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مجتمع صنعتی سپاهار

Application of aliphatic alcohols in fuel cells

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Fuel cells, the energy converting devices with a high efficiency and low or zero emission are attracting increasing attention in recent decades due to high energy demands, fossil fuel depletion and environmental pollution [1,2]. Carbon ceramic electrode, a new electrode substrate, was prepared by sol-gel procedure [3] and used for the electropolymerization of aniline and dispersion of platinum nanoparticles into the resulting polyaniline film. Aniline monomers were polymerized on carbon ceramic electrode by cyclic voltammetry. Then its surface was potentiostatically coated with Pt nanoparticles at -0.2 V (vs. SCE).

The effects of various parameters on the electrooxidation of methanol and ethanol at this modified electrode (CCE|PANI|Pt) such as, thickness of the polymer film, amount of platinum loadings, medium temperature, working potential limit in anodic direction, and potential scan rate were investigated.

Keywords: Carbon ceramic electrode, Methanol, Ethanol, Nanoparticles, Polyaniline.

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Electrochemical behavior of organic expander's up-414 and VS-A on Lead electrode in sulfuric acid

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Energy Resources Development of Organisation

Lignosulphonate is used as negative plate additives in Lead-acid batteries. This compound is more effective on lead-acid battery performance due to producing a porous film that enhances the reactant and product transport.

The purpose of this test is to compare the effect of VS-A and UP-414 with different concentrations (10, 20, 30, 40, 50,100ppm) on the performance of the lead negative electrode. The electrochemical method has been used to compare two following additives: cyclic voltammeter and electrochemical impedance.

Some modifications are visible on the cathodic branch: in the presence of the expander the cathodic peak is broader, and presents some shift on cycling towards negative potentials. In 20 ppm of VS-A concentrations, the anodic peak-current increases to a limited extent on cycling up to about 300 cycles, also in 20 ppm of UP-414 Concentrations, the anodic peak current tend to increasing up to about 300 cycles and more than it. The comparison, fig 5 and 8 shows that the result of I_{max} in UP-414 is more than VS-A. The results of research on negative plate are according to electrochemical cyclic voltammetry and impedance spectrometry on smooth lead techniques. The aim of our research is examination of optimum concentration of additives by combining electrochemical techniques on pasted electrodes.

nt important actions of the organic additives such as adsorption on lead and kinetics of electrochemical reactions.

Keywords: Electrochemical method; Lignosulphonate; Lead-acid battery; Negative plate.

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Hydrothermal preparation of TiO_2-Graphene oxide nanocatalysts and study of the electrochemically behavior of glassy carbon surface

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Fuel cells are considered as one of the promising green, reliable and efficient power sources in the current century[1]. In batteries and fuel cells, electrical energy is generated by conversion of chemical energy via redox reactions at the anode usually take place. The major avantages include electrical efficiencies of up to 60%, High energy densities (relative to batteries) and low emissions[2]. In this work, an environmentally friendly and efficient for the preparation of graphene oxide-titanium oxide (GO-TiO_2) nanocomposite with hydrothermal process was demonstrated. Graphene sheets have excellent mechanical, electrical, thermal and optical properties[3]. 2-D carbon nanostructure, such as graphene and its derivatives, were used as a support material for the dispersion of TiO_2 nanoparticles provides new ways to develop advanced electrocatalyst materials for fuel cells. Synthesis process was done in 2 steps: a) graphene oxide (GO) nanosheet were synthesized using the simplified Hummers method[4]. b) Coating of TiO_2 nanoparticles on the GO sheet by hydrothermal method. Amount of the GO in the nanocomposite is one of the important and effective parameters on the efficiency of the fuel cells, so in this study this challenge was studied in the various ratio. Structure and composition has been characterized by FT-IR and X-ray diffraction. The electrochemical behavior of GO_x-TiO_2 nanocomposite was investigated by cyclic voltammetry. In the other hand, ionic conductivity was measured by AC impedance spectroscopy. Results show that the incorporation of TiO_2 nanoparticles with graphene oxide significantly enhanced the electrochemical reactivity on Volta-metric response of nanocomposite. The impedance results show the conductivity enhancement in the GOx-TiO_2 nanocomposite. It is expected that the hybride material could also be promising for various other applications including lithium batteries, where strong electrical couping to TiO_2 nanoparticles is essential.

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Electrochemical performance of MnO_2/Carbon black nanoparticles for supercapacitor electrodes

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A supercapacitor is a charge storage device between the traditional electrostatic capacitor and the rechargeable battery. It has been used as an energy storage system for portable electronic devices, backup power sources, and hybrid electric vehicles due to its high power, energy density, and long cycle life [1–6].The electrode for the supercapacitor include, carbon materials, transition metal oxides (TMs), conducting polymers (CPs) [7] and hybrid systems, consisting of carbon/TMs [8], carbon/CPs [9], TMs/ CPs [10,11], or all three phases, i.e., carbon/TMs/CPs [12], are commonly utilized and hence have been studied for their energy storage capacities to be improved using their synergistic effect [13, 14-16]. in the present study, the electrodes in the form of transition metal oxide/carbon black were prepared in one step: manganese oxide was coated on carbon black by a direct coating method by the reduction of $KMnO_4$. The effect of MnO_2 on the electrochemical performance and cyclic stability of MnO_2/carbon black is investigated From the cyclic voltammograms. the MnO_2/carbon black show remarkably enhanced specific capacitance and cycle stability compared to carbon black, where the highest specific capacitance (121 F/g) is obtained at scan rate of 10 mV/s as compared to 44.87 F/g for Carbon black. This indicates that the improved electrochemical performance of MnO_2/Carbon black is due to the enhanced electrical properties by MnO_2 nano particles that leads to the increased cycle stability.

Key Words: Supercapacitor, MnO_2, Carbon black, Electrochemical performance.

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Preparation of TiO_2-Co-MWCNT Nanocomposite Electrode by Electrophoretic Deposition and Electrochemical Study of Hydrogen Storage

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Electrochemical hydrogen storage of nanocomposite multi-walled carbon nanotubes (MWCNTs) decorated by TiO_2-Co nanoparticles (NPs) has been studied by the galvanostatic charge and discharge method. The TiO_2-Co NPs have been synthesized by sol-gel method. The results of the SEM showed that the size nanoparticle size is ~50 nm. The TiO_2-Co NPs are deposited on the surface of MWCNTs by electrophoretic deposition method (EPD). EPD allows an efficient deposition of CNT films of controlled thickness and homogeneous microstructure on conductive substrates. EPD has the advantages of short formation time, simple set-up, low cost, and suitability for mass production. In general, EPD consists of three important steps: particle charging, particle transport under the applied electric field, and the deposition of particles with neutralization structural [1]. Morphological characterizations have been carried out using XRD, SEM and respectively. TiO_2-Co NPs can significantly enhance the discharge capacity of MWCNTs [2]. The MWCNTs modified with a certain amount of TiO_2-Co NPs have a discharge capacity of 600 mAh/g, corresponding to an electrochemical hydrogen storage capacity of about 2.02 wt%, which is quite interesting for the battery applications. The enhancement effect of TiO_2-Co NPs on the discharge capacity of MWCNTs could be related to the increased effective area for the adsorption of hydrogen atoms in the presence of TiO_2 [3] and improvement the catalysis efficiency of electrochemical oxidation of hydrogen by cobalt on MWCNTs [4] and also the preferable redox ability of TiO_2-Co NPs.

Keywords: Hydrogen storage, Electrophoretic deposition, MWCNT, TiO_2.

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Electrochemical investigation of redox and hybrid supercapacitors

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Electrochemical supercapacitors have gained great interest in many advanced power systems requiring high power density, and high cycle ability, such as in electric/hybrid vehicles, portable computers, cellular devices and nano-electronics. The capacitance of supercapacitors can be divided into two basic types according to its charge storage mechanisms: the one is electrical doublelayer capacitance C_{dl}, which is generated from charge separation at electrode/electrolyte interface, and it is determined by the effective surface area and the dielectric constant of the electrolyte; and the other is pseudo capacitance C_p, which is generated from fast faradic reactions of the electrode material. Materials employed to assemble supercapacitor are mainly focused on carbon, metal oxides and electrically conducting polymers (ECPs). The charge storage of carbon is mainly produced from electrical double-layer capacitance mechanism, and the maximum available specific capacitance (Cs) of carbon has reached up to 320 F g^{-1}. The charge storage of RuO_2 is mainly produced from the pseudo capacitance mechanism, and the available C_s of RuO_2 has reached up to 1170 F g^{-1}. But RuO_2 is currently too expensive to be commercialized. ECPs have an advantage over noble metal oxides on their low cost, and have an advantage over carbon materials on large pseudo capacitance [1, 2].

Poly tyramine (PT) with different size and composites with MWCNT and TiO_2 on graphite working electrode were prepared by cyclic voltammetry (CV) and normal pulse voltammetry (NPV) techniques in solution of $HClO_4$ and 0.01M monomer. The electrochemical properties of PT film investigated by impedance spectroscopy (EIS) in frequency range of 100 kHz to 10 mHz. CV, EIS and galvanostatic charge/discharge methods have been applied for characterisation of different forms of the polymers. The diffusion of counter-anions in PT is confirmed to be the rate determining step during the redox. This process degrades the charge/discharge capability of PT. Based on these factors, the experimental values for capacitance are much less than the theoretical one. In order to improve the performance of supercapacitors, the homogeneous PT nanostructures and nanocomposite with large surface area prepared to modify the substrate.

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Comparison of Graphite and Graphene oxide effect as a additive into cathode composition on Zn-air battery efficiency

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Recently, zinc–air batteries have gained more attention due to its high practical specific energy (~350 Wh kg^{-1}), low cost steady performance and environmentally benign materials. The key problem in development of Zn–air batteries is the oxygen-diffusion electrode. Usually, it is a porous, carbon-based oxygen-diffusion electrode consisting of a mixture of catalysts and carbon [1-3].

In this study, cathode catalyst of Zn-air battery based on graphite and graphene oxide was compared. Gas diffusion electrode is made of 18% KOH, 52.5% graphite, 10% polytetrafluoroethylene (PTFE), 7% CMC and 12.5% catalyst. To investigate of graphene oxide effect 2% of graphite replaced with graphene oxide. graphene oxide was synthesized by modified hummer's method. Synthesis of graphene oxide was approved by XRD, SEM, FT-IR, RAMAN. Electrochemical investigation was done by LSV, EIS and CV of graphene oxide effect on oxygen reduction reaction in cathode and chronopotentiometry in 2, 5 and 10 mA was applied to evaluation of its effect on battery efficiency. Electrochemical results indicate that current for oxygen reduction reaction was improved 7 times by second catalyst and resistances of the electrodes to current in second catalyst catalyst was 0.5 times lower in the first electrode. Capacity of the first electrode in chronopotentiometry corresponding to current were 95.41, 37.55 and 0.27 mAh/g respectively and for second electrode were 257, 82, 2 mAh/g, respectively. We found catalyst based on graphene oxide suitable to battery construction.

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Preparation of nickel nanoparticles modified electrode by electrolysis method and its application in methanol fuel cell

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Introduction: The development of alternative power sources is an important issue at present. Direct methanol fuel cells (DMFCs) have attracted considerable interest for application in automobile and portable consumer electronics. The use of methanol as a fuel has several advantages, where the energy density of methanol is twice that gained from the liquid hydrogen, in addition to its rapid start up and operation. Methanol is a liquid at normal ambient temperatures, thus it can be easily and inexpensively stored and transported. It is handled much like gasoline and diesel fuel. Moreover, methanol is independent on crude oil, a vital factor with the demand for constant increased mobility and is easily obtained from natural gas or renewable biomass resources [1]. Since the kinetics of methanol oxidation reaction are slow and incomplete, a catalyst is required in order to improve the oxidation efficiency. The purpose of the present work is to study the electrocatalytic oxidation of methanol using Ni nanoparticle modified graphite electrode in solution of 1 M NaOH.

Method: In this study, nickel nanoparticles were deposited on graphite electrode with an electrolysis procedure. Then the morphology of the electrode surface was inspected with scanning electron microscopy (SEM) and the chemical structure was examined with X-ray diffraction (XRD) method. The proposed modified electrode was used for electrocatalytic methanol oxidation in alkaline media.

Results: SEM images showed that the Ni nanoparticles size is about 40 nm.XRD pattern illustrated that the coated particles are only Ni. According to cyclic voltammetry studies, the proposed electrode catalyzed methanol oxidation in alkaline solution via Ni^{+3} species (mainly NiOOH). In first step Ni atoms in NaOH solution change to Ni(OH)$_2$, next by applying positive potentials Ni(OH)$_2$ change to NiOOH [2]. This electrochemical reaction is reversible [3]. Cyclic voltammograms with different scan rates was applied on the electrode surface, and a linear relation between anodic peak current and scan rate was observed, which means the electrochemical reaction is surface confined. In addition, a shift in peak potentials with scan rate is observed, which may be due to kinetic limitations.

Conclusions: The introduced electrode is very simple and cheap with a low overvoltage for methanol oxidation (about 0.4 V).

Keywords: Fuel cell, Ni nanoparticles, Electrocatalyst, Methanol.

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Electrochemical behavior of copper oxide and zinc in alkaline electrolyte as electroactive materials to use in Zn-CuO battery

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The fast growth of portable electronic devices, as well as developing requests such as electric trucks and renewable energy storage, has driven the need to develop tolerable, high energy-density (energy stored per unit mass or volume) and affordable storage devices [1]. So, here Zn-CuO alkaline battery is investigated because of its some advantages, such as zinc metal as anode is relatively economical and abundant [2]. In the other hand, copper oxide is an attractive cathode active material as it is inexpensive, relatively non-toxic, and has acceptable specific charge[3] .

The study of the Zn-CuO battery was performed in three steps: at first electrochemical behavior of its both active materials were separately investigated in an alkaline electrolyte versus a graphite electrode at low current rate regimes. Then two active materials were investigated simultaneously. Moreover, the effect of the electrolyte on the battery performance was studied. Here, cyclic voltammetry and chronopotentiometry were used as two important techniques.

The results show that in the Zn cell deposition of zincate ions on the cathode and anode surfaces reduce discharge life of the cell after a few consecutive charge/discharge cycle. But the CuO cell discharge life don't decrease with continues charge and discharge. Additionally in CuO cell increasing charge current rate decreases discharge life. Eventually, changing the charge current rates don't have considerable effect on the Zn-CuO battery discharge cycles.

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Electrochemical synthesis of nano manganese oxide and investigation of its electrochemical behavior as electroactive material for energy storage devices

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Manganese oxide nano structures were prepared via two combined electrochemical methods, cyclic voltammetric deposition mode in combine with galvanostatic or potentiostatic deposition modes. Synthesis was performed at room temperature, and the deposition bath was composed of 0.1M $MnSO_4$ and 0.1M Na_2SO_4 and 0.2 M $NaCH_3COO$ at the pH of about 6.5. four electrode system, a nickel sheet (area: 1.8 cm^2) as working electrode, two other nickels as counter electrodes, and a mercury/mercurous sulfate electrode (MSE) as a reference electrode, used for electrodeposition. cyclic voltammetric part of deposition was carried out at the potential range of (0-350 mV) vs. MSE, at a scan rate of 500mV/s, galvanostatic part was performed at the current density of $4mA/cm^2$, and the potentiostatic mode was carried out at the constant potential of 350 mV vs. MSE, with the control of deposited mass to be about 1.2 mg cm^{-2}. Scanning electron microscopy (SEM) and X-Ray diffraction (XRD) were used to study the morphology and crystal structure of the deposited films. Electrochemical properties of as prepared films were investigated via cyclic voltammetry and also electrochemical impedance spectroscopy (EIS) techniques, as the active electrode material of primary alkaline Zn/MnO_2 batteries and electrochemical supercapacitors. According to electrochemical tests, the film prepared via combined cyclic voltammetric-potentiostatic deposition technique show better supercapacitive behavior. Also combined cyclic voltammetric- galvanostatic deposition mode resulted in the formation of manganese oxide with better electrochemical activity as an alkaline battery electrode.

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Chemical Study of Electrochemical Cells

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The method by which each cell is able to convert input electrical energy into stored chemical energy, and stored chemical energy into electrical energy is through an oxidation-reduction, or redox reaction. Through oxidation and reduction, electrons are able to be transfered from one substance to another. Through oxidation electrons are lost, and through reduction electrons are gained (so when both oxidation and reduction occur, electrons leave one substance and make there way to another). This process becomes more understandable when we consider the three primary parts of an electrochemical cell: the negative electrode and positive electrode (sometimes referred to as the anode and cathode, respectively, although these descriptors change during charge and discharge), and the electrolyte (the medium for electron transfer between the two electrodes. During charge and discharge externally (between the electrodes and the external circuit) electrons flow, and internally (between the electrodes within the cell) ions flow (cations and anions, or positively and negatively charged ions, respectively, and together this completes an electric circuit. Chemically, the result of charge and discharge is to change the composition of the cell from one set of chemical species to another, then back again, and ideally the reversibility of this reaction could go on indefinitely, however, the equations presented here are a simplification of the actual reactions that take place, and those are unique for each type of electrochemical cell.

Electrochemical behavior investigation of different cathodes in reserve lithium batteries

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Organization of Development of Energy Sources

From the invention of the reserve lithium battery, chromates, oxides, sulfides and bisulfides materials have been used as the cathode. Chromate materials, e.g. calcium chromate and potassium dichromate, which possess high electrochemical capacity, are capable of providing high power while, their main drawback is sensitive equilibrium between chemical and electrochemical reactions. Oxide materials, e.g. tungsten oxide and vanadium pentaoxide, though having very good thermal stability, suffer the potential drop during the service life of the battery. Sulfide materials, e.g. copper sulfide and iron sulfide, having low electrical resistance ,during the service life go thorough phase transformations.

Eventually, the materials based on bisulfides, e.g. iron bisulfide and cobalt bisulfide, which nowadays have the most application as the cathode material, suffer the disadvantages of relatively complex refining treatments and high sensitivity to production method though having good electrochemical capacity. In this article, the requirement for selection of the materials for the cathode in the reserve lithium batteries is discussed and the electrochemical behaviors of these materials are investigated.

Keywords: Reserve lithium battery, Cathode, Iron bisulfide, Cobalt bisulfide

Electrochemical investigation of the anodes in the primary lithium batteries

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Organization of Development of Energy Sources

In this article, the history of the anode materials developed for use in the primary lithium batteries is presented. Different chemical compositions and electrochemical characteristics (discharge mechanisms) of these materials are described, along with general thermodynamic properties, where available.
LiCl-KCl electrolyte salt is used in this primary battery at temperatures of 400~450^{o}C. Iron sulfide compounds are employed as the active material for the positive electrode with either elemental lithium or a solid lithium alloy as the anode.

Keyword: Primary lithium batteries, Anodes, Active material

Electrochemical investigation of the reserve lithium batteries

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Organization of Development of Energy Sources

In lithium batteries two kinds of chemical reactions happen to produce the electrical current and transform the potential energy into the electrical type. First the oxidation reaction in which the heat source with external energy release the energy in the form of heat and the heat required to melt the electrolyte is provided. Then, the electrolyte melts and electrochemically reacts with the cell, ionizing the electrolyte and the anode and cathode are oxidized and reduced respectively.

Keyword: lithium battery, solid electrolyte, melting point

Study of electrochemical properties and surface morphology of PbO_2 on lead levels in bipolar battery Pb, PbO_2 electrochemical impedance spectroscopy method

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Organization of Energy Sources Development

As the positive active material of lead-acid battery, microstructure and surface morphology of lead dioxide (PbO_2) have a strong influence on the overall performance of lead-acid battery. In this paper, we fabricated a series of PbO_2 thin films on the pure Pb surface by means of the electrochemical oxidation of Pb substrate and used the as-fabricated Pb electrodes coated with PbO_2 thin films as the model electrodes to study the dependence of electrochemical properties of PbO_2 materials on their microstructure and morphology, thereby providing necessary technical basis for the improvement of electrochemical performance of PbO_2 active materials. Herein nanostructured PbO_2 thin films were electrochemically prepared using a galvanostatic oxidation method in dilute H_2SO_4 solution. The electrochemical properties of the PbO_2 films with different structure and morphology were investigated by using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and constant current charge/discharge methods. The results demonstrated that the PbO_2 layer formed at a current density of 10 mA cm^{-2} possessed the higher discharge capacity and the better cycle performance than the other PbO_2 layers, due to high surface area, relatively small and uniform size, and especially good connectivity between PbO_2 nanoparticles. The possible factors that affect electrochemical properties of different PbO_2 thin films were interpreted in detail.

The Effect of Density and Plate Group Compression in Absorptive Glass Mat Valve Regulated Lead-acid Battery

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By progress of power industry during the past decades, the demand for sufficient amounts of reserve energy and power has been increased. The more low cost source of reserve power is the lead-acid battery. However, the maintenance of these batteries is fairly expensive. One of the attempts to resolve this problem was aimed at recombining hydrogen and oxygen by the use of valve regulated battery design. These batteries differ from the conventional flooded lead-acid battery and contain only a limited amount of sulfuric acid that immobilized in a separator or gel. The cells in VRLA batteries have a pressure relief valve which facilitates the closed oxygen cycle (COC) within the active block. In AGM batteries a highly porous and absorbent mat acts as separator and electrolyte reservoir.

In this work which is done at Sepahan Battery Industrial complex, effect of electrolyte density and degrees of plate group compression on capacity of discharge and cycle life have been investigated.

As the volume of electrolyte in the battery was confined to the amount that the AGM separator could absorb and according to the role of the sulfuric acid in the batteries as electrolyte, its density should be increased. In other hand, increasing of electrolyte density causes a substantial drop in capacity of the positive plates, so different batteries with various electrolyte density investigated and optimized electrolyte density achieved. Increasing the plate group compression indicates the improvement of life cycle of battery.

Key words: Valve regulated lead-acid battery, Absorptive glass mat, Closed oxygen cycle.

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The Effects of Sulfuric Acid /Lead Oxide Ratio, Pasting Temperature and Curing Temperature on Cycle Life of Battery

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Changes in operating condition, technology and production method causes differences in battery properties. The active material on the positive plates is mainly a mix of lead oxide and sulfuric acid. In order to achieve a porous structure with a high surface area for the electro-chemical process, the pasted positive plates undergo a curing process to transform the lead oxide and lead sulfate into basic lead sulfates- either 3BS (tribasic lead sulfate) or 4BS (tetrabasic lead sulfate).

A field study carried out at the Sepahan Battery industrial complex, to prepare batches of lead oxide with predefined sulfuric acid/lead oxide ratio, pasting temperature and curing temperature. Quality control and laboratory routine analysis using X-ray diffraction and SEM techniques were conducted after drying process for detection of 3BS and 4BS percentage in the positive active mass. For each experimental run, some batteries were assembled using positive plate made from the obtained paste. Finally these batteries were subjected to some performance tests such as capacity, cycle life, cold-cranking ability and etc. according to EN standard.

The results indicated that the capacity and cycle life of the battery depends greatly on the structure of the active materials. The active mass obtained from 4BS paste proved to have longer cycle life and less initial capacity than that produced from 3BS paste.

Key words: Lead-acid battery, Positive electrode, Cycle life, Tribasic lead sulphate, Tetrabasic lead sulphate, Pasting temperature, Curing temperature.

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Synthesis and characterization of methyl benzyl alcohol–formaldehyde based carbon aerogels as a catalyst support in fuel cell

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The increasing demand for reliable power sources in today's power hungry portable electronics has promoted the development of integrated systems for micro fuel cells[1].carbon aerogels have been used as catalyst supports for fuel cell applications. Carbon aerogels have fundamental properties such as high conductivity, high mesoporosity, a relatively small degree of microporosity, and high surface area that potentially make them more suitable electrocatalyst supports than carbon blacks[2]. In this work, we synthesized Methyl- Benzyl Alcohol (MBA) – Formaldehyde (F) carbon aerogels (MBAF) in an aqueous alkaline (NaOH) solution by sol-gel process followed by drying at ambient pressure and carbonization. The gelation temperature was 348K to cure for 7 days. Upon pyrolysis of the organic aerogels at 1173 K, MBAF carbon aerogels were produced. The mole ratio of MBA to F (MBA/ F) was selected in 0.5, and the mole ratio of MBA to NaOH (MBA/ Cat) was studied in 50, 60. Scanning electron microscopy (SEM), thermal gravity analysis (TGA), and Brunauer–Emmett–Teller (BET) analysis, were used to study the obvious chemical and physical changes of aerogel microstructures in detail. The results indicated that the microstructure of carbon aerogels can be effectively controlled and tailored by varying the synthetic conditions during the initial sol–gel process.

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A rechargeable Zn/Poly aniline-Graphene oxide nano composite battery

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The exciting development of advanced nanostructured materials has driven the rapid growth of research in the field of electrochemical energy storage (EES) systems which are critical to a variety of applications ranging from portable consumer electronics, hybrid electric vehicles, to large industrial scale power and energy management. Owing to their capability to deliver high power performance and extremely long cycle life, electrochemical capacitors (ECs), one of the key EES systems, have attracted increasing attention in the recent years since they can complement or even replace batteries in the energy storage field, especially when high power delivery or uptake is needed. Graphene oxide Due to its high specific surface area, good chemical stability and outstanding electrical properties is one of ideal candidates for next generation energy conversion and storage devices. In this work polyaniline/graphene oxide composite have been synthesized by chemical oxidation polymerization of aniline monomer on the surfaces of graphene oxide sheets that synthesized from natural graphite by a modified Hummers method for useing in a rechargeable Zn- polyaniline-graphene oxide battery. The molecular structures of the synthesized samples were measured by Fourier transform infrared (FTIR) spectroscopy, XRD and Raman spectroscopy. The characteristic skeletal vibrations due to quinoid and benzoid ring stretching of PANI are observed at 1556.45 and 1479.3, respectively. a broad peak observed at 3408 cm^{-1} coresponding to -NH stretching, peak observed at 2933.53 and 1247.07 cm^{-1} due to C-H stretching and C-N stretching respectively. The GO FTIR spectrum exhibited a sharp peak at 1720.39 cm^{-1} due to carbonyl functional group and a broad peak about 3300 cm^{-1} coresponding to -OH group. The GO/PANI composite FTIR spectrum exhibited a weak peak at 1718.46 cm^{-1} due to carbonyl and some peaks about 3300cm^{-1} due to -OH group and also PANI peaks with some displacement due to its interaction with GO. The Raman spectrum of GO exhibited two Raman peaks at about 1588 and 1302 cm^{-1}, corresponding to G and D bands, respectively. The synthesized composite will be used as cathode material in the battery. Electrochemical performances of the battery will be considered as charge/discharge curves, coulombic efficiency and cyclic life. According to discharge curves capacity and energy density of the battery will be determined.

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Fabrication of a polymer rechargeable battery by graphite/polyaniline/carbon fibre ternary composite

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Polyaniline (PANI) is one of the most promising candidates for industrial application of conducting polymers. Due to PANI suitable reversible redox electrochemistry, it is used as secondary batteries and supercapacitors active material. In recent years, permanent efforts to improve performance of PANI batteries were seen. So, there are many researches about the improvement of its performance [1-3].

In this work, we focus on the chemical synthesis of PANI using different form of carbon such as Graphite (G) and Carbon Fiber (CF). The PANI composites and blends with G and/or CF were synthesized as cathode active material for Zn-PANI rechargeable batteries with aqueous electrolyte. The prototype battery (AA size) was constructed and tested by constant current charge/discharge (100 mA) method to 1.7-0.4 V cut off voltage for 100 complete cycles.

It was found that the conductive form of carbon (Graphite) and electrolyte absorbent form of carbon (Carbon Fiber) improve the performance of PANI active material on Zn-PANI battery up to 88 mAh/g (approximately 30% of theoretical value). This performance can be achieved when the PANI was composited with G and blended with CF with optimized percent.

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Design and construction of a bipolar electrode and electrochemical behavior of the zinc- carbon battery

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Organization of Energy Sources Development

Today coatings of carbon and energy generators, electronic and biological systems are mainly used. In this study, the deposition of carbon on the surface of zinc alloy coating properties using electrophoretic deposition of the coating and the surface was checked. Crystalline solid carbon forms are available mainly to those of diamond, graphite and amorphous carbon are classified. Recently, another structure of carbon called fullerenes, are soccer ball-shaped structure is introduced. In this multi-walled nanotubes and graphite more about the functional structure of aqueous electrolyte batteries are being discussed. Carbon structures in a liquid electrolyte battery electrodes and other components play different roles. Carbon structures in a liquid electrolyte battery electrodes and other components play different roles. In some cases only the deformation of the carbon electrode current collector is used. You can also include carbon as a catalyst for the electrochemical redox reactions in the batteries can be used.

Lab scale production of sponge iron used in the lithium batteries

Sh. Hashemi Shekofteh*, F. Valizadeh, R. Badrnezhad

Organization of Development of Energy Sources

Mixture of iron powder and potassium perchlorate is used as the heat source in the lithium batteries.

The iron oxide is of sponge type which has high specific area (0.5 m^2/g). This iron powder is produced from the reduction of FeOOH, Fe_2O_3 using hydrogen gas in 800-900^o C. generally, iron powder is mixed with 10-16 wt.% potassium perchlorate, passes through a sieve and them using force it is formed and is used in the battery. In this paper, lab scale production method of the sponge iron and the quality assurance (physical characteristics of heat paper, generated gas during firing, density, linear burning rage, dimensional stability before and after burning, reliability capacity, standard deviation, aging time and extended storage) are investigated here.

Keywords: Lithium batteries, sponge iron powder, quality control tests

Storage estimation of the heat sources of primary lithium batteries

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Organization of Development of Energy Sources

There are two kind of pyrotechnic material used as the heat source in batteries. Heat paper with the chemical composition of 88.12, 86.14 and 84.16 potassium perchlorate and sponge iron powders. This type is formed into the paper shape using cold pressing.

The other type is known as delayed wicks, which is composed of zirconium, barium chromate, potassium perchlorate and asbestos fiber. In this article the advantages and disadvantages of both kinds are discussed. Quality control tests (physical properties of the heat source, generated gas during the burning, flammability, density, burning rate, electrical conductivity before and after the burning, burning temperature, dimensional stability before and after burning, reliability capacity, standard deviation, aging time and extended storage) are investigated here.

Keywords: reserve batteries, paper heat source, delayed wicks, quality control tests

PVdF based composite electrolyte: Effects of the ceramic filler on the conductivity of composite polymer electrolytes

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lithium-ion batteries are used as high performance power sources for portable electronics application such as cell phones and laptops [1]. Due to solve the problems of leakage of liquid electrolyte and stability of lithium metal in lithium batteries, attempts have been made to substitute the liquid electrolyte with polymer electrolyte. Polymer electrolytes have many advantages but there are also many technical problems. Low ion conductivity in room temperature is a major disadvantage. The addition of ceramic fillers to the polymer membrane results in the enhancement of ion conductivity as well as the increase in the absorption level of electrolyte solution [2]. In this study, PVdF/Al_2O_3 composite gel electrolyte prepared with nano ceramic (NCGE) were investigated. The membrane were synthesized by Non-Solvent phase inversion technique (NIPS) using N-methyl 2-pyrrolidone (NMP) as solvent and deionized water as non-solvent. Weighted amounts of PVdF was dissolved in NMP and heated up to 50 ^{o}C for several hours to homogeneous gel was obtained then y-Alumina was added to solution to prepared nanocomposite gel electrolyte. This technique is simple and cost effective for synthesis gel electrolyte. In addition, non-toxicity of water is beneficial compared with the process with organic solvent such as methanol and ethanol as non-solvent [3]. A solution of 1.0 mol $LiClO_4$ dissolved in 1:1(w/w) mixture of ethylene carbonate (EC) and propylene carbonate (PC) was used as liquid electrolyte. The microporous Membranes were dipped into liquid for 2 h electrolyte to obtain gel polymer electrolyte. The prepared electrolytes were sandwiched between two stainless steel electrodes for ionic conductivity measurement. Results revealed that ceramic fillers have a significant effect on membrane uptake and ion conductivity. The conductivity of filler free membrane showed 1.25×10^{-3} $S.cm^{-1}$. The maximum conductivity Was obtained 2.36×10^{-3} $S.cm^{-1}$at a filler content of 2.5%.

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A Review of Battery Technologies as Electric Storage and its Modeling in Power Systems Operation Studies

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Global warming issues, environmental pollutions due to irregular use of fossil fuels and extinction of these resources, emphasizes necessity of approaching to use alternative resources and the more efficient utilization of present resources. Therefore there is a widespread attention to use energy storage systems in various fields epically in power system industry, which have a vital role to supply many different applications. In this paper, with a review of some battery technologies as a substantial energy storage system, we investigate different application of them for enhancing productivity of fuel utilization and reducing environment pollutions. Also a comparison between different properties of introduced battery is presented. In addition, a general modeling of various type of battery in power system operation studies is proposed. The proposed model can be used in different power system studies such as expansion planning, maintenance scheduling, unit commitment and economic dispatch problems. Finally the model is applied in an unit commitment problem on IEEE 24 bus reliability test system for a horizon of one week. The obtained results successfully reveals the applicability of the model for determining the charge and discharge periods of battery as well as other user required information about battery operation such as battery owner revenues.

Keywords: Energy storage, Battery, modeling, Power system, Unit commitment.

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Lead acid batteries modeling

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Batteries are crucial component in the stand-alone photovoltaic systems.They remain a complicated element, since they are the only dynamic element in a PV system. In fact many phenomena can occur such as charge and discharge. Many parameters vary during these processes such as voltage, current, density, temperature, resistivity, etc. This leads to a complicated behavior of this element and thus makes predictions of the state of charge much more complicated. The selected model is that elaborated by CIEMAT. CIEMAT model do not keep the parameters fixed. Thereby, it must fit for each battery design, the values used in charge also differs from those used in discharge. They are nonlinear equations, which takes into account not only the charge and discharge but also the overcharge, It also necessitates few input parameters. This model is general and normalized with battery capacity, it necessitate few input parameters, it takes into account the discharge, the charge and the overcharge processes, and can be applied for wide range of lead-acid batteries used in PV systems. For checking the validity of the mathematical model, the results of numerical simulation are compared with experimental data.

A Cost-Effective and Easy to Made Electronic Dummy Load for Constant Current Battery Charge/Discharge Studies

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Testing the batteries and other electric power storing devices in terms of charge and discharge parameters to evaluate their performance is an inevitable part of routine battery and fuel cell testing experiments and procedures. Constant current experiments, also known as galvanostatic charging/discharging tests are among quite well established methods to determine charge capacity of a battery and also to study its state of health and degradation behavior. In this respect, developing constant current sources/sinks with proper current and voltage ranges to fit such demands is of great importance. Nowadays, state-of-art digitally controlled electronic loads are commercially available but their high cost is a main barrier for their easy accessibility. Keeping this facts in mind, in this contribution, a cost-effective and easy to made electronic dummy load was developed, fabricated and successfully tested. Based on parallel connected N-gate power metal oxide semiconductor field effect transistors (MOSFETs), extremely stable voltage reference, and precision Op-amps, this dummy load can deliver /sink a maximum current of 20A at a maximum compliance voltage of 60V. The value of current can be controlled by a manual precision ten-turn dial in the front panel of the load at 10mA steps from zero to full scale. Comparative experiments on a 12V 200Ah lead-acid battery with this load and a standard commercially available load sowed that the charge/discharge curves obtained by both of instruments are practically identical in the range of experimental errata and electronic part tolerances. Also the current source/sink time functionality of this dummy load can be controlled via feeding a voltage signal from an external function generator. A prototype of this electronic dummy load built by the author has functioned quite satisfactorily for PEM Fuel Cell studies at Electrochemistry Research Laboratory, University of Tabriz, since March 3013.

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Power Management Setup for a Microbial Fuel Cell as a Miliwatt Battery Charger

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Developing power management systems for low power applications and tailoring electric power from renewable energy sources (biobatteries, solar cells and etc.) for battery charging purposes in emergency cases is of great importance for non-energy accessible temporal and spatial situations. In this contribution, a microbial fuel cells (MFC) consisting of three cells connected in parallel with a nominal open circuit voltage of 0.62V and a short circuit current of 3.8 mA were coupled via a 10F 2.6V supercapacitor to an ultra-low input voltage boost DC-DC converter based on a central oscillator at 45kHz frequency and a low-drop Schottkey diode rectifier. A voltage comparator circuit was also used to ensure the complete charging of the supercapacitor before the start-up of the DC-DC converter and delivering electrical energy to charge a low capacity (1.2V,100mAh) Ni-Cd miniature battery. Experimental results i.e. measurement of converter efficiency, converter output voltage and terminal voltage of the Ni-Cd battery showed that using the developed power management setup, with a continues operation of MFC in single fed bath mode, such a battery can be charged up to its 50% full capacity in about 30h. Therefore this setup can used as an efficient extreme emergency charger for low capacity Ni-Cd batteries in outpost situations where no other electric power source is available **.**

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An Ultra-Low Input Voltage DC-DC Boost Converter for Biobattery Applications as Power Sources

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In a biobattery or microbial fuel cell (MFC), electric energy is produced from organic matter by micro-organism assisted oxidation of biodegradable materials. However, at this time, mainly due to slow reaction kinetics and high internal Ohmic losses, power and voltage output level of these fuel cells is very low compared to other electricity generating technologies such as conventional batteries. In order to be applicable in practical situations such as remote power sources for sensory systems and devices, output voltage of MFCs, which is usually below 0.7V for a single cell, should be boosted to those levels of commonly encountered electronic systems, i.e. a few volts. In this regard, an ultra-low input voltage DC-DC boost converter was designed based on a rather obsolete germanium transistor as a central oscillator and ac couple transformer at 45kHz oscillation frequency. Rectification was performed using a low-drop Schottkey diode. A dual-chambered mixed-culture glucose fed MFC with nano-structure titanium/palladium cathode and graphite anode was employed as the biobattery to supply the input electric energy at a nominal voltage of 0.6V and a short circuit current of 0.85mA. Results revealed that the designed DC-DC converter is capable of delivering long-term (about 80h) stable power at 1.5V and 0.28mA with a conversion efficiency of 82%. Therefore this converter can be employed as an efficient power management interface for low power biobatteries.

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Study and investigation of Nickel Metal hydride (Ni-MH) battery

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Thin, Flexible Energy Storages have found considerable interest in many fields including smart objects, stand-alone sensors, active RFIDs etc. Lately there is a noticeable increase in sales of small electrical circuitry for articles of daily use that may be applied for "ambient intelligence" purposes will face rapid growth in future. Most of these systems will need a power supply which should be thin, flexible and adoptable to the design needs. The energy capacities of those power supplies should fit to the life cycles of the applications and they should be easily disposable or recyclable. Printed, rechargeable Ni-MH cells as the most important type used in wide range of application are considered as secondary cells with nominal voltage 1.2V. This could be in single or multi-cell (series connection) layout.

$$\text{Metal-H} + 2\,\text{NiOOH} \rightarrow \text{Metal} + 2\,\text{Ni(OH)}_2$$

For conventional batteries the electrode materials are available as powders or suspensions maybe called "slurries". These slurries are not suitable for printing without further treatment. The most common problems with this kind of batteries is anode inhomogeneous surface that tends to bubble and cathode with cohesive and adhesive failures.

In this work the aim is recognition and study of these kind of batteries. Different techniques have been used like chronopotentiometry (CP), chronoampro-metry (CA) and electrochemical impedance spectroscopy (EIS) to investigate these kind of printed battery by using a single printed battery cell (Camelion Ni-MH 1.2V 300mAh NO.C015).

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Improvement of lead acid batteries for hot climate applications

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Nowadays the lead acid battery technology is considered one of the best choices for automotive batteries. In hot climate applications the cycle life of these batteries decrease, because the temperature in the battery reaches probably up to 80°C. In such high temperature the critical causes of battery failure are shedding and irreversible sulfating of the positive active material, shrinkage of the negative active material, positive grid growth and positive grid corrosion. In order to meet the decreasing batteries life a variety of changes in effective parameters investigated and made an even more detailed analysis for improving the performance of flooded-electrolyte batteries in these application, and a new battery has been produced by Sepahan battery industrial complex. In these new batteries, some changes cause a significant improvement in battery cycle life and extending battery life on cycling at high temperatures.

The effects of additives for pastes, additives for electrolyte, pastes parameters, electrolyte characteristics, and sealed lid design, on the performance and cycle life of flooded-electrolyte batteries are assessed in terms of water loss, charge efficiency, charge acceptance, cycle life, and self-discharge. This paper will summarize these data and also test results will be comprised.

Keywords: Lead-acid battery, hot climate zones, cycle life

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Evaluation of the most effective Na_2SO_4 usage as an additive in the electrolyte, negative and positive electrodes paste on the performance of lead-acid battery

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Sodium sulfate could perform important role in improving the efficiency of lead-acid battery. Through the introduction of sodium sulfate in electrolyte solution, the solubility of $PbSO_4$ is significantly reduced at all acid concentrations. Also sodium sulfate impacts the electrochemical behaviors of nanostructures of lead dioxide in the positive electrode and facilitates the transportation of sulphuric acid and eventually increases the utilization of PAM.

Current research considers usage of sodium sulfate additive in three areas of battery such as positive active material, negative active material and electrolyte solution for the large-scale manufacture of automotive batteries. Improvements in battery performance in discharge capacity, cycle life test and cold cranking ability were investigated. Consequently test results and evidence from scanning electron microscopy (SEM) and X-ray diffraction techniques (XRD) indicated that the main role of sodium sulfate is in the cold cranking ability and established that Na_2SO_4 is more effective when introduced in the electrolyte.

In addition this work considers utilization of different sodium sulfate concentrations in electrolyte. The influence of different concentrations on electrochemical reactions will be illustrated by electrochemical methods such as cyclic voltammetry and differential pulse voltammetry.

Keywords: lead-acid battery, sodium sulfate, additive

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The Leading of Manufacturing Technology of AGM-VRLA Battery for Micro-hybrid Electric Vehicle

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The development of novel electrical vehicles for decrease of exhaust emission and fossil fuel consumption demands batteries with specific cycling performance. Increasing world-wide concern over these issues, has resulted in the introduction of new anti-pollution legislation, which significantly restricts exhaust emission from internal combustion engine (ICE) vehicles. So automobile manufacturers decided to reduce petrol consumption by combining an electrical engine with an internal combustion engine to propel the vehicle. Thus, the hybrid electric vehicle (HEV) was devised. According to VRLA battery usage, especially AGM-battery, in micro-hybrid electric vehicles (mHEV); nowadays it is important to have further definition of this battery for advanced automotive application.

The purpose of this paper is to recommend various types of hybrid electric vehicles and to guide the battery manufacturers in the preparing of AGM-VRLA (Absorptive Glass Mat Valve Regulated Lead Acid) batteries.

In this paper Some parameters have been discussed such as; differences between flooded and AGM batteries, various types and characterization of AGM separators, effect of plate group compression on the battery performance, different additives in positive paste, negative paste and electrolyte, various methods of filling and formation programs.

Key words; Valve-regulated lead-acid battery, Absorptive glass mat, Hybrid electric vehicle.

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An overview of the use of nanomaterials in lead- acid batteries

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During last decade, preparing of electroactive materials in nanometer scale and their application in rechargeable batteries are under intense investigation. Lead-acid batteries (LABs) and lithium ion batteries (LIBs) are two main types of rechargeable batteries in these studies. Although, some countries prohibited the manufacture and use of LABs, there are many interests to improve their performance by using some techniques such as nanotechnology. Preparing of spongy lead, lead oxide (litarge) and lead dioxide in nano scale are interest. Based on the published reports, nanotechnology is applicable in anode, cathode and separator of LABs. Negative nanomaterials (anode) can be used in two forms including nanostructured spongy lead and nanostructured leady oxide (mixture of metallic lead and lead oxide). When the nanostructured leady oxide is used to construct the LABs, the batteries should be electrochemically formed before using. During electrochemical formation, the nanostructured leady oxide in negative pole is converted into nanostructured spongy lead. Concurrent with this process, the nanostructured leady oxide is converted into nanostructured lead dioxide. When the nanostructured spongy lead is directly used to construct a LAB, lead dioxide should be already prepared and then used in LAB. The published documents show that there are many chemical, physical, mechanical and electrochemical methods to prepare nanostructured spongy lead and lead dioxide. In this review, we investigate the all methods which used to synthesize these nanomaterials and the results of using these nanomaterials in LABs.

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The effect Diatomaceous earth additive of positive active material in Lead acid battery

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Diatomaceous earth material (Celite 504) to improve the charge acceptance of the positive paste in lead acid battery, with the aim of increasing surface area in the active material which leads to an increase in specific capacity[1]. Celite 504 composite comprised of CaO, MgO, Na_2O and SiO_2(89.4%) to form $SiO_2.XH_2O$ phase [2] which the composite enhances water retention in the active material, improves ionic conductivity (gel phase), and reduces strength in positive paste.

In the present study, was reported by the effect Diatomaceous earth material (Celite 504) of positive paste in the lead acid battery. The amount of Celite 504 which could be used in the positive paste to improve the plate properties was only up to about 0.5% by weight .Anything above this level tended to reduce the density of the plates too much or lower the strength of the plate. The three –stage experimental test was doing of the battery: Cold cranking Capacity, Acceptance charge and Cycle life tests. Good results were obtained with Celite 504in acceptance charge of the batteries.

The morphologies of Celite 504 were observed using a field emission scanning electron microscope (Fe-SEM, Hitachi S 4800).which is shown small and uniform particles as agglomeration on the surface spiral crystal structures. The X-ray diffraction patterns were obtained from on X-ray diffractometer (Cu target, Philips) is observed the lower phase active material and increase amorphous phase.

Keywords: Diatomaceous earth material, Charge acceptance, Positive paste, Specific capacity.

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A Review of Preparing Methods for Nano-Structured Lead Oxide to Use in Lead Acid Batteries

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Lead-acid technology currently remains the most reliable, safe and affordable power source. None of the new developed battery types (e.g. Li-ion and Ni-MH batteries) has so far reached the commercial success of the lead-acid battery. This is partly a result of the continuous development and evolution of the lead-acid battery, which has led to major improvements in performance [1]. Due to their low cost, rechargeability and easy construction, lead acid batteries have attracted great interest for use in motorcycles, electrical vehicles, and communication equipments.

There are increased studies devoted to improvement of efficiency of these batteries. A major part of efforts to improve the performance of lead acid batteries has been focused on the improvement of lead oxide characteristics to obtain more discharge capacity and more cycle-life. It is expected that the lead oxide in form of nano-particulates can deliver more electrical energy at discharge process due to its large specific surface area and good reversible property. In the past few years, the synthesis of nano-structured oxide materials has attracted considerable attention of chemists and metallurgists. In recent years, there has been an increase in the amount of trends focusing on nanotechnological methods to prepare nanoparticle with extended advantages[1-8].

The lead element has many oxide forms including PbO, Pb2O3, Pb3O4, PbO2 and amorphous. Among lead oxides, lead dioxide (PbO2) has been studied more than any other forms. A variety of physicochemical methods, including metal evaporation[9], spray pyrolysis [10-12], sol–gel [13], hydrothermal synthesis [14] and electrochemical methods [15] have been used to produce nanometer-sized materials. A number of electrochemical techniques have been used to prepare lead dioxide some of which are constant current and constant potential [16], cyclic voltammetry [17] and pulse current [18]. The overall goal of this article is to review researches conducted to various methods to obtain lead dioxide in the range of nanometric to micrometric size and report the result of the obtained particles as active material in lead-acid cells.

key words: Nano-stracture, Lead dioxide, Lead-acid battery.

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Anion Exchange Membranes for Battery Applications

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Batteries as electrochemical energy storage systems have a remarkable role in technical applications. New generation of batteries utilize solid-state electrolytes such as polymeric ion exchange membranes instead of conventional liquid electrolytes. In the recent decades researchers focus on anion exchange membranes as suitable candidate to use in different battery systems. These membranes have high performance and favorable cost and their material and properties have significant effects on the battery's efficiency. Desirable anion exchange membranes for batteries application should have some essential properties such as reasonable ionic conductivity, high ion exchange capacity, and good thermal, mechanical, chemical and electrical stability in operating condition. Some parameters can be used in the performance characterization of these membranes in battery systems such as electrical area resistance, columbic efficiency, voltage efficiency and energy efficiency [1] Vanadium redox flow, zinc-air and nickel-metal hydride batteries are the most important secondary (rechargeable) battery systems that can utilize anion exchange membranes as separator and solid electrolyte. Vanadium reodx flow battery consists of a solution of vanadium in sulphuric acid in both half-cells and anion exchange membrane transfers sulphate ions to keep electro neutrality in overall battery system. Zinc–air batteries composed of air and zinc electrodes for the cathode and anode, respectively. This battery has already been used in practical application as button cells for use in hearing aids. Nickel-metal hydride battery quickly replaced the nickel-cadmium battery for electronic applications because of its lighter weight and considerably higher energy storage capability. This battery consists of proton-inserting metal alloy as negative electrode and nickel as positive electrode. In both recent batteries, anion exchange membrane carrying hydroxide ion from cathode to anode [2-3]. As a result, anion exchange membranes can be reliable option for different battery systems applications because of the best efficiency, cost and flexibility.

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Microwave assisted air cathode for Zinc Air battery

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Oxygen reduction reaction has technological importance in the development of electrochemical devices such as Zn-Air batteries, Fuel cells and etc. The slow kinetics of oxygen reduction reaction under experimental conditions causes the deterioration of performance of the devices. In order to improve the performance with enhanced kinetics, a better electrocatalyst is necessary. For the catalyst synthesis microwave irradiation has been widely used due to its advantage of high heating efficiency [1-2]. In this work, a simple, microwave-assisted heating method has been developed to embed Ag on the surface of carbon cloth in different condition for use as Zn-Air battery cathode.

For this purpose, at first carbon cloth was functionalized in acid, base and neutral medium by means of microwave irradiation, then a microwave-assisted reduction method used to deposition of Ag catalysts onto functionalize carbon cloth. At the end, as prepared gas diffusion electrode used as cathode electrode in Zn-Air battery. The constant current discharge results of constructed batteries showed that discharge capacity of Zn-Air battery at 10 mA/cm^2 were 100, 70 and 40 mAh for functionalize carbon cloth in the presence of H_2SO_4, HNO_3 and neutral medium respectively.

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A new metal oxide/polymer composite additive for lead acid battery negative plate

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From the literature, it is known that temperature affects the performance of a lead acid battery in multiple ways [1]. One of them is thermal degradation of organic additives of negative plates. Polyaniline (PANI) is an important conducting polymers, also PANI-inorganic nanocomposites have been proven to possess a wide range of properties such as electrical, mechanical, and structural properties because of synergistic effect owing to the intimate mixing between organic components in molecular level [2-4].

Here in, a new PANI-PbO2 nanocomposite was synthesized by redox polymerization of aniline monomer in the present of PbO2. The thermal degradation behavior of PANI chains in the nanocomposite was investigated by a TGA and XRD. As prepared nanocomposite used as additive in negative plate of lead acid battery, and evaluated by constant current charge-discharge method.

The results shown that PANI-PbO2 nanocomposite were more thermally stable than those for lignin sulfonate. Battery test indicated that negative plate of lead acid battery had capacity retention above 80% after 200 complete charge-discharge cycles. In addition the lead sulfate reduced in negative plate after cycling.

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Study of composite catalyst in Zn-air battery efficiency

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Metal-air air batteries, especially zinc-air batteries, are widely used as a high capacity primary power source because of their advantages, such as, being light weight, having high energy density and portability[1,2]. Gas diffusion electrode design has important effect on battery performances[3].

In this study cathode catalyst prepared by composite and blending of catalyst and graphene oxide, and compared with each other. Cathode electrode Zn-air battery consist of 18% KOH, 52.5% graphite merck, 10% PTFE, 7% CMC and 12.5% catalyst. Two types of catalysts were comprised. The first catalyst was mixture of MnO_2 and graphene oxide but the second one was composite of MnO_2 and graphene oxide. Graphene oxide was synthesized by modified hummer's approach and composite was synthesized by graphite, $KMnO_4$, H_2SO_4 and $MnSO_4$.

The synthesis of composite catalyst were confirmed by XRD and SEM. These catalysts were assembled by other parts (separator, steel mesh, …) to construction of battery. To investigation of efficiency of assembled batteries, chronopotentiometry method was done in 2, 5 and 10 mA. The results showed that capacity of battery with blend catalyst correspond to 2, 82 and 257, and capacity with composite catalyst were 7.160, 269.3 and 400.12 mAh/g, respectively. These results indicated the performance of composite catalyst was higher than that blend catalyst to cathode electrode of Zn-air battery.

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Investigation of $NiMnO_3$ as new electrocatalyst for oxygen reduction reaction in Zn-air battery

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Global warming and the pollution of environment are caused due to fossil fuels and toxic metals in batteries have forced to search new sustainable Vehicles and energies. Zn-air battery is one of the most types of cells for energy storage and electrocatalysts was used for decreasing of over potential of the oxygen reduction reaction (ORR)[1,2]. The aim of the present paper is activity investigation of Nickel Manganese oxide as a new electrocatalyst for cathode electrode in alkaline medium[3].

The NiMnO3 was synthesized by molten salts method. Phase and morphology of synthesized material were studied by XRD and SEM analyses. The electrochemical behavior was studied by linear sweep voltammetry (LSV) and electrochemical impedance spectroscopy (EIS) in a three electrode configuration. Battery tests were done in different currents in two electrode system.

XRD pattern of Nickel manganese oxide showed compeletly crystalline structure. The SEM results showed that the electrocatalyst was prepared layer, without impurity and have nano structure.

The LSV test showed that over potential are been reduced in Oxygen reduction and tofel slope measurements showed that catalyst I_0 is higher than graphite electrode I_0. The EIS test showed that charge transfer resistance is lower than blank electrod in oxygen reduction.

The battery tests showed that $NiMnO_3$ electrode capasity is higher than blank in oxygen reduction. The tests showed that NiMnO3 compound is an electrocatalyst for ORR.

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Synthesis of Hard Carbon as Anode Material for Lithium Ion Battery

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Due to the limited theoretical capacity, a series of anode materials have been proposed to replace graphitic carbons which are the conventional anode materials of lithium ion batteries. Among the proposed alternatives, hard carbons (HCs) with the amorphous structure become attractive due to their high capacity, low cost, long cycle life, good rate performance, and improved safety [1-6]. In this work, a pitch sample as precursor material was cross-linked through oxidation of dispersed microparticles in nitric acid solution followed by carbonization at 700 °C under nitrogen atmosphere to prepare HC sample. Then, the electrode materials were prepared by mixing 85 wt % HC, 5 wt % carbon black (for enhancement of electrical conductivity), 10 wt % Polyvinylidene Fluoride (PVDF) (as binder), and N-Methyl-2-pyrrolidone (NMP) to prepare a slurry followed by coating onto copper foils using doctor blade method. The as-prepared electrodes were dried at 120 °C for 10 min, pressed using a roll-pressing machine, punched into round pieces, and finally dried under vacuum at 170 °C for 12 h. The anode electrodes were inserted into a two-electrode cell along with a Celgard separator, and metallic lithium as both counter and reference electrodes. A solution of $LiPF_6$ (1 M in a 1:1 V/V of ethylene carbonate: diethyl carbonate) was injected into the cell as electrolyte. The entire cell assemblies were conducted in a dry argon filled glove box. For electrochemical characterization, typically, an assembled cell was charged to 10 mV with constant current (CC) of 500 mAg^{-1}, held at constant voltage (CV) of 10 mV until the current dropped to 250 mAg^{-1}, and then discharged to 2 V at constant current (CC) of 500 mAg^{-1}. Electrochemical tests showed the HC has 1127 $mAhg^{-1}$ charge capacity at the first cycle that indicating the produced HC is suitable as anode material for lithium ion battery. XRD analysis demonstrated that the HC has higher d-spacing and lower stacking height than graphite, resulting in higher capacity than the theoretically maximum capacity of 372 $mAhg^{-1}$ for C_6Li in graphitic materials.

Keywords: Hard carbon, Lithium-ion battery, Anode material, Pitch.

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Importance of nano size $BaSO_4$ in advanced batteries

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The application of barium sulfate have been continued to thrive in many industrial fields especially in lead acid batteries. Barium sulfate has special function in lead acid batteries which is studied from past decades. Because, barium sulfate acts to provide sites for nucleation of lead sulfate when the battery discharges. Similarity of the unit cell of the barium sulfate with lead sulfate facilitates the formation of the very small lead sulfate crystals. So, small lead sulfate crystals help the discharge process to accomplish easily. Therefore, barium sulfate has very important role in the operation of the active materials in the battery [1, 2].

Nowadays, nanotechnology dedicate us higher performance from a special material. Because by converting a micro to nano size, the properties of the materials improve surprisingly. So, nano scale fabrication of barium sulfate let us higher surface area and performance [3]. Strategy for the synthesis of nano size barium sulfate attracted the attentions because of the new advances in lead acid batteries.

In our work new attempts carried out for the synthesis of nano size, fine and uniform barium sulfate using low cost substrates. The synthesized barium sulfates characterized by X-ray diffraction, scanning electron microscopy and FT-IR. Results showed that barium sulfate particles were pure and synthesized in the range of 40 to 150 nm.

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Investigation of the electrolyte role in the performance of a primary lithium battery

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Organization of Development of Energy Sources

Halide salts are used to manufacture this kind of electrolyte. These electrolytes have different models and are made using a variety of methods. LiCl-KCl electrolytes are of the most important types also LiF-LiCl-LiI is another type. In this article, change in the chemical composition of the electrolytes of the primary lithium batteries lead to the development of electrolytes with lower melting point and higher performance time. In the end, the prepared samples were evaluated in the lab and the performance tests on two batteries using two electrolytes and their comparison were done.

Keywords: primary lithium batteries, electrolytes, melting point, batteries

Synthesis of Nano Composite TiO_2 Nanotube/SnO_2/C as Anode Materials for Li Ion Batteries

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Abstract

Lithium rechargeable batteries are now well established as power sources for portable equipment. Wide range of high theoretical capacity Tin oxide composite is under study as the anode materials of these batteries. TiO_2NT/SnO2/C composite as anode materials was synthesized by Tin oxide nanoparticles that embedding on high cycleable nanotube titanium oxide as substrate and improving its electrical conductivity by Vulcan XC-72. Electrode performance was tested by charge/discharge galvanostatic and cyclic voltammetry experiments. The structure of nanotube titanium oxide will be studied by scanning electron microscope (SEM).

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Effects of Aging in Positive and Negative Plates in Reserve Lead Acid Batteries

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Battery life prediction therefore involves determining how the battery is aging and degrading. Aging refers to the degradation in the property of component or material used in the battery, which leads to fading in performance and shortened service life. Degradation can be reversible or irreversible, depending on the nature of the process.[1]

Real time testing prolongs periods of time, and then accelerated aging is used. Since positive and negative plate are important parts in the battery and degradation of plates results to decreasing in performance of battery, Then accelerated aging and effects of time and temperature on structure and performance of plates was investigated.

In this experiment positive and negative plate are placed in different temperature for different time and it was shown that aging affect structure and performance of plates.

Keywords: Aging, Temperature, Positive Plates, negative plate

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An overview of different fabrication methods of $LiFePO_4$ and its effects on Li-ion batteries application

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Recent powder fabrication technologies provide opportunities to develop high-performance, low-cost cathode materials for rechargeable lithium-ion batteries. Among various energy storage technologies, rechargeable lithium-ion batteries have been considered as effective solution to the increasing need for high-energy density electrochemical power sources. Recently, lithium iron phosphate ($LiFePO_4$) powders have become a favorable cathode material for lithium-ion batteries because of their low cost, high discharge potential, large specific capacity, good thermal stability, and high abundance with the environmentally benign and safe nature. As a result, there is a huge demand for the production of high-performance LiFePO4 powders. However, $LiFePO_4$ also has its own limitation such as low conductivity ($\sim 10^{9}$ S/cm), which results in poor rate capability. This can be addressed by modifying the powder structure using novel fabrication technologies. This paper presents an overview of recent advances in the fabrication of high-performance $LiFePO_4$ powders for lithium-ion batteries. The $LiFePO_4$ powder fabrication methods covered include: solid-state synthesis, mechanochemical activation, carbothermal reduction, microwave heating, hydrothermal synthesis, sol-gel synthesis, spray pyrolysis, co-precipitation, microemulsion drying, and others. The impacts of these fabrication methods on the structure and performance of LiFePO4 powders are discussed. In addition, the improvement of the conductivity of $LiFePO_4$ powders through novel powder technologies is addressed.

Scrutiny and determination of heat transmission coefficient in battery insulators under various operational conditions

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Insulation has been and still remains one of the fundamental tools for achieving energy conservation both in the buildings' and in the industrial sector.

Some batteries are primary disposable systems specially designed to develop a high energy density in during a short period. Differently from the classical electrochemical systems, the electrolyte of some batteries is solid at room temperature, which make them inert until they are heated to high temperatures, when the electrolyte melts and begins to exhibit enough ionic mobility to establish electric current.

Fibrous material is a complex porous medium and steady test methods are the main test approaches we currently depend on to study the heat transfer properties. The application of unsteady test methods on fibrous material is still not mature. In this paper, some systematic studies are taken to investigate of heat transfer in battery thermal insulation. Under some operational conditions, the thermal conductivity factor may change. Insulators are important operative, therefore we investigate thermal behavior in battery thermal insulations.

The study presented focuses on fibrous thermal insulators, which is the most widely used, and in that sense the most representative inorganic fibrous material.

Investigation of activated carbon in EDLC super capacitors

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Super capacitors are new energy storage systems. Receiving and producing high power are important properties of super capacitors. In this paper, making of one type of laboratory EDLC super capacitor is investigated and after making some samples have tested and evaluated.

For making this super capacitors, we use activated carbon, because it has high surface area ,and high capacity is concluded. At last a sample of super capacitor with 21f capacity successfully tested in charge and discharge condition.

Keywords: Supercapacitor, Carbon activated , Capacity, EDLC

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Design and construction of a bipolar electrode and electrochemical behavior of the zinc- carbon battery

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Organization of Energy Sources Development

Today coatings of carbon and energy generators, electronic and biological systems are mainly used. In this study, the deposition of carbon on the surface of zinc alloy coating properties using electrophoretic deposition of the coating and the surface was checked. Crystalline solid carbon forms are available mainly to those of diamond, graphite and amorphous carbon are classified. Recently, another structure of carbon called fullerenes, are soccer ball-shaped structure is introduced. In this multi-walled nanotubes and graphite more about the functional structure of aqueous electrolyte batteries are being discussed. Carbon structures in a liquid electrolyte battery electrodes and other components play different roles. Carbon structures in a liquid electrolyte battery electrodes and other components play different roles. In some cases only the deformation of the carbon electrode current collector is used. You can also include carbon as a catalyst for the electrochemical redox reactions in the batteries can be used.

Manufacturing of fibrous zinc and investigation the effect of addition zinc fibers on zinc electrode performance in alkaline batteries

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Organization of Development of energy sources

Zinc possesses a unique set of attributes including low equilibrium potential, electrochemical reversibility, stability in aqueous electrolytes, low equivalent weight, high specific energy, rugged physical structure, abundance, low cost, environmentally friendly materials, and ease of handling. It forms the anode for many battery systems, such as the Ag–Zn, $Zn–Br_2$, $Zn–MnO_2$ (i.e., alkaline zinc) [1,2,3].

Porosity and distribution of porous space in electrodes are very important for the performance of the electrodes inside the batteries. Their control is determined by the form of material and the design of the electrodes. Anodes made of fibrous materials have a greater advantage in that porosity can vary a much greater range than in powder anodes without compromising the conductivity of the anode.

Various approaches are used for preparation of fibrous zinc. In this paper zinc fibers is manufactured by a spin casting method. Characteristics of manufactured Fibrous zinc are included as follows: length which is from 1mm to 50 mm and width which is 1mm to 2mm. This work introduces Discharge performance of the Zinc electrode which is improved by addition of fibrous zinc.

The electrochemical behavior of an alkaline cell during discharge displays that the Capacity increases with the fibrous zinc addition. Best result gets with addition 10% Fibrous zinc.

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Manufacturing of rechargeable textile battery

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Organization of Development of Energy Sources

In this study, a new type of rechargeable battery was made. Two types of textile carbon were made. Two types of cloth carbon were made: a typical carbon and a modified one. They were used as appropriate bases for the synthesis of PANI (Poly aniline) as the cathode and the anode was Zinc and $NH_4Cl/ZnCl_2$ was used as the electrolyte. PANI was synthesized within the pores of textile carbon by oxidizing the aniline. Different electrochemical methods were used for synthesizing the PANI: pulse voltammetry, cyclic voltammetry and constant current method. After synthesizing PANI with different methods, cathode properties of synthesized PANI's were evaluated with 100 charge-discharge cycles with constant currents.

The results showed that the efficiency of these batteries was increased with the method of normal pulse voltammetry as a result of increased surface area of synthesized polymer. The measured discharge capacity was 247 $AhKg^{-1}$. In addition, better capacities were obtained by synthesized PANI with voltammetry on the modified (oxidized) textile carbon.

CFD Simulation of Lead-Acid Batteries – a Review

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Lead acid batteries involve multi disciplines engineering field and are used for a vast number of purposes due to lower price, deep cycling and high rate discharge. Modeling and Simulation allow scientists and engineers to design and manufacture engineering products that are too complicated to be designed by simple engineering approach. In this study, a review on simulation of lead acid batteries using computational fluid dynamic (CFD) methods is presented. For this purpose, some appropriate studies which have had an important impact in the development of lead acid battery CFD simulation are introduced, chronologically. For each study, the geometry of numerical or experimental test case is described and the initial and boundary conditions are presented. In addition, all the governing equations with their assumptions and method of solution such as finite-difference method (FDM) or finite-volume method (FVM) are presented. Moreover, the advantages and disadvantages of each method are discussed, separately. Finally, a few important results of each work are presented.

By looking at the development of lead acid battery simulation methods, one can understand the importance of simulation in this field of study. On the other hand, investigation of all studied works can state the limitations, capabilities and potentials of lead acid battery simulation in our country and in the world.

The lack of a good experimental benchmark is a critical issue for this area to step forward. In conclusion, it seems a new field has been developed i.e. BFD which is abbreviated for Battery Fluid Dynamics.

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