiO_2 nanotube arrays (TNAs) have been fabricated by growing Fe metal particles onto the TNAs, and then followed by thermal transformation to α-Fe_2O_3 in air. Owing to their structural advantages, such a exhibits superior electrochemical performance with a remarkable areal capacity of over 600 μA h cm^{-2} at a current density of 100 μA cm^{-2} (680 μA h cm^{-2} at 100 μA cm^{-2}). This structure might be easily integrated as a binder-free electrode for microscale lithium-ion batteries considering the improved performance and the simple synthesis.

Keywords**:** Titanium Nanotube, Iron Oxide, Anodizing, Li ion Battery, Anode Electrode.

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Non-Platinum Cathode ElectrocatalystsForDirect Methanol Fuel Cell

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Abstract

Fuel cell reactions invariably involve an oxygen reduction reaction (ORR) at the cathode, which is oneof the main rate-decreasing steps on platinum (Pt)-catalysts in the water formation reaction and energyconversion efficiency in direct methanol fuel cells(DMFCs). Platinum is the most effective electro-catalyst for oxidation and reduction processes in fuel cells. The Platinum scarcity and costhave led to the development of alternative catalyst materials for fuel cell applications. However, problems include low reaction rates, high over-potentials and low stabilities remain unsolved particularly for cathode catalyst.Recent efforts have focused on the discovery of palladium-basedelectrocatalysts with little or no platinum for oxygen reductionreaction (ORR).

Keywords**:** *Direct Methanol Fuel Cells (DMFCs), Non-Platinum Catalysts,Cathode,Oxygen Reduction Reaction (ORR).*

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Studing and performance comparing of membrane electrode assembly fabricated by Pt/N-rGO with Pt/Vulcane

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Abstract

Proton exchange membrane fuel cells (PEMFCs) are one of the most promising clean energy conversion devices due to their high conversion efficiency, low/zero emission, and high power/energy densities. Nitrogen doping has been an effective way to tailor the properties of graphene and render its potential use for various applications. We developed a simple chemical method to obtain bulk quantities of N-doped, reduced grapheme oxide (GO) powder through thermal annealing of GO in ammonia and hydrazine. Oxygen reduction and nitrogen doping were achieved simultaneously under the hydrothermal reaction. Electrochemical measurements and MEA performance show that the nitrogen doped graphene support has the better activity than Vulcan.

Keywords: *PEMFC, graphene, N-doped, Pt nano particle*

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Enhancement of electrocatalytic O_2 reduction on carbon supported Pt alloy nanoparticles in Proton exchange membrane fuel cells

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Abstract

Electrocatalytic activity of carbon supported Pt-Pd alloy electrocatalysts of different Pt Pd_x atomic ratios (x = 0.25, 0.5, 1 and 2) formed by the impregnation synthesis method, was investigated with regard to the oxygen reduction reaction (ORR) in sulforic acid solution. To improve the utilization and activity of cathodic catalysts for ORR reaction, the alloy nanoparticles were loaded on the mixture of Vulcan XC-72 and MWCNT (1:3), which were functionalized in the mixture of 96% sulfuric acid and 4-aminobenzenesulfonic acid using sodium nitrite to produce intermediate diazonium salts from substituted anilines. The performance of the electrodes for the ORR was measured using electrochemical techniques, inductive coupled plasma (ICP), X-ray diffraction (XRD) and transmission electron microscope (TEM). For the synthesized Pt Pd_x/C electrocatalysts, the highest catalytic activity for the ORR, was found for a Pt:Pd atomic ratio of 2:1 in acidic media. Since the sulfonation of carbon-supported catalysts as mixed electronic and protonic conductors is an efficient way to increase the triple-phase boundaries, the modified electrocatalysts showed better performance compared to unsulfonated one. A membrane-electrode assembly (MEA) has been prepared by employing of the modified carbon supported catalyst as a cathode for single cell test and characterized by polarization curves and impedance diagrams. The PEMFC test results indicate that the MEA prepared from modified Pt_2Pd/C cathode exhibits better performance compared to the MEA prepared from Pt/C (Electrochem), in terms of maximum power density and minimum charge transfer resistance.

Keywords: Pt-Pd alloy electrocatalysts, Modified carbon support, Polymer electrolyte fuel cell, Membrane–electrode assembly.

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Proton dissociation and water interactions in Nafion fuel cell membranes studied by first principle modeling

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Abstract

Proton conductivity property of Polymer electrolyte membranes (PEMs) in proton-exchange membrane fuel cells is dependent on the level of water absorbed by membrane. In this work, quantum mechanics (QM) modeling was adopted to attain in-depth understanding of proton dissociation and water interaction in Nafion PEM. For this purpose, Nafion model with one to six water molecules was considered for modeling. During modeling, geometries of all models were optimized by means of Hartree-Fock (HF) theory employing 6-31G** basis set [1] followed by density functional theory (DFT) [2-3] using B3LYP [4-5] first with 6-31G** basis set and then with larger basis set of 6-311G** [6].

Figure 1 presents the geometry-optimized structure of Nafion model solvated by different number of water molecules. Fully optimized structures indicate that proton dissociation of Nafion is occurred when its side chains is surrounded by at least three water molecules. These results imply that for proton dissociation phenomenon to occur in Nafion based PEMs at least three water molecules per sulfonic acid group are required. From this figure, it can be seen that by enhancing the number of water molecules from three to six, total number of hydrogen bonds of 5, 6, 8, and 10 is formed. It is also seen that at hydration level of three, the formed hydronium ion is in direct contact and interaction with sulfonic acid group, whereas at higher hydration levels, hydronium ion is separated from sulfonic acid group by one water molecule, which indicates that increasing hydration degree reduces the interaction between appeared hydronium ion and sulfonic acid group and thereby give rise to the intensified proton dynamics.

Keywords: *Polymer Electrolyte Membrane, Nafion, Proton Dissociation, Hydrogen Bonding, First Principle Modeling*

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Study of methanol solvent effects on aromatic fuel cell membrane behavior using molecular dynamics simulations

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Abstract

Sulfonated poly(2,6–dimethyl–1,4–phenylene oxide) polymer electrolyte membranes (PEMs) have been widely investigated as promising direct methanol fuel cells (DMFCs) membranes [1]. Various experimental studies characterized proton conductivity and methanol permeability in different SPPO membranes, which greatly affect performance of DMFCs [2-3]. However, MD simulation studies of these membranes were not carried out in earlier works. In the current research, the effects of methanol solvent molecules on properties of pure SPPO membranes were examined using MD simulations. For MD simulations, five methanol weight percents (wt%) (20, 40, 60 and 80) were selected. MD simulations were conducted on three-dimensional (3-D) cubic amorphous cells by making use of DREIDING force filed for SPPO [4], flexible 3-centered (F3C) force field for water [5] molecules, and OPLS-AA parameters for methanol molecules [6].

Figure 1 (a) and (b) displays the RDFs of sulfur atoms of sulfonic acid groups towards the oxygen atoms and methyl groups of methanol solvent, respectively, for methanol concentrations from 20 to 80 wt%. A peak in S–Om RDFs occurs at 3.66 Å, while it is observed in the range of 4.26–4.86 Å for S–Cm RDFs. It is seen that with increasing the methanol concentration, the height of the observed peak enhances for both S–Om and S–Cm RDFs. Since an increase in methanol concentration is accompanied by a decrease in the number of water molecules, the higher peak intensity at higher methanol uptakes of membrane is owing to the lower water screening effect on methanol molecules. Parts (c) and (d) in Figure 1 indicate the Os-Om and Os–Cm RDFs, respectively. A peak with greater height is observed at 2.82 and 3.42 Å in Os–Om and Os–Cm RDFs, respectively, for all values of methanol concentration. The trend of these two RDFs against methanol concentration is the same as that of S–Om and S–Cm RDFs. Existence of a high peak in RDFs of sulfonic acid group with regards to methanol, which is as a result of the

hydrogen bonding interaction between hydroxyl hydrogen atom of methanol and sulfonic acid oxygen atoms, implies the appearance of methanol solvation shell around anionic sulfonic acid groups. Therefore, it could be inferred that the presence of methanol molecules can help the phase segregation of SPPO membranes.

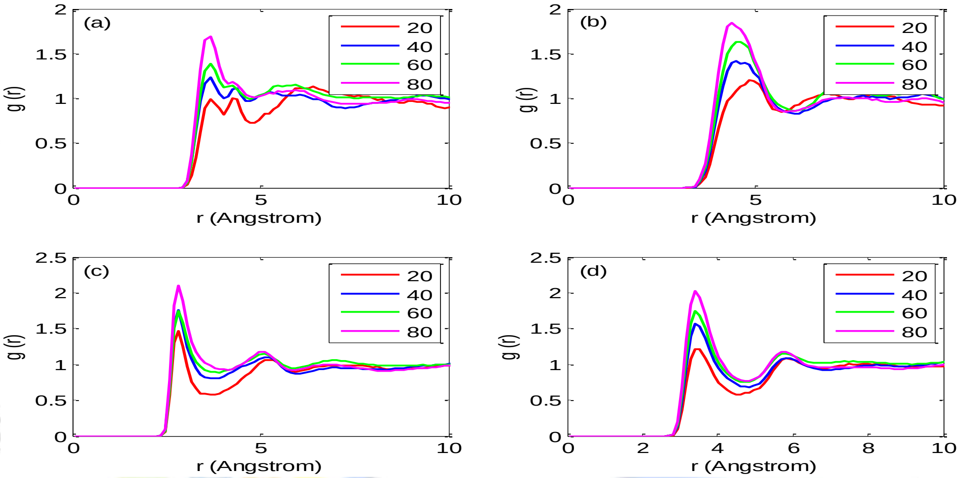

Figure 1: RDFs of (a) sulfur(sulfonic acid group)–oxygen(methanol), (b) sulfur(sulfonic acid group)–methyl(methanol), (c) oxygen(sulfonic acid group)–oxygen(methanol) and (d) oxygen(sulfonic acid group)–methyl(methanol) for different methanol concentrations.

Keywords: *Polymer Electrolyte Membrane, Sulfonated poly(2,6-dimethyl-1,4-phenylene oxide) (SPPO), Methanol Solvent, Molecular Dynamics Simulation*

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Direct isomeric alcohol fuel cells with Pd|CC anode catalyst

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Abstract

The comparative studies of methanol, ethanol, 2-propanol and 2-butanol electrooxidationwere carried out on CCE potentiostatically modified with Pdnano-particles. The Characterization of catalytic layer by SEM, EDXand XRD indicated that welldispersedcatalytic particles with high density have been formed on CC substrate. CV,CA and EIS were used to investigate the alcohols oxidation reactions.

Keywords: *A*lkaline fuel cell; *I*someric alcohol; *P*alladium.

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Application of CuBDCMetal Organic Framework as electrocatalyst for hydrogen production

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Abstract

There are several ways to produce hydrogen including hydrolysis, thermal catalysis and thermochemical, photocatalysis, photoelectrocatalysis, steam reforming, gasification and electrolysis. In the electrochemical production of hydrogen, platinum (Pt) is an excellent electrode for hydrogen generation, but it is expensive and its present resource is very limit. Therefore we should look for a suitable alternative to Pt.There are very rare report on using metal- organic framework (MOF) as electrocatalyst for hydrogen evolution reaction (HER). In this study CuBDCMOFwas used as a HER electrocatalystin carbon paste electrode (CPE). The performance of the proposed modified CPE for electrochemical hydrogen production was studied by cyclic voltammetry, linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS) and chronoamperometry techniques. For optimization of conditions some parameters including catalyst percent,paste binder amount and pH was changed and their effect on HER was evaluated. The best performance was obtained for 25% catalyst, 30% binder and 2 M H_2SO_4 solution. In addition, a promisingresult showed that by applying successive CVs the current density increases.

Keywords*: *Carbon paste electrode, Electrocatalyst, Metal–organic framework, Hydrogen production

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Molecularly imprinted polymer (MIP) electrochemical sensor based on graphene modified platinum electrode for sertraline determination

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Abstract

In this paper, a novel molecularly imprinted polymer (MIP) electrochemical sensor for selective detection of sertraline has been developed by coating a very thin layer of polymer onto a support, so that all of the binding sites at the surface of the polymer access easily to the target molecules. Graphene were used because of their high mechanically and chemically stability, high electrical conductivity and large surface areas as the platform of the polymer, that makes the graphene/MIP an excellent electrical transducer for direct electrochemical sensing. The molecularly imprinted polymer was synthesized by precipitation polymerization, using sertraline hydrochloride as a template molecule, methacrylic acid as a functional monomer and ethylene glycol dimethacrylate as a cross-linking agent. The sensor was developed by dispersing the sertraline imprinted polymer particles in DMF solvent and embedding the suspension obtained on the graphene modified Pt electrode. A $K_3Fe(CN)_6$/ $K_4Fe(CN)_6$ redox couple was used as a probe to characterize the sensor by using cyclic voltammetry & differential pulse voltammetry methods.

The sertraline binding experiments indicated that the graphene-Pt electrode modified by MIP have higher adsorption ability than the non-imprinted polymer graphene modified Pt electrode. Factors affecting the response of the sensor such as composition of MIP suspension, extraction pH and preconcentration time were optimized. Under optimized condition the sensor modified by MIP-graphene exhibited good sensitivity(1.2×10^6 µA L mol^{-1}) for sertraline with a linear range of 1.0×10^{-8} to 1.0×10^{-6} mol L^{-1} ($R^2 = 0.9846$) and detection limit of 7.2×10^{-9} mol L^{-1}. The sensor was successfully applied for determination of sertraline in human serum sample with recovery values in the range of 98.2–103.5%

Keywords: Sensor, Molecularly Imprinted Polymer, Geraphene, Sertraline.

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Study of platinum electrodeposition on carbon paper as electrocatalyst for oxygen reduction reaction

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Abstarct

A PEMFC is a device that converts the chemical energy of a fuel directly into electrical energy by electrochemical reactions.When hydrogen is used as the source of the fuel, the byproduct is essentially the pure water. PEMFC has attracted plenty of interest for various applications such as power sources for stationary power generation, transportation, and portable electronic applications. The proton exchange, or polymer electrolyte, membrane fuel cell (PEMFC) combines a series of interesting features such as high energy density, low temperature operation, long stack life and fast startup, which make them suitable for stationary and portable applications. Nevertheless, some economical and technical challenges must be overcome before getting their wide massive commercialization. Among them, the electrodes fabrication constitutes an important factor in the total PEMFC cost. Metal electrodeposition is able to become a simple and cheap method to obtain electrodes with low Pt loadings, having many degrees of freedom originated in the numerous variables that can be manipulated (as electrolytic solution composition, temperature, type of electrical signal, time of application, etc.) [1, 2]. In this study, preparation of platinum electrocatalyst was performed by electrodepositing of platinum on carbon paper electrode. Substrate is fabricated by applying carbon Vulcan and polytetrafluoroethylene paste (70:30) on carbon paper and then it was dried by heating in 80 ^{0}C for 2 hours.The as-prepared substrate expose to following precursor solutions for 45 minutes: H_2SO_4 (0.03 M) , Na_2SO_4 (0.27 mM) and H_2PtC_6 (0.16 mM). Then Cyclic voltammetry (CV) (50 mV/s, 1.20 to − 0.60 V vs. Ag/AgCl sat KCl) were applied at various scan rates up to 40 cycles. The fabricated electrode was used to study oxygen reduction reaction. Lenear Swepping Voltammetry (LSV) and Electrochemical Impedance Spectroscopy

(EIS) were determined then 10 CV scans (50 mV/s, 1.20 to − 0.60 V vs. Ag/AgCl sat KCl) were applied on the as-prepared electrode and LSV and EIS determind again.

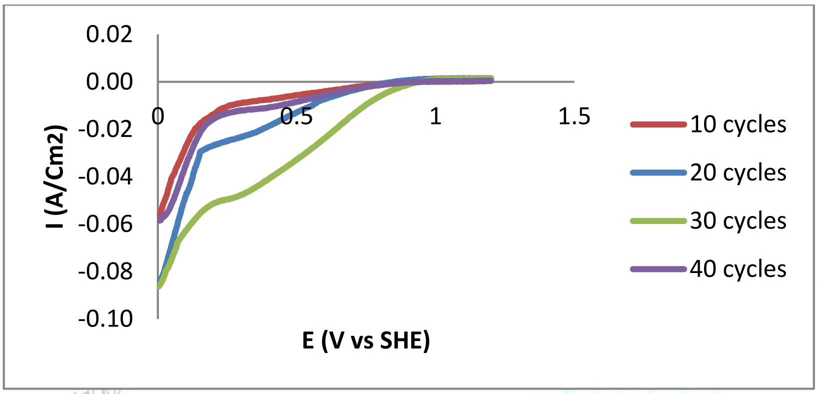

Figure1- LSV diagrams of prepared electrodes for oxygen reduction reaction

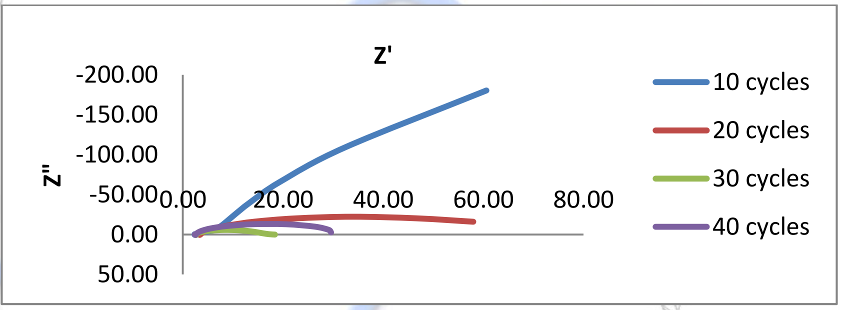

Figure 2-EIS diagrams of prepared electrodes for oxygen reduction reaction

As it was shown, the optimized condition for preparation of electrodes for oxygen reduction reaction was achived at electodeposition solution with 0.16 mM H_2PtCl_6 and 30 CV cycles.

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Design and development of unmanned aerial vehicles using fuel cells

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Abstract

This paper deals to design and simulation of a small unmanned aircraft fly, using cell fuel cell, fuel cell systems, is proposed, combined with a hydrogen generator, as a new power source, replace the battery. Hydrogen generator is built using a catalytic hydrolysis reaction with creating hydrogen from alkali solution of sodium boron hydride and a reactor, a separate pump and fuel cartridges, according to the characteristics of performance of fuel cell, Energy management and mixture power is made from a fuel cell, a fuel cell stack battery. Hydrogen generators and power management systems have been studied in different load conditions.

Keywords: unmanned aircraft, fuel cells, sodium boron hydride, hydrogen generator, flight testing, system power management

Fabrication of electrochemical nano- structured sensor for determination of atrazine contaminants in waste and tape water

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Abstract

In this research work, the surface of gold bare electrode is modified with a thin layer of electro polymerized poly pyrrole containing doped Nickel and Cobalt nanoparticles this modified electrode was used determine Atrazine pesticide pollutants in water and waste waters with good accuracy and precision in analysis.

The sensor has a good response to Atrazine the optimum pH=9 and adjusted by Britton –Robinson Buffer under other optimized chemical and instrumental parameters .

In this experiment cyclic voltametric techniques was used for the study of electrochemical reactions and scanning electron microscopy was used to study the morphology of the electrode structure ranges from a linear containing from 0.01to 1oo nM with the detection limit of 0.009 nm high signal to noise ratio a wide linear range of response high sensitivity and good selectivity of sensor is its unique advantages.

keyword: nano sensors , differential plus voltametric , modified electrode herbicide Atrazine

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