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Faculty of Science

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Physical chemistry- Electrochemistry Department of K.N. Toosi University of Technology &

Electrochemical Society of Iran

In the name of God

WELCOME ADRESS

At the opening of the 7th annual seminar of electrochemistry of Iran

Dear participants and researchers

7th annual seminar of electrochemistry of Iran has hosted hundreds of scientists in the field of electrochemistry who have come together to share their experience, exchange information and work for the advancement of the profession. This year the K.N. Toosi University of Technology is having the pleasure of hosting Iran famous scientists and researchers.

Delegates for different provinces of Iran have gathered here to communicate and share the benefits of scientific as well as humanistic values. The conference will provide a wide-ranging survey on the present state of knowledge and future trends in different areas of electrochemistry. There will be plenary, keynote lectures as well as oral and poster presentations.

We thank all of them, all of you who have made this conference possible. We would like to offer our special gratitude to the numbers of the organizing committee whose help and support have been invaluable. We would heartedly hope that your participation in the 7th annual seminar of electrochemistry of Iran in Tehran will be fruitful.

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Oral

Copper Iodide Modified Sol-Gel Electrode: Application for Electrocatalytic Oxidation of Hydrazine

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Abstract

In recent years the immobilization of the chemically active species for construction of chemically modified electrodes (CMEs) and their applications have received great attention in improving the sensitivity and selectivity of the electrochemical techniques. The sol-gel technique is a new, simple, and reliable way for the preparation of modified electrodes. A new sol-gel electrode using CuI as a suitable modifier is fabricated in the present study. Cyclic voltammetry was employed to study the electrochemical and electrocatalytic properties of proposed electrode. It was found that in comparison to unmodified sol gel electrode, electrochemical behavior of hydrazine was greatly improved at copper iodide modified sol-gel electrode, indicating that the anodic oxidation of hydrazine could be catalyzed at copper iodide modified sol-gel electrode. The transfer coefficient (α), the number of electrons involved in the rate-determining step (n_α) and the catalytic rate constant (k) for modified electrode were calculated.

Keywords: modified sol-gel electrode, electrocatalytic oxidation, hydrazine

Monte Carlo Simulation of Gemini Surfactants

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Abstract

By the covalent linking of two ‘‘conventional’’ surfactants via a spacer, a new class of surfactants, generally referred to as Gemini or Gemini surfactants, has been created. These surfactants usually have better surface active properties than corresponding conventional surfactants of equal chain length. Further the critical micelle concentration (CMC), Gemini surfactants tend to form larger micelles than those assembled by conventional surfactants. In order to investigate the spontaneous formation of micellar aggregates, model Gemini surfactants were initially dispersed randomly in a $L_x \times L_y \times L_z$ system with a coordination number of $Z = 6$.The microscopic lattice model of a gemini surfactant, which we propose here, can be represented by the symbol $T_pH_qS_nH_qT_p$. The principle features of the aggregation of Gemini surfactants with hydrophilic spacers can be summarized as follows: (i) the CMC decreases with increasing spacer length; (ii) the aggregation number decrease; (iii) the micelles are spherical.

Keywords: Simulation, Monte Carlo, Gemini Surfactant

The catalyst layer containing sulfonated poly(ether ether ketone) as the electrode ionomer for polymer electrolyte fuel cells

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Abstract

Cyclic voltammetry (cv) has been employed to investigate the effect of ionomer content in the electrode that can be used in polymer electrolyte membrane fuel cells (PEMFC). As a key component of electrode, ionomer forms the ionomer network in the catalyst layer and acts as a proton conducting medium. In addition, since it causes change of the pore structure in the catalyst layer, it has a great influence on catalyst utilization and gas transfer to the catalyst. Sulfonated poly (ether ether keton) (sPEEK) was used as the ionomer within the electrocatalytic layer of gas diffusion electrodes (GDEs). In this study sPEEK was prepared by sulfonation of PEEK. The degree of sulfonation was determined 65% by H-NMR. The results showed that in 25 weight percent of sPEEK ionomer in the catalyst layer, electrochemical active surface is maximum.

Keywords: fuel cell, cyclic voltammetry, sulfonated poly (ether ether keton), ionomer.

Rotating Disk Electrode and Electrochemical Impedance Spectroscopy Study of Oxygen Reduction Reaction on Copper Modified Electrodeposited Silver Electrode

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Abstract

Electroreduction of oxygen on silver deposited on glassy carbon electrode and modified by copper deposition is investigated by cyclic voltammetery, polarization measurement and AC Impedance spectroscopy where rotating disk electrode (RDE) has been employed. The mechanism and kinetic parameters of the reaction are compared in two cases. In both, electrode reaction follows 4e pathway and the synergetic effects of adding Cu to Ag improved the electrochemical activity of the electrode. The calculated Tafel plots show the electron transfer reaction is rate determining step. The improvement in catalytic activity was confirmed by AC impedance results. The effect of rotation rate of disk on the responses of EIS studies has been investigated and mass transport coefficient of Oxygen and rate constant of ORR reaction are extracted from EIS results.

Keywords: Silver, Copper, Oxygen reduction reaction, Alkaline, Kinetic parameters

Fractal Dimensions and Electrochemistry in Conducting Polymers

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Abstract

Fractals have been characterized by several methods that can be classified as physical, chemical and electrochemical[1]. The Fractal dimension D_f is related to surface roughness and when $D_f=2$ the surface is completely smooth without any porosity and roughness but when $D_f=3$ the surface is completely rough and amorphous[2] so with increasing D_f from 2 to 3 the roughness of surface increases. CV and EIS methods can be used for calculating fractal dimension. Besides electrochemical methods atomic force microscopy (AFM) can used to ensure the accuracy of the results of electrochemical methods (CV and EIS) in calculating the fractal dimension and roughness. Atomic force microscopy is one type of scanning force microscopy (SFM), which uses different kinds of intermolecular forces as the detection signal to achieve the measurement of different physical properties of a surface in nanometer scale. An AFM basically uses the van der Waals force between a tip, which scans the surface, and the sample surface[3]. An AFM image is a simulated image base on the height of each point of surface and in fact each point (x,y) of surface has a height z(x,y). According to height distribution and height difference between different areas of surface we can find information about surface roughness.

Keywords: Fractal, Cyclic Voltammetry, Impedance, Atomic Force Microscopy

Electrochemical study on ionic and electronic conduction in conducting polymer

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Abstract

Charge-transport process of an electrode modified by an electroactive polymer film is affected by ionic transfer at the polymer electrolyte interface, ionic and electronic charge carrier transport inside the polymer and an electronic transfer at the metal polymer interface [1]. These processes would only be dependent on the degree of oxidation of the polymer. However, it has also been suggested that the external supporting electrolyte contacting the polymer film could be incorporated into the polymer phase [2]. This internal electrolyte phase can play an important role in the charge-transport and charge transfer processes of the polymeric material. In this way, a certain fraction of the ionic charge could be transported across the polymer film by this excess of electrolyte and another one by the charge-balancing inions.

A transmission line model was employed to interpret the impedance response of POAP film electrodes in contact with different anions. These different anions were chosen due to their different characteristics of size and electron distribution, which assures a different interaction with the redox centers of the polymer. Electron (De) and ion (Di) diffusion coefficient values were separately obtained. Both diffusion constants depend on the type of anion present in the electrolyte solution. The effect of anions on the electron conduction of POAP was explained in terms of their abilities to reduce repulsive interactions between redox sites of the polymer. Also, both parameters depend on the electrolyte concentration and film thickness. These effects were attributed to incorporation of electrolyte into the porous structure of POAP. The increase of the ion conduction of POAP with the incorporation of electrolyte was attributed to a contribution of the counterions, contained in the inner electrolyte, to the charge transport process.

Keywords: conducting polymer, ionic conduction, impedance

Electrocatalytic Oxidation Of m-Nifedipine Using NHPI And TBAPINO As Catalysts

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Abstract

Dimethyl-2,6-dimethyl-4-(3-nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (m-nifedipine) is a dihydropyridine calcium-channel blocker and is used in the treatment of primary (essential) hypertension to decrease blood pressure. On the other hand, the corresponding pyridine has been detected in the plasma of patients receiving nifedipine , as one of its metabolites. m-nifedipine was synthesized by the reaction of 3-nitrophenyl benzaldehyde with ammonium acetate and ethyl acetate in EtOH under reflux conditions (Hantzsch reaction). The electrochemical properties of m-nifedipine have been investigated in aqueous solution (Britton– Robinson buffer:ethanol 70:30 mixture) by cyclic voltammetry. The method is based on the oxidation of the drug at a graphite electrode. m-nifedipine was electro-oxidized to the corresponding pyridine using N-Hydroxyphthalimide (NHPI) as catalyst or tetrabutylammonium phthalimide-N-oxyl (TBAPINO) for the first time.

The voltammograms of m-nifedipine on pH and scan rate have been examined. Cyclic voltammograms of 1 m-nifedipine shows only one anodic peak at different scan rates. The voltammetric peak at acidic pHs between 1 and 4 is pH-independent, but it shows a pH-dependent behaviour above pH 5. On the other hand, the peak current, Ip , was not affected with pH changes. However, it depends on the nature of the catalytic system. These findings demonstrate that the use of TBAPINO improves the catalytic activity in comparison with NHPI.

Keywords: 1,4-dihydropyridine, cyclic voltammetry, electro-oxidation, N-Hydroxyphthalimide (NHPI), tetrabutylammonium phthalimide-N-oxyl (TBAPINO)

Selective Determination of Penicillamine in Presence of Tryptophan Using a Modified Glassy Carbon Nanotube Electrode

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Abstract

In this study, a new synthesized ferrocene derivative (1-benzyl-4-ferrocenyl-1H-[1,2,3]-triazole) electrodeposited on multi-wall carbon nanotubes (MWCNT) immobilized on the surface of a glassy carbon electrode (GCE) for the simultaneous determination of Penicillamine (PA) and Tryptophan. The electrochemical properties of the modified electrode was studied in a 0.1 M phosphate buffer solution (pH 8.0) using Cyclic voltammetry. The results show that the reversibility of ferrocene derivative is significantly improved at a MWCNT-modified GCE in comparison with GCE alone. This modified GCE shows an excellent electrocatalytic activity for penicillamine (PA) oxidation, with a diminution of the electrode overpotential of about 250 mV. The values of electron transfer coefficients (α), diffusion coefficient (D) and catalytic rate constant (k) were calculated for PA, using electrochemical approaches. Square wave voltammetry exhibited a wide linear dynamic range and a sub-micro molar detection. Also, the modified electrode was used for voltammetric determination of PA in some real samples.

Keywords: Electrocatalysis, penicillamine, Carbon nanotubes,

Designing a Biosensor for Determination of H_2O_2 by Modified Carbon Paste Electrode with Cadmium Oxide Nanoparticles and Cytochrome C

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Abstract

In designing various biosensors and sensing redox proteins the redox activation is not easily done, because protein redox center (metal ion) is located inside the peptide compartment. Thus, various types of nanomaterial which catalyze the redox proteins and facilitate the transfer of electrons between the electrode surface and the center Redox protein are used. The modified electrode was analyzed by SEM microscope. Direct electrochemical of cytochrome c in carbon paste electrode is easily obtained and a reversible pair of peaks that are similar, of Fe (II) and Fe (III) with the formal potential (E °) of about - 0 / 295 volts appears. This electrochemical reaction occurred in phosphate buffer solution (PBS) at PH = 7. Bio-modified electrode that has been produced by our group has a good ability to redox H_2O_2 that is promising for the mass production the third generation of biosensors.

Key words: cytochrome C, carbon paste electrode, hydrogen peroxide, cadmium oxide nanoparticles, Biosensor

Design a biosensor for determination of NO,using modified electrode by CdO NPs and hemoglobin

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Abstract

In this study, modified carbon paste electrode surface with cadmium oxide nanoparticles, the ability for hemoglobin sensing was made possible. This sensing can be used to design biosensor to measure NO gas, because NO has a high affinity to heme iron of hemoglobin, and electrochemical and biochemical studies have revealed that NO penetration into the pocket of the hemoglobin disrupts the coordination bond between ferrous heme and O_2, which finally produces met-Hb. Therefore, it is anticipated that traces of NO in solution may compete with O_2, and the electrocatalysis behavior of hemoglobin reduction is modulated, and of these properties can use to measure NO in solution. Hb immobilized on the electrode surface facilitates the reduction of oxygen, and in original catalyzed it reduction. The modified electrode was recognized by SEM microscope. Finally we designed a novel hemoglobin-based NO biosensor that is not only very sensitive but also usable in air.

Keywords: biosensor, electrochemistry, CdO NPs, hemoglobin, NO

Electron transfer kinetics of cholesterol oxidase on an ionic liquid/NH_2-MWCNTs glassy carbon electrode

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Abstract

Electron transfer kinetic of cholesterol oxidase (ChOx) immobilized on the modified glassy carbon electrode was achieved using a desirable nano-composite containing the amine functionalized multi-walled carbon nanotubes and 1-butyl-3-methylimidazolium tetra fluoroborate as room temperature ionic-liquid. The modified electrode exhibited a couple of quasi-reversible redox peak corresponding to the direct electron transfer of the ChOx ($FAD/FADH_2$). In 0.1 M phosphate buffer solution (pH 7.4) a formal potential of -400 mV was obtained. Apparent heterogeneous electron transfer rate constant (k_s) and charge transfer coefficient (α) was calculated using Laviron's model. α was estimated using the slopes of peak potentials (E_p) vs. logarithm of scan rate (log □). The slopes for the cathodic and anodic peaks, were $-2.3RT/\alpha_c nF$ and $2.3RT/\alpha_a nF$ respectively. The values for $\alpha_c n$ and $\alpha_a n$ were calculated to be 0.46 (average value of $\alpha n=0.46$). Since n was reported to be within the range of 0.3 and 0.7, the values for n and α were estimated to be 1 and 0.46, respectively. Also, the average value of k_s was obtained to be $3.11 \pm 0.57\ s^{-1}$. This value is much better than those reported in the literature. Surface concentration of immobilized ChOx (Γ_c) was also estimated from the slope of peak currents vs. scan rate plot, as 1.62×10^{-11} mol cm^{-2}. As conclusion, the prepared nano-composite made a desirable microenvironment for establishment a direct electron transfer between enzyme and electrode.

Keywords: Cholesterol oxidase, Amine functionalized carbon nanotubes, Room temperature ionic-liquid, Direct electron transfer, Biosensor.

Design a reagentless glucose biosensor based on direct electron transfer of GOD immobilized on modified electrode.

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Abstract

The determination of glucose concentration is very important in clinical, biological and chemical samples.Many techniques have been developed for this purpose.One of the best electerochemical techniques is based on direct electron transfer between glucose oxidase(GOD) and electrode, producing mediatorless glucose sensors. GOD adsorbed on gold colloid nanoparticles maintained its bioactivity and stability. The adsorbed GOD on a colloidal gold modified glassy carbon electrode displayed a pair of redox peaks with a formal potential of –(443±1) mV in 0.1 M pH 5.0 PBS. The immobilized GOD could electrocatalyze the reduction of dissolved oxygen and resulted in a great increase of the reduction peak current. Upon the addition of glucose, the reduction peak current decreased, which could be used for glucose detection with a high sensitivity (8.5 μA/mM), a linear range from 0.05 to 0.30 mM and a detection limit of 0.01 mM at a signal-to-noise ratio of 3δ.

Keywords: Biosensor, Glucose, Glassy carbon electrode, GOD, Electrocatalysis, Colloidal gold.

Penicillamine Determination at Very Low Potential on Bare Carbon Paste Electrode

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Abstract

Penicillamine is a chelating agent. It works by removing excess copper in patients with Wilson disease, reducing excess cystine in patients with cystinuria, and reducing disease activity in patients with rheumatoid arthritis [1]. The overpotential of PA on bare carbon paste electrode (CPE) is high [2]. In this work by using well interaction of PA with copper, this drug was determined in presence of copper (II) ions on CPE at potential of 0.05 V (vs. Ag/AgCl). This potential is very low related to high overpotential of PA on CPE (about 0.8 V) and compare to some recent reports for PA determination on modified CPEs [2,3] and modified carbon nanotube paste electrode [4]. In this report some important parameters, such as pH effect, Cu^{2+} concentration, adsorption time and scan rate was studied. The linear range for PA was from 8.0×10^{-7} to 1.0×10^{-4} M with a detection limit of 100 nm. The relative standard deviation for 6 measurements was 3.8%. This electrode was applied successfully for determination of PA in urine sample.

Keywords: Penicillamine, Carbon paste electrode, Copper (II) ion, Urine

An Immuno-Sensor based on Direct Electrochemistry of HRP for Determination of T_3

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Abstract

3,3′,5-triidothyronine (T_3), the thyroid hormone, is tyrosine-based hormone produced by the thyroid gland and its determination is so important for diagnosis diseases as hyperthyroidism and hypothyroidism. In the present study the amount of T_3 was determined based on a sandwich model immunoassay system. Anti-T_3 antibody was immobilized on nano-magnetic particles via biotin-streptavidin binding. Then T_3 as target antigen was entrapped on immobilized anti-T_3. In the third step, the secondary antibody which was labeled with horseradish peroxidase (HRP) was exposed to the antigen. Formation of each protein layer on nano-magnetic particles was confirmed using cyclic voltammetry method. Finally, based on direct electrochemistry HRP the concentration of T_3 in the solution was estimated. The relative amount of HRP substrates (pyrocatechol, aniline, H_2O_2) were optimized by using voltammetry. The maximum response was obtained at a fixed concentration of pyrocatechol (170 mM), aniline (2.5 mM), H_2O_2 (1.7 mM) in potassium phosphate buffer solution (pH =7.0, 20 mM).

Keywords: 3,3′,5-Triidothyronine (T_3), Electrochemistry, Nano-magnetic particles

Effective parameters in producing electroformed silver oxide electrodes

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Abstract

The most widely used silver oxide electrode for secondary silver-zinc battery is the electroformed type. The electrode is made by silver powder then the electrode is anodized to generate the oxide. Previous works had shown that electrochemical oxidation of silver take place in two distinct steps. Chronopotentiometric data were recorded in our laboratory and by studying of these data we could show that the first reaction prolongs during the second step with the second reaction at the same time in other words quantity of Ag was changing with time till the end of oxidation. Current density, time and electrolyte concentration were studied as effective parameters in the electrochemical oxidation of silver. With this aim these parameters have been changed separately and we could optimize them according to the efficiency of electroformed silver electrode in the silver-zinc battery. It is clear that all the effective parameters are concerned to each other.

Keywords: Electroformed silver electrode, Electrochemical oxidation, Silver-zinc battery

The electrochemical evaluation of the modified cellophane membranes

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Abstract

Here in order to attain the proper membranes which are used in zinc-silver oxide batteries with high discharge rate, modification of the cellophane membrane is carried out. For reaching this goal, two modifying methods are performed. In the first procedure by using silver nitrate and formaldehyde, stability towards hydrolysis and oxidation and also the mechanical resistance are enhanced, and in the second method of modification, functional groups that create crossed-linkages between the cellulosic chains are applied. By using epoxides, the surface etherification reaction is done and the stability and properties of the membrane will improve. For studying the electrochemical operation of two mentioned modified membranes and the unmodified cellophane membrane, a series of dry charged batteries contains of zinc and silver oxide electrodes with different membranes are assembled. The discharge capacity of consecutive cycles, voltage stability, and the cell behavior of fourteen cycles of charge and discharge were compared.

Keywords: Zinc-silver oxide batteries, Cellophane membrane, High rate discharge

Comparison Between Micro and Nano Particles of Electrolytic Manganese Dioxide as Batteries Cathode Materials

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Abstract

Nano and micro particles of electrolytic manganese dioxide (EMD) were synthesis with a novel method. The surface morphology of the nano particles of manganese dioxide was examined using transmission electron microscopes (TEM) and X-ray powder diffraction and the electrolytic manganese dioxide have been found as particle shaped in the average size range of 20 nm. These materials were used as a cathode material of rechargeable alkaline manganese dioxide-zinc (RAM) battery. Electrochemical properties of batteries were investigated by cyclic voltammetry and galvanostatic charge/discharge tests. Cyclic voltammetry studies showed tow pair of well-defined peaks for redox reaction, for nano particles compare to that of micro particles. Also when nano particles were used as a cathode material, the capacity increased about 80 percent and Cycle life tests showed that life time of nano particles is 6.5 times more than micro particles.

Keywords: Rechargeable Alkaline Batteries, Nano particles, Electrolytic Manganese Dioxide.

Glycerol Electrooxidation on the Palladium zero electrocatalyst in Alkaline Media

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Abstract

In this work bis (dibenzylidene acetone) palladium(0), $Pd(DBA)_2$ nano-powder was employed as an effective catalyst for the electrooxidation of glycerol in alkaline environment. The properties of $Pd(DBA)_2$ catalyst were investigated with different electrochemical and spectroscopic techniques; X-ray spectroscopy for characterization of the catalyst structure, Cyclic Voltammetry (CV), Electrochemical Impedance Spectroscopy (EIS) and Chronoamperometry techniques for investigation of glycerol electrooxidation on the surface of $Pd(DBA)_2$. The obtained results have highlighted the excellent electrocatalyst activity of $Pd(DBA)_2$ in terms of both specific peak current density, as high as 0.48 mA/µgPd and onset potential, as low as -0.33V. CVs results demonstrate that $Pd(DBA)_2$ is still active even after 200 cycles. Stability of catalyst against poisoning by intermediate products of glycerol oxidation reaction was confirmed by the Chronoamperometry experiments.

Keywords: $Pd(DBA)_2$ nanostructure, Glycerol, electrooxidation reaction

Preparation and Characterization Of Nickel/Nano- Porous Carbon (Ni-NPC) Composite Structures as a new Material for Electrochemical Supercapacitor

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Abstract

The increased demand for high energy and high power energy storage devices has provided the impetus to develop higher energy electrochemical capacitors (supercapacitors). In this research work, a new composite material (nickel/nano-porous carbon or Ni-NPC) was developed for supercapacitors. Ni-NPC was produced by electrolytic co-deposition of Ni ion and PC particles on copper cylinder substrates. The surface morphology and structure of composites were examined by SEM, EDX, and XRD, and the electrochemical properties were tested by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) in alkaline electrolytes. The BET surface area, mean pore diameter, and pore size distribution were calculated from the adsorption isotherms of nitrogen at –196 °C. The surface area and the mean pore diameter were 925 m2/g and 2–8 nm, respectively. The results showed, the Ni-NPC is a good material for supercapacitors for its nearly high capacitance, energy density and power density.

Keyword: Supercapacitor, nano-porous carbon, Ni/NPC composite, specific capacitance

Thermal batteries and their application in ejection seats

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Abstract

Thermal batteries are high-temperature power sources typically operating between 350 and 550 °C that use an ionically conducting molten salt in the separator between the anode and cathode. Consequently, they will generate heat during operation, which can be detrimental to nearby electronic packages. These types of batteries are primary batteries that use molten salts as electrolytes and employ an internal pyrotechnic (heat) source to bring the battery stack to operating temperatures. Until the electrolyte becomes molten, the battery is inert. Once activated, power can be delivered at extremely high rates because of the high intrinsic ionic conductivity of molten salts.

Thermal batteries primarily used for military applications, primarily as power sources for guided missiles (Tow, Patriot, Sidewinder, Cruise, etc.) and proximity fuses in ordnance devices. Thermal batteries have been utilized in aircraft ejection seats for a number of years. The properties ideally required for this type of application are long term inert storage in typical aircraft environments of vibration, shock and acceleration, fully connected into the system waiting to be brought into operation should the need arise.

This paper discusses the development history and presents a general overview about electrochemistry of this technology. Then, test results of some commercial thermal battery for applying in ejection seat will report.

Keywords: Thermal battery, Industrial aviation, Ejection seat, molten electrolytes.

On the effects of electropolymerization methods on the properties of polyaniline as a bipolar plate material

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Abstract

Bipolar plate is a multifunctional part of a fuel cell. An ideal bipolar plate would exhibit excellent corrosion resistance, good compatibility with other cell components and provide electrical contact with gas diffusion layer with minimum electrical resistive loss. Stainless steel, as a bipolar plate material, has relatively high strength but it may make a passive film during fuel cell operation. This reduces the electrical conductivity and consequently lowers the fuel cell efficiency.

In this study, we covered stainless steel by electrodeposited polyaniline prepared by different electrochemical methods containing of constant applied potential, constant applied current and cyclic voltammetry. Briefly, a solution containing of 0.2 M aniline and 0.1 M H_2SO_4 was prepared. Electropolymerization of aniline took place in a standard three-electrode cell containing of Ag/AgCl electrode as the reference electrode, a platinum grid as auxiliary electrode and a piece of commercial stainless steel as working electrode. Then the electrochemical tests like electrochemical impedance spectroscopy, CV and polarization were carried out. Our studies showed that the corrosive properties of electrodeposited polyaniline depend to its morphology and consequently the electropolymerization method.

Keywords: Bipolar plate, polyaniline, electropolymerization

Electrochemical study of Anthrarobin in absence and presence of nucleophiles

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Abstract

Electrochemistry has emerged as a powerful tool for the synthesis and study of complex organic molecules [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 [2,3].

"Anthrarobin", anthracene-1,2,10-triol involves chemical structure of both antheracene and catechol, reveals inhibitor [4] and photochemical properties [5]. Based on our previous experiences [3], p- or o-benzyl-hydroxy groups provide oxidation ability under the electrochemical conditions to form corresponding quinones [3], in the presence of some nucleophiles with different functional groups undergo typical Michael reaction and leads to form new join compounds. In the present work, by means of the electrochemical techniques like cyclic voltammetry (CV) and controlled potential columetry (CPC), we provide required mechanistic information to better understanding of chemistry of anthrarobin and its behavior on this phenomena. Also, kinetic parameters related to anodic electron transfer process of these molecules were estimated by the fitting of the digitally simulated voltammograms to the experimental data. Finally, electrochemically synthesized product were characterized by spectroscopic techniques such as ^{1}HNMR, MS and IR.

One-Pot Synthesis of Highly Conjugated Symmetric Indole Derivatives: Based on Electrochemical Oxidation of 4-(piperazin-1-yl)phenol In the Presense of Two Nucleophiles

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Abstract

Electrochemical oxidation of 4-(piperazin-1-yl)phenol has been studied in the presence of 1,2-dimethyl indole and 2-methyl indole as nucleophile in water/acetonitrile (70:30) using cyclic voltammetry and controlled-potential coulometry methods. The interesting chemical properties of indole and its derivatives have inspired chemists to design and synthesize a variety of indole derivatives. Among the numerous methods to synthesize substituted indoles, Michael-addition reactions play an important role. In this context, as a part of a program to electrochemical synthesis of novel compound based on the in-situ generation of Michael acceptor [1-3] and containing of indole moiety in structure, we thought that synthesis of organic compounds with both structures of indole and piperazine would be useful from the point of view of pharmaceutical properties. The results revealed that quinone imines derived from oxidation of 4-(piperazin-1-yl)phenol participate in Michael-addition reactions with indoles. we derived a variety of symmetric products in good yields based on controlled potential electrochemical oxidation at carbon electrode in an divided cell.

Keywords: Electrochemical synthesis; **p**-quinone-imines**,** Phenylpiperazine; indole derivatives; Cyclic voltammetry; Hydrolysis reaction.

Electrodeposition and electrochemical studies of α–PbO_2 as semiconductor

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Abstract

Semiconductors for specific electrical and optical properties, are widely used in optic industry, photovoltaic instruments, photo catalytic, solar cells, sensors and lasers. Lead dioxide electrodes are still widely used for these purposes, as the material is cheap and relatively stable under the high positive potentials required and the electrodeposition method is simple, scalable and reproducible.

So, we electrodeposited α–PbO_2 on the lead surface in basic solution (0.1M NaOH) by choronoamperometry method at the applied potential 1V vs. sat'd calomel for 60 seconds. Then, the semiconductor properties of this film, investigated by impedance spectroscopy in frequency range of 100KHz to 10mHz in different dc potential between 0.8 to 1.2 V vs sat'd calomel in dark and light conditions. All of electrochemical studies were carried out in a conventional three electrode cell powered by an electrochemical system comprising of EG&G model 273A potentiostat/galvanostat and EG&G frequency response analyzer. Electrochemical impedance spectroscopy studies showed the resistance of high frequencies and also diameter of charge transfer resistance decreased with light (Fig.1). For a semiconductor in depletion condition, space charge capacitance can be obtained by impedance measurements. The values of C_{SC}^{-2} can be determined experimentally as a function of potential by using Mott-Schottky equation. The positive slopes of Mott-Schottky plots (Fig.2) of them show that we can categories them as n-type semiconductor. Hence, the value of the free charge carrier concentration, Nd, can be calculated from the slop of $1/C_{SC}^{2}$ versus V plot and flat band potential, Vfb, can be obtained from the intercept on the potential axis. It is observed that these two important semiconducting parameters are different under light illumination from their values in the dark condition.

Key words: Alpha lead dioxide; Electrodeposition by choronoamperometry; semiconductor; Electrochemical impedance spectroscopy.

Electrocatalytic Oxidation of Captopril by Iodide and Its Application to Pharmaceutical Analysis

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Abstract

Potassium iodide was used as a homogeneous electrocatalyst in the oxidation of captopril. Cyclic voltammetry and chronoamperometry were used for kinetic studies. The diffusion coefficient and catalytic rate constant were calculated to be 4.94×10^{-5} cm^2 s^{-1} and 1.87×10^3 M^{-1} sec^{-1}, respectively. Linear sweep voltammetry was applied to quantitative determination of captopril; a linear calibration curve was obtained for captopril concentration in the range of 4.0–500 μM with a limit of detection of 0.84 μM and a sensitivity of 0.03 $A.M^{-1}$. The method was applied to the determination of the drug in its tablets and validation methods showed that the results were quite satisfactory.

Keywords: Captopril, Electrocatalysis, Iodide, Voltammetry

Solid State Silver Selective Electrode Based on 5-(4 dimethylaminobenzyliden)rhodanin ionophore

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Abstract

Silver has an important role in electrical and electronic applications, photographic film production, manufacturing of fungicides and drugs [1]. Potentiometric detectors based on ion selective electrodes are especially suited for fast, accurate, reproducible and selective determination of metal ions [2].

A silver selective electrode was prepared based on PVC membrane and 5-(4-dimethylaminobenzyliden)rhodanin as an ionophore. Several influential parameters on the electrode performance were optimized. With the optimized composition (PVC:30%; NPOE:61%; NaTBP: 6%; Ionophore:3%), the electrode shows a slope of 56.5 mV/dec over the concentration range of 1.0×10^{-5} to 1.0×10^{-2} M. the detection limit of the electrode based on the intersection of the extrapolated linear response part and horizontal part of the electrode was 1×10^{-5}. This sensor has a short response time of 15 s and could be used in the pH range of 2-10. The electrode was applied for determination of silver ion in water samples.

Keywords: Silver ion selective electrode; Sensor; PVC membrane; 5-(4-dimethylaminobenzyliden)rhodanin

Determination of Tetracycline at a UV-irradiated DNA film modified glassy carbon electrode

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Abstract

In this study, interaction between tetracycline (TC) and DNA in the Britton–Robinson buffer solution (BR) was studied by cyclic voltammetry. The results indicated that tetracycline can bound to DNA and the binding constants K were obtained. Then DNA was fabricated on a glassy carbon electrode by UV-irradiation. Through this process, water-soluble DNA was converted into insoluble materials, and a stable DNA film formed on the electrode. The electrochemical oxidation behaviors of TC have been studied at UV-irradiated DNA film modified glassy carbon electrode (UV-DNA-GCE) and bare GCE by electrochemical methods. This modified electrode shows an enhanced effectiveness towards the oxidation of TC. TC at the electrode has a linear dynamic range of 3.0×10^{-7}- 9.0×10^{-5}moll^{-1} and a detection limit of 2.77×10^{-7}mol l^{-1}.

Keywords: Tetracycline, DNA modified electrode, Differential pulse voltammetry

Determination of Nitrite on Sol-gel Electrode Modified with Multi-walled Carbon Nanotubes

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Abstract

Nitrite is used as an additive for the preservation of food products due to its antimicrobial action. Nitrite is highly toxic due to its carcinogenic effects, e.g., its reaction with dietary components in the stomach forms toxic and carcinogenic nitrosamines [1]. Therefore, the quantitative determination of nitrite concentrations is of great importance, especially for control of the quality of food. Various methods for nitrite determination have been developed in recent years, such as, spectroscopic [2], chromatographic [3] and electrochemical methods [4,5]. In the present work, a new electrochemical method was proposed to determination of nitrite using sol-gel electrode modified with carbon nanotubes (MWCNTs). The modified electrode was presented excellent electrocatalytic activity for nitrite. Determination of nitrite on this electrode was performed by differential pulse voltammetry method. After optimizing the operational conditions, determination of low levels of nitrite was possible.

Keywords: Nitrite, Modified electrode, Sol-gel, MWCNTs

Electrocatalytic oxidation of hydrazine on a modified gold electrode with a new Cd(II)-terpyridine complex by sol-gel technique

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Abstract

In the present study, elctrocatalytic oxidation of hydrazine in pH 7 phosphate buffer solution has been examined on a gold modified electrode with a new derivative of terpyridine Cd complex by sol-gel technique.The modified electrode containing Cd(II) complex that was achieved on the surface of gold electrode by sol-gel technique. This involves two steps, i.e. the first formation of a colloidal suspension (sol) containing Cd complex solved at in and immersing the gold electrode into sol and then gelation of the sol on the surface of electrode. This electrode has a good sensitivity and electrocatalytic activity toward oxidation of hydrazine. Using cyclic voltammetry, a large catalytic current is observed upon oxidation of hydrazine in phosphate buffer (pH 7), compared to the current obtained from the Cd(II) complex modified electrode with no hydrazine present. It has been found that the catalytic current of the system depends on the concentration of hydrazine. The overall number of electrons involved in the catalytic oxidation of hydrazine and the number of electrons involved in the rate determining step were found to be 4 and 1, respectively. Finally the catalytic rate constant of hydrazine oxidation at a new modified electrode was determined by cyclic voltammetry experiments.

Keywords: Electrocatalytic oxidation, Hydrazine, sol-gel, Cd(II)- terpyridine

Application of an Acetaminophen Ruthenium Oxide Nanoparticles Sensor for the Simultaneous Determination of Ascorbic acid, Dopamine and N-Acetyl-L-Cysteine

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Abstract

N-Acetyl-L-Cysteine (NAC), Dopamine (DA) and ascorbic acid (AA) are compounds of great biomedical interest in human metabolism. So, it is very important to measure the concentration of AA in the presence of DA. In this work a new modified electrode was prepared by electrodeposition of ruthenium oxide nanoparticles (RuONP) and acetaminophen (AC) at the surface of a glassy carbon electrode (ACRuONP-GCE). The charge transfer coefficient, α, and the surface charge transfer rate constant, k', for the electron transfer between NAC and the modified electrode were obtained 0.6, and 5.63×10^{-4} cm s^{-1}, respectively in pH=7.0. Also, the detection limit of 6.33 μM is obtained for NAC determination at the ACRuONP-GCE surface using a DPV method. The modified electrode is found quite effective not only in detection of NAC, but also in simultaneous determination of AA, DA and NAC which coexist in a homogeneous solution.

Keywords: N-Acetyl-L-Cysteine, Nanoparticles, Ascorbic acid

Electrocatalytic Determination of 1,3-dihydroxybenzene Resorcinol at Carbon nanoparicle-Chitosan Composite Film Electrode

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Abstract

Resorcinol (RS), 1,3-dihydroxybenzene, is a hydroxyl substituted phenolic derivative widely used in the many fields of rubber, plastics, organic synthesis, wood adhesives, phenolic resins, pharamaceuticals, lotions, hair daye formulation [1,2]. This compound is a moderate toxic substance and easily soluble in water. There is a growing need for developing highly sensitive, simple methods to detected resorcinol in the waste water at a low level. This study represented a modified electrode for sensing of RS with carbon nanoparticles- chitosan (CNP-CH) composite. Voltammetric experiments were performed using a Metrohm Computrace Voltammetric Analyzer model 797 VA. A stock solution of chitosan (CH) was prepared by dispersing of it in acetic acid. The modified suspension was prepared by dispersing of some CNP in CH solution under sonication, the modified glassy carbon electrode (GCE) was prepared by casting of the suspension on GCE surface and letting water evaporate. The electrode characterization was performed by cyclic voltammetry (CV), electrochemical impedance spectroscopy and atomic force microscopy (AFM). A voltammetric study of resorcinol has been carried out at the surface of glassy carbon electrode modified with ultrathin carbon nanoparticles -chitosan composite film. The modified electrode shows an excellent electrocatalytic effects on the oxidation of RS. The effect of pH of the buffered solutions and potential sweep rate on the response of RS was studied. Differential pulse voltammetry (DPV) was used for quantitative determination of RS. A dynamic linear range for resorcinol was obtained in the range of 3.0×10^{-5}-1.0×10^{-3} mol L^{-1}. The detection limit was estimated to be 1×10^{-5} mol L^{-1}. This electrode was applied for determination of RS in real water samples successfully.

Electrochemical behavior of ketamine in nonaqueous solutions

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Abstract

Ketamine is a short-acting but powerful general anesthetic which depresses the nervous system and causes a temporary loss of body sensation. In this paper, electrochemical behavior of ketamine has been studied at Pt, GC and Au electrodes in various organic solvents. Electrochemical techniques including differential pulse voltammetry (DPV), cyclic voltammetry, and chronoamperometry were employed to study the mechanism of the electrode process. An irreversible behavior was observed from cyclic voltammograms obtained under different conditions, which was dependent upon the anode nature. The diffusion constant (D) and transfer coefficient (α) were obtained from this process. DPV studies indicated the best peak potential and high current of ketamine oxidation obtained at Pt electrode and in Dimethyl sulfoxide. The results indicated that DPV at a Pt electrode can be used for the determination of ketamine in organic solution.

Keywords: ketamine, Voltammetry, nonaqueous

Application of Ordered Mesoporous Carbons for Simultaneous Electrochemical Determination of Epinephrine and Acetaminophen

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Abstract

The ordered mesoporous carbons (OMC) have a large surface area, well defined pore size and chemical inertness [1]. The ordered nano-structured carbon material has been widely used in sensing [2], energy storage [3] and electrocatalytic application [4].

In this research, we reported an easy method for synthesis of ordered mesoporous carbon (OMC) with hexagonal arrays of tubes. The synthesized OMC was characterized using X-ray diffraction and scanning electron microscopy. Due to the large surface area and good biocompatibility of OMC, The OMC modified glassy carbon (OMCs/GC) electrode was prepared. The electrochemical behavior of epinephrine (EP) and acetaminophen (AP) at OMC/GC electrode was also investigated using cyclic voltammetry (CV). In differential pulse voltammetry (DPV) technique, both EP and AP give sensitive oxidation peaks at 120 mV and 320 mV, respectively. Therefore, investigated method was applied for the simultaneous determination of EP and AP. The low detection limits were found to be 0.08 µM for AP and 1.0 µM for EP.

Keywords: Ordered mesoporous carbons, Acetaminophen, Epinephrine

Determination of dopamine using carbon paste electrode modified α – cyclodextrin

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Abstract

Among many methods for determination of DA in biological samples, α –cyclodextrin modified electrodes have shown to be a powerful tool. In this work, a carbon paste electrode modified with α –cyclodextrin is preported and electrochemical behavior of DA at it is described. The modified-CPE was prepared by mixing graphite powder and paraffin liquid a mortar by hand until a homogeneous paste was obtained.

α- cyclodextrin deposition on electrode for 25N.Differential puls voltammetry(DPV) measurements were performed in 0.1M phosphate buffer solution (pH=7),DA was prepared 1×10^{-6}M stock solution by dissolving in double distilled water.The DP voltammetry peak current was found to be linear with the DA concentration in the range $1\times10^{-3}$to 1×10^{-6}M. The lowest detection limits (S/N = 3) were 0.۴۳µg/ml. In general CPE are popular because CPE are easily obtainable at minimal costs. CPE is highly selective sensors for inorganic and organic electrochemistry.

Keywords: Carbon paste electrode, Dopamine .α –cyclodextrin

Electrocatalytic and Simultaneous Determination of Isoproterenol, Uric Acid and Folic Acid at Molybdenum (VI) Complex-Carbon Nanotube Paste Electrode

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Abstract

This work describes the development, electrochemical characterization and utilization of a novel modified molybdenum (VI) complex-carbon nanotube paste electrode for the electrocatalytic determination of isoproterenol (IP). The electrochemical profile of the proposed modified electrode was analyzed by cyclic voltammetry (CV) that showed a shift of the oxidation peak potential of IP at 175 mV to less positive value, compared with an unmodified carbon paste electrode. Differential pulse voltammetry (DPV) in 0.1 M phosphate buffer solution (PBS) at pH 7.0 was performed to determine IP in the range from 0.7-600.0 μM, with a detection limit of 35.0 nM. Then the modified electrode was used to determine IP in an excess of uric acid (UA) and folic acid (FA) by DPV. Finally, this method was used for the determination of IP in some real samples.

Keywords: Isoproterenol, Uric Acid, Folic Acid, Carbon nanotubes, Electrocatalysis, Chemically modified electrodes

Stabilization of 2-Hydroxy-N'-[(E)-1-(3-methyl-2thienyl) methylidene] benzohydrazide on Gold Electrode as a Biosensor

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Abstract

A self-assembly technique for electrode modification is simple and has diverse materials for modification. A number of organic compounds containing the thiol group can readily adsorb on the electrode surface, such as gold, and form a self-assembled monolayer. Epinephrine is one of the important neurotransmitters in mammalian central nervous systems. In this work the application of self-assembled monolayer on gold electrode for the electrochemical determination of epinephrine in the presence of ascorbic acid was studied. The electrode modification process was characterized by cyclic voltammetry and electrochemical impedance spectroscopy (EIS). The EIS was used to evaluate pK_a of the adsorbed 2-hydroxy-N'^{1}-[(E)-1-(3-methyl-2 thienyl) methylidene] benzohydrazide on gold surface in the presence of $Fe(CN)_6^{3-/4-}$ as a redox probe. The electrochemical behaviors of epinephrine on modified electrode were studied in phosphate buffer solution (pH=6). Differential pulse voltammetry of epinephrine at the modified electrode exhibited two linear dynamic ranges with a detection limit of 0.39 µM.

Keywords: Self Assembly, Epinephrine, Ascorbic acid, Electrochemical Impedance Spectroscopy

A voltammetric method for determination of carbidopa in the presence of uric acid

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Abstract

Accordingly, the development of an analytical method is very important to control the content of these catecholamines in pharmaceuticals. Different techniques have been employed for the determination of carbidopa (CD) in pharmaceutical formulations .Long analysis times, the use of organic solvents and high costs are some of the drawbacks associated with these techniques. Voltammetry is considered an important electrochemical technique utilized in electroanalytical chemistry because it provides low cost, sensitivity, precision, accuracy, simplicity and rapidity. To the best of our knowledge, no study has reported the electrocatalytic determination of CD in the presence of uric acid using carbon nanotube paste electrodes. In this study, a chemically modified carbon paste electrode (MCPE) containing p-aminophenol and carbon nanotubes was constructed. It showed good characteristics for the oxidation of CD. This sensor exhibited a potent and persistent electron mediating behavior followed by well separated oxidation peaks of CD and uric acid.

Keywords: Carbidopa, Uric acid, p-Aminophenol, Sensor

A new electrochemical sensor for determination of $Cd^{2+}$by using carbon paste electrode modified with ion-imprinted polymer

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Abstract

Cadmium is an element with no known biological function and is one of the most serious environmental pollutants [1]. A new Cd(II)- imprinted polymer was prepared by formation of 1-(2-pyridylazo)-2-naphthol (PAN) complex for stripping and determination of Cd^{2+} in real samples. Polymerization was performed with ethyleneglycoldimethacrylate (EGDMA), as crosslinking monomer and methacrylic acid as functional monomer; in the presence 100 mg of 2,20-azobis(isobutyronitrile) (AIBN), as initiator. The imprint copper ion was removed from the polymeric matrix using 5M HNO_3. A carbon paste electrode modified with IIP powder was used for fabrication of a Cd^{2+} sensitive electrode. The measurements were carried out in an cloused circuit accumulation at a negative potential (-1.2 V) following by electrolysis of accumulated Cd(II) at the modified carbon paste electrode and differential pulse voltammetric determination. Some parameters, effective on the electrode response, were optimized. The developed method was applied to Cadmium determination in water samples.

Keywords: Cd(II), Ion-imprinted polymer, Carbon paste electrode, Voltammetry

Determination of chlorpheniramine by using Carbon Paste/Cobalt nanocomposite electrode

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Abstract

Carbon paste electrode have attracted significant interest during last decade because of low background current, low cost, renewability of surface and ease of modification. In this paper, 3dimentional cobalt porous spheres with a hierarchical structure used as modifier due to its unique properties such as high specific surface area and large pore volume. The modified electrode was applied for voltammetric determination of chlorpheniramine which is an anti-histaminic drug. The modified electrode has an excellent performance in electrocatalytic activity, sensitivity toward chlorpheniramine. The effect of some parameters such as pH and scan rate was studied in voltammetric response. Differential pulse voltammetry (DPV) was used for quantitative determination of chlorpheniramine. A dynamic linear range was obtained in the range of 1.0×10^{-5}-1.0×10^{-7} mol L^{-1}, and the detection limits were estimated to be 3.0×10^{-8}.

Keywords: Chlorpheniramine, Voltammetry, Carbon paste electrode, Cobalt 3D Nanostructure

Modified glassy carbon electrode by electropolymerization of *meso*-tetra(p-carboxyphenyl)porphyrinato nickel(II) for the determination of dopamine in the presence of ascorbic acid

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Abstract

Detection and determination of the trace amounts of biologically important compounds using electrochemically modified electrodes have been widely used as a selective and sensitive analytical method [1].Dopamine (DA) is a catecholamine neurotransmitter which plays an important role in the central nervous, hormonal, renal, and cardiovascular systems in biological and medical samples [2]. (AA) hinders (DA) trace determination, as the oxidation potential of (AA) is close to that of (DA) at most solid electrodes. The most commonly practiced way to separate or eliminate the oxidation peak of (AA) from (DA) may be polymer modification of the electrode surfaces [3].

In this work a glassy carbon (GC) electrode was modified with electropolymerized *meso*-tetra(p-carboxyphenyl)porphyrinato nickel(II) (poly-NiTCPP) in 0.1M NaOH solution at which dopamine (DA) and ascorbic acid (AA) were clearly resolved at pH 7.4 by cyclic voltammetry (CV), square wave voltammetry (SW) and differential pulse voltammetry (DPV). Also electrochemical impedance spectroscopy (EIS) studies were carried out to investigate the kinetic behavior of dopamine electro-oxidation on modified electrode (GC/poly-NiTCPP). Electrochemical studies were carried out in a conventional three-electrode cell powered by an electrochemical system comprising of EG&G model 273 potentiostat / galvanostat and Solartron model 1255 frequency response analyzer. Polymeric film was prepared by oxidative electro-polymerization of complex by repetitive cyclic voltammetry (RCV) in 0.1M NaOH aqueous solution.

Keywords: Dopamine*; meso*-tetra(p-carboxyphenyl)porphyrinato nickel(II); Modified electrode; Ascorbic acid

Prepraration, structural characterization and activity of carbon supported non-platinum nanoparticles for oxygen electroreduction in direct methanol fuel cells

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Abstract

Carbon-supported Pd and Pd_xCo alloy electrocatalysts of different Pd:Co atomic ratios(1:1, 2:1, 3:1 and 10:1) were prepared by the impregnation synthesis method at room temperature by ethylene glycol (EG) reduction. As-prepared Pd_xCo bimetallic nanoparticles show a single-phase face-centered-cubic (fcc) disordered structure. The performance of these electrodes in the ORR was measured with cyclic voltammetry (CV), linear sweep voltammetry (LSV), electrochemical impedance spectroscopy (EIS), chronoamperometry (CA), inductive coupled plasma (ICP), X-ray diffraction (XRD), and scanning electron microscopy (SEM). For synthesized Pd_xCo electrocatalysts, the highest catalytic activity for the ORR, was found for a Pd:Co atomic ratio of 3:1 in presence of methanol. Since the Pd_xCo/C electrocatalysts are inactive for the adsorption and oxidation of methanol, it can act as a methanol-tolerant ORR catalyst in a direct methanol fuel cell (DMFC).

Keywords: Oxygen Reduction Reaction; Pd_xCo alloy; Impregnation method; Methanol tolerance

Ni-Al LDH Nanoparticles Modified Sol-Gel Derived Carbon Ceramic Electrode

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Abstract

A novel modified carbon ceramic electrode (CCE) containing Ni-Al LDH nanoparticles was fabricated by a sol–gel technique. The use of carbon ceramic electrode (CCE) modified with Ni - Al LDH nanoparticles was studied for the electrocatalytic oxidation of formaldehyde in alkaline medium by cyclic voltammetry and chronoamperometry. In CV studies, in the presence of formaldehyde, modified electrode shows a significantly higher response for formaldehyde oxidation. The peak current of the oxidation of nickel hydroxide increase is followed by a decrease in the corresponding cathodic current in presense of formaldehyde. The anodic currents show linear dependence on the concentration of formaldehyde. The process is diffusion controlled and the current-time responses follow cottrellian behavior. The effect of kinetic parameters such as the electron transfer coefficient (α) and the number of electrons involved in the rate-determining step (n_α) for the oxidation of formaldehyde were determined utilizing cyclic voltammetry (CV).

Keywords: Modified carbon ceramic electrode, Formaldehyde**,** Cyclic voltammetry, Sol–gel

A Comparison of the Kinetic Parameters of Dopamine, Acetaminophen and Acetylsalicylic acid at Bare and Ruthenium Oxide Nanoparticles Modified Glassy Carbon Electrode

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Abstract

Modification of electrochemical interface with nanosized metal oxide is one of the recent approaches used extensively in the development of sensing platforms. Due to different oxidation states of ruthenium, its compounds have been used as excellent electron transfer mediators for modification of different electrode surfaces. In the present work, the electrochemical oxidation of dopamine (DA), acetaminophen(AC) and acetylsalicylic acid (ASA) has been studied on a ruthenium oxide nanoparticles modified glassy carbon electrode (RuON-GCE) using chronoamperometry and rotating disk electrode voltammetry (RDE) method. The heterogeneous charge transfer rate constant (k') and diffusion coefficient (D) are calculated for DA, AC and ASA at bare glassy carbon electrode (BGCE) and RuON-GCE. The results showed that diffusion coefficient of DA, AC and ASA at the BGCE surface are equal in comparison with RuON-GCE. Also, heterogeneous charge transfer rate constant of DA, AC and ASA at BGCE are smaller than in comparison with RuON-GCE.

Keywords: Acetaminophen, Acetylsalicylic acid, Diffusion coefficient

Electrochemical Performance of Polyaniline/MWCNT Nanocomposites as Electrode Materials

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Abstract

Polyaniline (PANI) has been considered as one of the attractive electrode materials in supercapacitors due to its low cost, easy synthesis compared to other conducing polymers. The combination of PANI with various carbon materials such as carbon nanotubes (CNTs) has been proved to be attractive to reinforce the stability of PANI as well as maximize the capacitance value. In this work, PANI/MWCNT nanocomposites with different mass ratio prepared by adopting the in situ chemical synthesis method and their electrochemical performance are evaluated by cyclic voltammetery (CV). The electrode was prepared by mixing the nanocomposite material, carbon black and nafion in a mass ratio of 75: 20: 5 and the samples were casted on to a glassy carbon electrode. The structure of these composites was characterized by IR, SEM techniques. The electrical conductivity and specific capacitance of nanocomposites were enhanced compared with individual PANI. The samples showed good application in supercapacitors.

Keywords: PANI, CNT, Supercapacitor

Simultaneous Determination of Tyramine, Levodopa and Uric acid with a new Multi-walled Carbon Nanotube composite

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Abstract

In this study, a simple and novel modified electrode for simultaneous determination of tyramine (Tyr), Levodopa (LD) and uric acid (UA) was reported for the first time. Tyr is one of the well-recognized biogenic amines [1]. Tyr and Tyr-containing foods cause dietary migraine patients to suffer a classical migraine attack [2]. LD is considered the most effective treatment available for hyperuricemia and Parkinson's disease [3] and UA is the end product of purine metabolism since its abnormal concentration levels lead to hyperuricaemia and gout [4]. Therefore, their determination is necessary in the diagnosis and treatment of diseases. For this purpose, multi-wall carbon nanotubes (MWCNT) are evaluated as an immobilization matrix for the construction of a modified electrode based on quercetin electrodeposited on MWCNT immobilized on the surface of a glassy carbon electrode (GCE). Quercetin MWCNT modified GCE (QMWCNT-GCE) showed an excellent electrocatalytic activity for Tyr, LD and UA oxidation. The QMWCNT-GCE displayed strong function for resolving the overlapping voltammetric responses of Tyr, LD and UA into three well-defined voltammetric peaks with a decrease in the electrode overpotential of about 175, 254 and 156 mV, respectively. The detection limits for Tyr, LD and UA were 0.3, 0.1 and 0.5 µM, respectively. Furthermore, QMWCNT-GCE showed very good responses for determination of these compounds in real samples.

Keywords: Tyramine, Quercetin, Modified electrode, Electrodeposition

Application of 1,4-Diaminobanzan as a Homogenous Mediator for Electrocatalytic Determination of Norepinephrine

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Abstract

Carbon nanotubes are a kind of porous nanostructure material with properties such as high electrical conductivity and high mechanical strength. The subtle electronic properties of carbon nanotubes suggests that they have the ability to promote electron transfer reaction when used as the electrode material in electrochemical reaction, which provides a new way in the electrode surface modification for designing new electrochemical sensors. In this study, a novel modified carbon nanotubes paste electrode of 1,4-diaminobanzan was fabricated, and the electrooxidation of it has been studied using electrochemical methods. The modified electrode displayed strong catalytic function for the oxidation of norepinephrine. A linear response in the range of (3×10^{-6})-(4.5×10^{-4}) M with a detection limit (S/N = 3) of 1×10^{-6} for norepinephrine was obtained.

Keywords: 1,4-Diaminobanzan, Norepinephrine, Carbon paste electrode, Voltammetry

Electrocatalytic oxidation of *N*-actylcysteine in the presence of acetaminophen using novel dopamine-derivative as a mediator

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Abstract

N-acetylcysteine (NAC) is typically administered for the treatment of acetaminophen (AC) overdose. Large quantities of paracetamol cause aminor metabolite called N-acetylp-benzoquinone imine (NAPQI) that accumulates in the body and is normally conjugated by glutathione. When taken in excess ,the body's limited glutathione reserves fail to inactivate the toxic NAPQI. The metabolite thus produced is then free to react with key hepatic enzymes, damaging hepatocytes. Due to this fatal effect, simultaneous determination of these compounds is very important. However, a major problem is that at bare electrodes, the anodic peak potentials for NAC and AC are almost the same, which results in their overlapped current responses and makes their discrimination very difficult. In this study, a new dopamine-derivative was synthesized and its application was investigated for the simultaneous determination of NAC and AC. This sensor exhibited a potent and persistent electron mediating behavior followed by well separated oxidation peaks of NAC and AC.

Keywords: *N*-acetylcysteine, Acetaminophen, Multiwall carbon nanotubes paste electrode

Selective Detection of CN^- in the Presence of High concentration of SCN^- Using Self-Assembly Modified Gold Electrode with Gold Nanoparticles

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Abstract

A new synthesized ligand containing thiol group, 1,2,4,5-tetrakiss[2-(4-phenyl-5-thion-1,2,4-treeazole-3-ile)phenoxy methyl]benzene (TPTAP) was bound on to surface of the pretreated gold electrode (GE). Gold nanoparticles (GNPs) were self-assembled to the electrode binding with TPTAP via strong Au-S covalent bond to fabricate the gold nano self-assembled modified electrode (GNPs/ TPTAP /GE). The electrochemical behavior of CN^- on the modified electrode was investigated with cyclic voltammetry. A well-defined redox peaks of CN^- on the GNPs/ TPTAP /GE were obtained at $Ep_a = 0.3$ V and $Ep_c = 0.1$ V (vs. Ag/AgCl), respectively. The peak current of CN^- is linear with the concentration of CN^- in the range of 123µM-6.5mM, with the correlation coefficient of 0.996. The detection limit is 1.78µM(S/N = 3). The modified electrode exhibited an excellent reproducibility, sensivity and stability for determination of CN^- in the presence of high concentration SCN^-.

Keywords: Gold nanoparticles, CN^-, SCN^-, Gold electrode

Effect of Morphological Parameters Variations across Anode Electrode on the Aging of Li-Ion Batteries

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Abstract

In this work we model the variation of solid electrolyte interface (SEI) across the anode electrode of lithium ion battery. It is anticipated that due to higher thickness of SEI layer at the electrode side connected to the separator, a more critical condition prevails there. The present work also investigates the effects of variations in the morphological parameters including porosity, interfacial surface area and active particle radius across anode electrode on the uniformity of side reaction. Results show that positive gradients of morphological parameters across anode electrode, when parameters are changed independently, have considerable effects on uniformity of side reaction. This could be a criterion in choosing new morphologies for the part of anode electrode connected to separator.

Keywords: Solid Electrolyte Interface, Morphology, Variation, Aging

Effect of Anions on an Organic Pollutant Removal in Electrochemical Coagulation Process using aluminum and iron anodes

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Abstract

In textile industries the large amounts of various electrolytes including sodium nitrate, sulphate and chloride are used in dyeing process which appear in consequent wastewater stream. In this study, influence of chloride, sulfate and nitrate anions on the removal of reactive red 43, as a model pollutant, using electrochemical coagulation process was evaluated**.** Higher removal efficiency of dye was obtained using aluminum anodes in the presence of chloride ions. Potentiodynamic polarization tests and determination of total Al^{3+} concentration showed that sulfate ions inhibit the release of Al^{3+} from the anode. In EC using iron anodes, the higher removal efficiency was achieved in the presence of chloride and sulfate ions. Potentiodynamic polarization tests revealed the passive layer formation on the iron surface in the solution containing nitrate which caused to a considerable decrease in the current and removal efficiency.

Keywords: Wastewater Treatment, Electrochemical coagulation, Potentiodynamic polarization test.

Electrochemical Hydrogen Production by MoO_3/ Shimalite-Nickel modified Carbon Paste Electrode

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Abstract

Nowadays fossil fuels consumption is very high, and their resources are limit. Furthermore, combustion of fossil fuels produces several pollutants. Therefore attempts are focused on replacing other fuels, which can be renewable and green. Hydrogen is being considered as a suitable and clean substitute of fossil fuels for future energy supply [1]. There are several ways for hydrogen production that one of them is electrochemical method. In this method Pt is extensively used, but there are two disadvantages (high cost and its low resources on crust [1]) for this electrode. In this study carbon paste electrode was chemically modified with MoO_3 (13%) and Shimalite-Nickel commercial catalyst (13%). The response of the proposed electrode was examined in 2 M H_2SO_4 for hydrogen production. The results showed that the onset potential for hydrogen evolution is about -0.3 V, and its current density is high. Also by applying 80 successive voltammograms from 0.5 to -0.8 V, the current density not only did not decrease the performance of the electrode, on the contrary increased its performance. It can be concluded that the proposed electrode is a good candidate when we don't want to use expensive Pt electrodes.

Keywords: Hydrogen evolution, Carbon paste electrode, MoO_3, Shimalite-Nickel

Influence Fe_3O_4 Ferrofluid on Corrosion of Copper Metal in different Rotation Speeds

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Abstract

Ferrofluids are composed of nanoscale particles (diameter usually 10 nanometers or less) of magnetite,hematite or some other compound containing iron. They potentially useful in many applications such as electronic devices, mechanical engineering, arospace,analytical instrumentation ,medicine,heat transfer and optics.Corrosion of various part of these systems is one of the major issues in the industry,hence the corrosion of Cu metal in Fe_3O_4 Ferrofluid was investigated by several electrochemical methods including open circuit potencial(OCP) ,liner sweep voltametry (LSV) and cyclic voltammetry (CV) in different rotation speeds with scan rate1 mv/sec.The experimental result shows that corrosion rate decreases in higher rotation speed.

Keyword: Corrosion,Ferrofluid, Fe_3O_4

Corrosion Protection of Aerospace Aluminum Alloys by Self-Assembled NAnophase Particle Sol-Gel

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Abstract

The Air Force Research Laboratories are developing environmentally benign alternatives to the traditional chromated coating for aircraft corrosion protection, targeted at three last decades. The Self-assembled NAnophase Particles (SNAP) process is a method of forming functionalized silica nanoparticles in-situ from hydrolyzed tetramethoxysilane (TMOS) or tetraethoxysilane (TEOS) and glycidoxypropyltrimethoxysilane (GPTMS) in an aqueous sol–gel process, and then cross-linking the nanoparticles to form a thin, fully dense, protective film on Al aerospace alloys. These nanostructured coatings have been shown to provide an excellent barrier to corrosion for aluminum aerospace alloys; and other applications are envisioned.

This paper investigates modification of SNAP formulation with Tetrapropylorthotitanate (TPOT) in the presence of a complexing agent. Films were formulated and developed to produce a dense barrier sol–gel coating on AA2024. Corrosion protection properties of these films were evaluated with potentiodynamic scan (PDS) electrochemical technique, electrochemical impedance spectroscopy (EIS) in Harrison solution.

Keywords: Corrosion, SNAP sol-gel, AA2024

Electropolymerization of Nano Structure Poly(aniline-co-4-hydroxy benzyl acetic acid) on 430 Stainless steel and Investigation of its Corrosion Protection Properties

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Abstract

The discovery of the corrosion protective properties of electrochemically deposited conducting polymers such as polythiophene, polyaniline and polypyrrole on metallic surfaces has opened a new dimension in the field of anticorrosive organic coatings[1-8].

In this study electrochemical deposition of Nano Structure poly(aniline-co- 4-hydroxy benzyl acetic acid) was carried out by cyclic voltametry using aqueous oxalic acid 0.3M solutions as reaction medium in order to protect the ferritic and economic 430 SS from corrosion. The monomer ratio was of 1:1 (mol/mol). The electrodeposited coatings were characterized by cyclic voltammetry and FT-IR techniques. The morphology and the structure of the films were investigated by scanning electron microscopy (SEM).Corrosion behavior of coated steels was investigated by potentiodynamic polarization and electrochemical impedance spectroscopy(EIS). The obtained results revealed that nano structure poly(aniline-co-4-hydroxy benzyl acetic acid) coatings provided a noticeable protection against corrosion progression.

Keywords: Nano Structure, Aniline, 4-Hydroxy benzyl acetic acid, Corrosion, Electropolymerization

Comparing performance of anticorrosive Second and Third generation phosphate Pigments

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Abstract

The best compounds used as anti-corrosive pigments were chromate ones but their application has been limited recently due to their poison. Second and third generation pigments are suitable substitutes for those chromate pigments. Logically, in this study preserving behavior of zinc-aluminum-phosphate (ZPA) and zinc-aluminum-poly phosphate (ZAPP) in epoxy powder coating on surface of steel with ST37 alloy in 3.5% sodium chloride corrosive solution was investigated. For this purpose EIS test as well as Cathdic Disbonding test were done. Samples which have organic coatings entail zinc-aluminum-poly phosphate in shorter terms of immersion showed better preservation properties which is related to higher solubility of that in water. In addition, these pigments are capable of production of more phosphate groups, so they can passivate the surface better while, in immersion times took long, coatings contains zinc-aluminum-phosphate showed better results This can be deduced, as more intense polarity and solubility of poly-phosphate pigments in long terms of immersion results in more electrolyte adsorption and leading toward swelling and faster organic coating degradation consequently. Furthermore samples baring coating containing Zinc-Aluminum -Polyphosphate showed better performance than coating contains Zinc-Aluminum-Phosphate pigment in cathodic disbonding test.

Keywords: ZPA pigment, ZAPP pigment, EIS, Cathodic Disbonding, Corrosion

Posters

Influence of Nano Spinel Coatings on Cr_2O_3 Thickness for Solid Oxide Fuel Cell Application

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Abstract

Oxidation resistance of solid oxide fuel cells interconnects can be ameliorated by use of a protective, effective, relatively dense and well adherent spinel coating. The aim of this study was to compare the effect two types of coating layer on the growth of chromia layer. AISI 430 ferritic stainless steel was coated in a cobalt and manganese-base pack mixture by pack cementation separately. Isothermal and cyclic oxidation were applied at 800 °C to evaluate the oxide layer thickness which was created during these tests. XRD analisis showed the cobalt coating transformed to $MnCo_2O_4$ and $CoCr_2O_4$ spinels during isothermal oxidation and manganese coating transformed to nano manganese spinels. Results showed that the increase of isothermal oxidation time and cycle number increased the oxide thickness. Also in each test the cobalt coating showed lower oxide thickness in comparison to the manganese coating.

Keywords: Chrimia (Cr_2O_3), AISI 430 stainless steel, Nano spinel, Oxidation.

Evaluation of Electrical Resistance Activation Energy of Nano Spinel Coated Interconnects

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Abstract

In order to restrict oxidation and enhance the ferritic stainless steels electrical conductivity, which are used as interconnect material in solid oxide fuel cell, a layer of protective/conductive coating can be deposited on the surface. The aim of this research was to investigate the electrical resistance activation energy of AISI 430 ferritic stainless steel which was coated in a cobalt and manganese-base pack mixture by pack cementation separately. Electrical resistance of the coated substrates was measured as a function of temperature by annealing the samples from room temperature to 700 ºC. Also electrical resistance has been measured as a function of time during annealing at 700 ºC. The cobalt coating transformed to $MnCo_2O_4$, $CoCr_2O_4$, $CoFe_2O_4$ and Co_3O_4 spinels during isothermal annealing and manganese coating transformed to nano manganese spinels. Results showed the increase of temperature caused to the increase of electrical resistance. The formation of spinel compositions improved electrical resistance activation energy of cobalt-coated substrates (0.0.26 eV) and manganese-coated substrates (0.029eV) compared to the uncoated substrates (0.033 eV).

Keywords: Solid oxide fuel cell (SOFC), Oxidation, Activation energy, AISI 430 ferritic stainless steel, Interconnect.

Investigation of Oxidation Activation Energy of Cobalt Coated Interconnects

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Abstract

The oxidation resistance of AISI 430 ferritic stainless steels which are used as interconnects in solid oxide fuel cells (SOFCs) for the intermediate temperature operation can be improved with a protective coating layer. In this study, the pack cementation method was employed to coat cobalt onto AISI 430 ferritic stainless steel. Isothermal oxidation, cyclic oxidation, and oxidation at different temperatures (600-900 ºC) were applied to evaluate the parabolic rate constant (k_p). In each test, the coated samples demonstrated lower $k_{p,}$ indicating that the coating layer had acted as a mass barrier against the outward diffusion of cations, especially Cr. The formation of $MnCo_2O_4$ and $CoCr_2O_4$ spinels, during the oxidation, improved the oxidation resistance of AISI 430 ferritic stainless steel and it resulted to the lower oxidation activation energy of cobalt coated samples in comparison with the coated ones.

Keywords: AISI 430 ferritic stainless steel, oxidation, oxidation activation energy, solid oxide fuel cell (SOFC).

Improvement of Oxidation Resistance of Mn-Coated AISI 430 Alloy For SOFC Application

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Abstract

The oxidation resistance of AISI 430 ferritic stainless steels which are used as interconnects in solid oxide fuel cells (SOFCs) for the intermediate temperature operation can be improved with a protective coating layer. In this study the pack cementation method was employed to coat AISI 430 ferritic stainless steel. Isothermal oxidation, cyclic oxidation and oxidation at different temperatures (600-900 ºC) were applied to evaluate the parabolic rate constant. The coated samples demonstrated lower kp in each test and it indicates that the coating layer has acted as a mass barrier against the outward diffusion of cations specially Cr. XRD analysis revealed that the formation of Mn_3O_4 and $MnFe_2O_4$ spinels during oxidation caused to the improvement of the oxidation resistance and it resulted to the lower oxidation activation energy of Mn-coated samples in comparison with the coated ones.

Keywords: manganese, AISI 430 ferritic stainless steel, oxidation activation energy, solid oxide fuel cell (SOFC).

Investigation of micro-arc oxidized films on AZ31 magnesium alloys in different electrolytes

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Abstract

Micro-arc oxidation (MAO) is a relatively new surface treatment method based on electrochemical and plasma chemical knowledge which can form corrosion protective films on valve metals such as titanium, aluminum and magnesium alloys .In this research micro arc oxidized films were formed on AZ31 magnesium alloys in two different electrolytes composed of silicate and phosphate with NaF addition. Microstructure, element and phase composition and corrosion resistance of coatings were investigated by SEM, EDX, XRD and corrosion tests respectively. The results indicated that the coatings had porous morphology which was composed of Mg_2SiO_4 and $Mg_3(PO_4)_2$ for silicate and phosphate coatings respectively. The corrosion resistance of MAO films was improved considerably as showed by potentiodynamic polarization curves, so that in comparison with the electrode treated in phosphate bath, the electrode treated in silicate containing bath had better corrosion resistance.

Keywords: magnesium, micro arc oxidation, corrosion resistance

Electrochemical Oxidation of Ethyl Benzene By Nickel Electrode

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Abstract

In this paper we studied the electro chemical oxidation of ethyl benzene by nickel electrodes. One interesting field in chemistry which has still remained unsolved is selective oxidation of C-H bonds in ethyl benzene oxidation. The product of this oxidation is acetophenon that it is used as intermediate for manufacture of alcohols, pharmaceuticals, resins, esters, tear gas and aldehydes. Cyclic voltammetric method was employed for electrochemical measurements. Electrolyze technique must be used at first in order to make the electrodes. Graphite electrode was mechanically polished by papers from different grades prior to electro-deposition of the nickel. Then, acidic solution of $NiSO_4$ was used to deposit Ni on graphite. The Activity of C/Ni electrodes for oxidation of ethyl benzene was dependent on the content of Ni which was electro-deposited. The correlation between oxidation current and scan rate was also discussed in this research.

Keywords: Electrochemical Oxidation Ethyl Benzene, Nickel Electrode

Impedance responses of poly ortho aminophenol film electrodes in the presence of different anions: comparative study

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Abstract

Some practical applications of electrodes coated with electroactive polymer films depend on both the possibility of an electron transfer mediation at the solution-polymer interface and the permeability of the film to act as an effective barrier protecting the electrode from fouling. However, the mechanisms of these processes in some polymers are not well understood.

Improved understanding of the detailed mechanism of the charge transfer process across the polymer-electrolyte interface, where the electrolyte solution contains an electroactive solute, and of the charge transport phenomena inside the films should facilitate optimization of these thin-film devices. The polymerization of o-aminophenol by potential sweeps in acidic solutions presumably leads to phenoxazine and phenazine chains. The impedance response of conducting polymers derived from arylamines generally shows, before and during the insulator–conductor transition, a large depressed semicircle in the complex plane representation. This has been interpreted through a charge transfer resistance in parallel with the corresponding double layer capacitance. The nature of this semicircle is controversial. Some workers state that the semicircle is due to charge transfer at the metal-polymer interface and others at the polymer-solution interface. Data about the dependence of this charge transfer on the electrolyte composition and on the polymer film thickness are scarce.

Keywords: POAP, impedance, diffusion

Preparation and characterization of aluminum electrode modified by palladium nanoparticles and its use for the oxidation of methanol

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Abstract

Palladized aluminum electrodes are prepared by electroless plating of palladium nanoparticels on aluminum plates. The morphology and surface analysis of Palladized aluminum electrodes are investigated using scanning electron microscopy and energy-dispersive X-ray spectroscopy, respectively. The results indicate that palladium nanoparticles are homogeneously deposited on the surface of titanium plates. The electro-catalytic activity of Palladized aluminum electrodes in the methanol electro-oxidation is studied by cyclic voltammetry and chronoamperometry methods. The results show that the electro-catalytic oxidation of methanol on the Pd Palladized aluminum electrode improved compare to pure palladium electrode and confirmed the better electro-catalytic activity and stability of these new electrodes. These results indicate that the system studied in the present work is the most promising system for use in direct methanol acid fuel cells.

Keywords: Fuel cell, Palladium nanoparticle, Electro-oxidation, Palladized aluminum, Methanol.

Simultaneous Detrermination of N-Acetylcysteine and Folic Acid Using a Modified Glassy Carbon Nanotube Electrode

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Abstract

In this study, A novel 1-benzyl-4-ferrocenyl-1H-[1,2,3]-triazole (BFT) modified glassy carbon nanotube electrode (BFTGCNE) was prepared for the simultaneous determination of N-acetylcysteine (NAC) and folic acid (FO). The separation of the oxidation peak potentials for NAC–FA was about 280 mv. The BFTGCNE showed an excellent electrocatalytic activity for NAC oxidation. The anodic peak potential for the oxidation of NAC at modified electrode is about 330 mV. Therefore, we prepared BFTGCNE and studied its electrochemical properties in a 0.1 M phosphate buffer solution (PBS) (pH 8.0) using Cyclic voltammetry (CV). The values of electron transfer coefficients (α), diffusion coefficient (D) and catalytic rate constant (k) were calculated for NAC, using electrochemical approaches. Square wave voltammetry exhibited a wide linear dynamic range and a sub-micro molar detection. Also, the modified electrode was used for voltammetric determination of NAC in some real samples.

Keywords: N-Acetylcysteine, Folic Acid, Electrocatalysis, Carbon Nanotubes

Electrooxidation of methanol on Ni and NiCu modified graphite electrode

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Abstract

Investigation of electrooxidation processes of alcohols is critical in attaining a better understanding of the direct alcohol fuel cell (DAFC). Methanol is one of the interesting future fuels for fuel cell application. Compared with other cells, the direct methanol fuel cell (DMFC) has several advantages such as high efficiency, very low polluting emissions, a potentially renewable fuel source, fast and convenient refueling, simple operation and ease of fuel storage and distribution. The low operating temperature of a DMFC (typically <95 ◦C) allows for easy start up and rapid response to changes in the load or operating conditions [1–3]. However, compared to the hydrogen based fuel cells, DMFC still remains to be further developed. One of the problems still unsolved is the slow kinetics of methanol electrooxidation. Considerable efforts have been directed towards the study of methanol electrooxidation at high pH. The use of alkaline solutions in a fuel cell has many advantages such as increasing its efficiency, a wider selection of possible electrode materials, almost no sensitivity to surface structures and negligible poisoning effects in alkaline solutions [4].

The purpose of the present work is to study the electrochemical oxidation of methanol on a nickel and nickel-copper modified graphite electrode in a solution of 1M NaOH and the usefulness of the electrocatalytic process. Electrochemical studies were carried out in a conventional three electrode cell powered by an electrochemical system comprising of EG&G model 273 potentiostat/galvanostatand Solartron model 1255 frequency response analyser. The system is run by a PC through M270 and M398 commercial software via a GPIB interface.

Nickel and nickel–copper modified graphite electrodes prepared by anodic cyclic voltammetry in nickel sulfate and copper sulfate solution were examined for their redox process and electrocatalytic activities towards the oxidation of methanol in alkaline solutions. The methods of cyclic voltammetery (CV), chronoamperometry (CA) and impedance spectroscopy (EIS) were employed. In CV studies, in the presence of methanol NiCumodified electrode shows a significantly higher response for methanol oxidation. The peak current of the oxidation of nickel hydroxide increase is followed by a decrease in the corresponding cathodic current in presence of methanol. The anodic peak currents show linear dependency upon the square root of scan rate. This behavior is the characteristic of a diffusion controlled process. Under the CA regime the reaction followed a Cottrellian behavior and the diffusion coefficient of methanol was found to be 2×10^{-8} cm^2 s^{-1}. A mechanism based on the electro-chemical generation of Ni^{3+} active sites and their subsequent consumptions by methanol have been discussed.

Induced catalytic mechanism by surface adsorption

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Abstract

electron transfer trough physisorbed 4-methylesculetin was examined on glassy carbon (GC) electrode for inner and outer sphere electron transfer systems in aqueous solution.[1] GC Electrode shows strong adsorption of 4-methylesculetin in aqueous solution. The various redox couples were examined for evaluation of their electron transfer via physisorbed layer (or layers) of 4-methylesculetin on GC surfaces in aqueous electrolyte solutions consists of catechol, 4-methylcatechol, 4-tertiobuthylecatechol, 3,5-di-tert-butylcatechol and Fe(II). These systems were categorized according to their kinetic sensitivity to surface adsorbed 4-methylesculetin.[1,2] Electron transfer from catechol was profoundly inhibited by a monolayer (monolayers) of 4-methylesculetin on the GC surface, so that voltammetric waves were not observed.[2] Other system, Fe(II), is insensitive to surface adsorption and is considered outer sphere and electron tunneling system through adsorbed monolayer films. On the other hand catechol derivative such as 3,5-ditertiobutylcatechol that comities for adsorption sites on GC electrode with 4-methylesculetin can participate in direct electron transfer and it’s voltammetric wave can be observed in presence of 4-methylesculetin.

keywords: 4-methylesculetin, adsorption, catalytic process

Investigation of the Structure Effect on Nucleophilic Addition of Amines to Electrochemically Generated Quinone

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Abstract

Electrochemical oxidation of catechol has been studied in the presence of various aromatic and aliphatic amines with electron donating and withdrawing substituent. The present results complete the previous report on the anodic oxidation of some catechols in aqueous solutions. The results of this work show that catechol is oxidized in water to their respective o-quinone. The quinone is then attacked by the amine group to form amino-o-quinone derivatives. The reactions of electrogenerated o-quinone with amines are studied by diagnostic criteria of cyclic voltammetry and ECE mechanism is proposed for the overall reactions. The cyclic voltammograms were digitally simulated and the effect of amine structure and substituent are studied kinetically. The effect of pH on the oxidation pathway is remarkable considering the basicity of alkyl or aryl-amines. The rate constants of Michel addition (km) are calculated for various amine derivatives at a wide range of pHs. The simulated cyclic voltammograms show good agreement with those obtained experimentally.

Keywords: Cyclic voltammetry, Digital simulation, o-Quinone, ECE mechanism.

Mechanistic Study of ORR on Ag/GC Disk Electrode in Acidic Solution by Impedance Spectroscopy

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Abstract

The electro-reduction of oxygen on silver-modified glassy carbon electrode (Ag/GC) in acidic solution at different potentials was studied by the method of ac-impedance spectroscopy. The influence of the electrode potential on impedance of reduction reaction is studied and a mathematical model was put forward to quantitative account for the impedance behavior of oxygen reduction reaction (ORR). At potentials higher than -0.4 V/Ag-AgCl, a pseudo-inductive behavior is observed. The conditions required for this behavior are delineated with the use of the impedance model.

Keywords: Disk Electrode, Impedance Spectroscopy, Oxygen reduction reaction**.**

Effect of Pt content in Pt based catalysts on chemical stability of nanocomposite membrane based sPEEK

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Abstract

A novel $Cs_{2.5}H_{0.5}PW_{12}O_{40}$ supported Pt catalyst (Pt-$Cs_{2.5}H_{0.5}PW_{12}O_{40}$ catalyst or Pt-$Cs_{2.5}$) was prepared to mitigate the free radical attack through the membranes in fuel cell environment. In this study, we have prepared nanocomposite membranes based on sPEEK and Pt-$Cs_{2.5}$. The prepared particles were characterized by X-ray powder diffraction (XRD) and XRF was used to determine the particle size and quantity of reduced platinum on the $Cs_{2.5}H_{0.5}PW_{12}O_{40}$ catalyst supports respectively. The membranes' chemical stability was investigated via ex situ Fenton test. In the chemical stability tests, the chemical stability of membranes reduced with increasing amount of Pt catalysts.

Keywords: Polymer electrolyte membrane, Sulfonated poly(ether ether ketene), Nanocomposite membrane, Chemical Stability.

Measurement of activity coefficients of bio-molecules in aqueous NaCl solutions at 298.2 K

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Abstract

The industrial scale production of biochemical is of potential interests for the chemical, pharmaceutical and food industries. The separation and purification of bio-molecules is one of the important economical stages in their production. In separation we need equilibrium and thermodynamic properties such as activity coefficient. Knowledge of the thermodynamic properties of bio-molecule in aqueous electrolyte solutions is a first step towards the rational design of production of bio-molecules.

We used electrochemical cell with two ion-selective electrodes (Cation and Anion) against double junction reference were used to obtain the activity coefficient of biomolecules like penicillin and cephalexin in aqueous electrolyte solution. The mean ionic activity coefficient was determined from measurements of potential differences of a cation an anion each versus a double junction reference electrode. The activity coefficients of antibiotics were calculated from the values of the mean ionic activity coefficients using the exact cross differential relation between them.

The maximum concentration of sodium chloride and biomolecule were (1, 0.012) mol.kg $^{-1}$, respectively.

Key words: Activity coefficient, Electrolyte, NaCl, Electrochemistry

Hardness, Softness and Electrophilicity as Electrochemical Reactivity Indices in Catechols

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Abstract

An electron uptake will be energetically favorable when the system posses a higher electrophilicity. A small gap between frontier orbitals means easier change in electron density and more reactivity. Therefore hardness, softness and electrophilicity can be used as reactivity indices in chemical process. In this study, 16 catechol derivatives as model compounds have been studied using cyclic voltammetry on a glassy carbon electrode in aqueous solution containing phosphate buffer as supporting electrolyte. The chemical structure of catechols and their corresponding ortho-benzoquinones has been optimized by using Gaussian 03 program and Ab Initio method in gas and water media. Optimization was performed at SCIPCM model and #B3LYP/6-311+G** level. Cathodic peak potentials were correlated with the computed LUMO energy levels (R^2 0.77 in gas, 0.85 in water) of ortho-benzoquinone derivatives. Half wave peak potentials were correlated with the calculated hardness (R^2 0.78 in gas) and softness (R^2 0.74 in gas) of catechols.

Keyword: Reactivity Indices, Catechols, Gaussian 03.

DFT Investigations of Redox Properties of Catechols and Their Corresponding ortho-benzoquinones

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Abstract

Since long, it has been known that the HOMO and LUMO energy levels of chemical systems correlated with the respective redox potentials. In this investigation, a group of 16 catechol derivatives has been studied using cyclic voltammetry on a glassy carbon electrode in aqueous solution containing phosphate buffer as supporting electrolyte. The chemical structure of 16 catechol derivatives and their corresponding ortho-benzoquinones has been optimized by using Gaussian 03 program and Ab Initio method in gas and water media. Optimization was performed at SCIPCM model and #B3LYP/6-311+G** level. Anodic peak potentials were correlated with the computed HOMO energy levels of catechol derivatives. Also, cathodic peak potentials were correlated with the calculated LUMO energy levels of electrochemically generated ortho-benzoquinones. An interesting relationship was observed between E_p^a vs. E_{HOMO} (R^2 0.7 in gas, 0.7 in water) for catechols and E_p^c vs. E_{LUMO} (R^2 0.78 in gas, 0.82 in water) for ortho-benzoquinones.

Keyword: Catechols, Ortho-benzoquinone, Gaussian 03.

Modern Technology in Producing Continual Energy from Organic Compounds and Industrial Wastewaters by Microbial Fuel Cell (MFC)

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Abstract

With growing population and evanescent resources of fossil fuels, demand for replacing them with renewable resources and bio-energy; have been transformed to a public interest, also a necessity among researchers and industry owners. In other hand, harmless, safe and low-cost exclusion urban and industrial wastewaters due to variety of industries, is a facing challenge for industrial and developing countries. From this view, turning to technologies and equipments that can refine, analyze, eliminate wastewaters and produce energy simultaneously; are converted to a novel and very interesting research area. Among all, technology of Microbial Fuel Cells has attracted much attention as producers of continual energy from organic compounds and industrial and urban wastewaters that are economic, effective and low harm for environment. Microbial Fuel Cells is able to convert chemical energy to electrical energy directly by a destruction process on organic compounds. From 2000, wastewaters and other complex compounds from organic materials were under experiments in fuel cells for first time.It made this possibility to refine and produce electricity – or bio-energy – simultaneously. For first time, Microbial Fuel Cells were creating in order to refine wastewater at experimental scale in Australia [3].In this article, we present mechanism of Microbial Fuel Cells and effect of functional parameters on its operation. Parameters such operation temperature, culture in anode, amount of input material, input material, analyzer microorganisms and type of membrane.

Keywords: Microbial Fuel Cell، Technology ،Energy

The effect of electrolyte on operating the zinc-silver oxide cells

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Abstract

The concentrated solutions of potassium hydroxide not only provide ionic conductivity between the zinc and silver oxide electrodes, but hydroxide ions are consumed as a part of the chemical and electrochemical reaction at the zinc electrode. Consequently silver zinc cells under certain circumstances can be limited in capacity by the amount of hydroxide ions. When the rate at which the hydroxide ions diffuse at the surface became less than the rate at which the insoluble zinc intermediates are formed, the electrochemical reaction ceases. In the other word a passive layer was constructed on the zinc electrode surface and remaining zinc cannot contribute in the electrochemical reaction. In this investigation, with regards to results, in operating parameters of batteries concentration and amount of electrolyte are important as well as electrodes. The amount of electrolyte that is necessary for the cell to operate as a silver limited cell is optimized in this study.

Keywords: Potassium hydroxide, Electrolyte, Silver zinc cells

Modeling of MnO_2 Particle Size and Applied Current Effect on Maximum Capacity of EMD Batteries

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Abstract

Electrochemical properties of the Electrolytic Manganese Dioxide(EMD) batteries strongly depend on the physical and chemical properties such as particle size, and applied current. In the present study, factorial design of experiment was employed to investigate the effect of two factors, size of MnO_2 particles (18nm and 290nm) and applied current (50ma and 500mA) on maximum capacity at two levels low and high. Main effects and interaction effects of two factors were analyzed using statistical technique. A model equation relating the level of parameters and maximum capacity was obtained and it was validated by tests the model at current 250mA. The results were analyzed statistically using analysis of variance, F-test and lack of fit to define most important variables affecting the maximum capacity. The most significant variable was thus found to be particle size.

Keywords: Electrolytic Manganese Dioxide, Batteries, Factorial design of Experiment, Analysis of Variance.

Palladium Membrane for Hydrogen Purification

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Abstract

Palladium-based membranes have been the focus of many studies because of their ability to separate hydrogen from other gases. Nanoporous layer with high chemical and mechanical strength is very attractive in hydrogen purification. In this study, dense palladium coating was fabricated on macroporous α-alumina using nanoporous γ-alumina thin film as surface modifier. The γ-alumina film has been prepared by a catalytic sol-gel process. Aluminium isopropoxide was starting material and transparent solution was prepared and coated on α-alumina disk by dip-coating. Then heated slowly (1° C/min) to 400°C in air. Pd layer deposited electrolessly on it. Surface morphology of γ-alumina film and palladium layer have been studied by EDS and SEM. Finally Permeation study is reported .

Keywords: Palladium membrane; sol-gel; permeation; diffusion barrier.

Review and comparison of approaches to proton exchange membrane fuel cell modeling

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Abstract

A review of recent literature on proton exchange membrane fuel cell modeling is presented. Proton exchange membrane fuel cell (PEMFC) components and its functions are introduced and explained briefly. The state of the art of fuel cell modeling is presented. Comparisons of both modeling and experimental studies are also presented in tables. Governing equations and assumptions are briefly reviewed and presented for PEMFCs.

Keywords: Proton exchange membrane fuel cells; Fuel cell modeling; Computational modeling

Performing of a Gas Diffusion Layer Made by Pulse Ultrasonic Technique in PEM Fuel Cell

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Abstract

The efficiency of gas diffusion layer (GDL) in PEM fuel cell is serious parameter because of its functions such as current collecting, supplying the reactant gases, and water management. In this work the ink of the electrode microporous layer was made by pulse ultrasonic method to improve the homogeneity of GDL. Then ink painted on Toray carbon paper as the electrodes backing substrate. A homemade single PEMFC was employed to investigate the performance of membrane-electrode-assembly under a wide range of operational conditions. The main focus was on pursuing the manufactured GDL effect on the cell performance due to varying cell temperature, pressure and relative cathode humidity. Electrochemical impedance spectroscopy was also carried out to confirm the polarization curves results in order to find optimal operating conditions. Results showed that control of the operational conditions, especially relative cathode humidity is an effective way to eliminate the flooding and sudden voltage losses.

Keywords: diffusion layer, electrode flooding, PEMFC

fuel cell in alkaline media

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Abstract

Alkaline direct ethanol fuel cell (ADEFC) has become a new focus due to faster electrochemical reaction kinetics in alkaline medium than in acid medium.

The charge carrier in the electrolyte ion exchange membrane is anion (OH^-) and it moves from the cathode side to the anode side, opposite to the movement of the proton in acid membrane (reversed electro-osmotic effect is formed which may depress ethanol crossover through the membrane accordingly).

Ethanol is also a preferred fuel because of its non-toxicity and less carbonation effect in the electrode. Ethanol has higher energy density than methanol (8.0 kWh kg^{-1} vs. 6.1 kWh kg^{-1}) and can be produced in large quantities from agricultural products or biomass, which will not change the natural balance of carbon dioxide in the atmosphere in contrast to the use of fossil fuels. The main mechanisms of poisoning are blocking of the pores in the cathode with K_2CO_3, which is not reversible, and reduction in the ionic conductivity of the electrolyte, which may be reversible by returning the KOH to its original concentration.

In this study an air breathing direct ethanol fuel cell has been made and evaluated at room temperature with static fuel composition of 10% Wt Et-OH and 10% Wt KOH. The maximum power density and open circuit voltage were of 40 mW/Cm^2 and 900 mV respectively which is comparable with conventional direct ethanol fuel cell (DEFC)

Keywords: Direct ethanol fuel cell, air- breathing, alkaline media

Effect of Diffusion Layer Ink Preparation Method on the Permeability and Performance of Electrodes in PEMFC

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Abstract

Air permeability is one of the properties which play an important role in the performance of the diffusion layers in proton exchange membrane fuel cells (PEMFCs). In other words the performance of PEMFCs can be predicted in according to permeability of the gas diffusion layer. Higher permeability in gas diffusion layer leads to better performance in PEMFC. In this study the permeability of two gas diffusion layer made by carbon paper (TGP-H-060T) as support and covered equally by same amount of microporous layers with same composition, which made by two different methods, have been studied. Pulse ultrasonic and magnetic stirring methods were employed for diffusion layer inks preparation. The measurements have been done at room temperature with N_2 flow in the range of 100 to 500 ml/min under 5% compression. I-V curves results in the PEMFC indicate there is a good consistency between permeability data and performance of the GDE.

Keywords: gas diffusion layer, permeability, PEMFC

Investigation and Study of Zinc-Silver Oxide Battery

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Abstract

Batteries are used a lot as one of the most applicable sources of energy in industry, army and daily usages. One of these batteries is Zn-Ag_2O battery, which in the middle of nineteenth century fabricated primary sample of them. The diffusive potential of oxygen in silver can be demonstrated by the formation of Ag_2O. High electrical resistance is among the Ag_2O characteristics which is used as an active material. Zinc is the anodic pair in this electrochemical cell consisting of features such as: low equilibrium potential, reversibility, adjustment with aqueous electrolyte, low equivalent mass, high theoretic capacity, high special energy, high volumetric density, low price and high formability. It is also active material in rechargeable alkaline batteries. In this study, different time of silver coating on graphite was studied by using different electrochemical techniques. The effect of area and its impact on discharge time, and also the charge of coating Ag on graphite area by electrochemical methods in different time via alkaline solution (NaOH or KOH) were also investigated by the researchers in order to find discharge curves and the comparison between discharge curves and different concentration of electrolyte. Finally, the battery capacity was calculated to reach a concentration, coating time, and an optimized charge via electrochemical techniques.

Key words: Alkaline batteries, zinc-silver oxide battery, coating, charge and discharge curve

Effect of temperature on the performance of PEMFC prepared by Ballard diffusion medium

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Abstract

The performance of the proton exchange membrane fuel cell (PEMFC) is significantly affected by its operational conditions such as; anode, cathode and cell temperatures, gases pressure and humidity of reactants. Temperatures of reactants play an important role in the balance between of electrode flooding and ionic conductivity of the membrane. In this paper, effect of various operational conditions including anode, cathode and cell temperatures on the performance were evaluated in homemade PEMFC made by MEA base on Ballard backing layer at ambient pressure. Results show that the performance of the MEA made by Ballard backing layer in both side increases with increasing of cell temperature but it can work better at dry conditions especially in the cathode side. In other words the best performance has been achieved at low humidity of anode and cathode. This result could be related to thinner microporous layer and higher permeability of Ballard diffusion medium.

Keywords: PEMFC, relative humidity, operational conditions

Investigation and Study of Zinc-Copper Oxide Battery

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Abstract

In the last century, batteries are use a lot as one of the most applicable sources of energy. These applications are in industry, military and daily utilizations. Zinc- Copper Oxide can be mentioned as one type of battery which for high electrical conductivity and low price of primary materials is one of the active materials in batteries. In this study we presentation one technique for preparation of copper oxide. The anodic used couple at this electrochemical cell is Zinc with the properties such low equilibrium potential, reversibility, adjustment with aqueous electrolytes, low equivalence weight, high theoretic capacity, high especial energy, high volume density energy, low price and formability. Zn is one of the favorite active materials in rechargeable alkaline batteries. In this study, different length of copper oxide wire with same cross section, different time of charge and they effect on discharge curves was studied. Finally the battery capacity was calculated to reach optimized time of charge at different length of copper oxide wire via electrochemical techniques.

Key words: Zinc-copper oxide battery, Alkaline batteries, Electrochemical Techniques

Evaluation Air Breathing Direct Alcohol Fuel Cell with different Alcoholic fuels in Alkaline Media

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Abstract

Direct alcohol fuel cells (DAFCs), which generate electricity from electro-oxidation of alcohols, are promising electrochemical devices for various applications. During the past decade, much attention has been paid to direct methanol fuel cells (DMFCs). Several highr molecular weight alcohols and poly-alcohols such as ethanol, ethylene glycol and glycerol are featured by high solubility in water, low toxicity, high boiling point and high specific energy. These alcohols are difficult to oxidize on platinum or platinum alloys. In particular, no known anode catalyst based on platinum has demonstrated the capacity to produce acceptable power densities in either a direct alcohol fuel cells, unless a partially inorganic solid electrolyte is used at temperatures more than 130 ^{o}C. In this work, we developed an air breathing direct passive alcohol fuel cell with non-platinum electrocatalysts which can work with different alcohols. Performance results show that the performance of developed DAFC by different alcohol fuels is comparable with the best reported results in the open literature.

Keywords: Direct Alcohol Fuel Cell (DAFC), Anion Exchange Membrane (AEM), non-platinum electrocatalyst.

NewTechnology in Producing Molecular Imprinting Catalysts (MICs)and quartz crystal microbalance (QCM) and Investigation of EffectiveParameters

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Abstract

At the present time, numerous compounds are used as template molecules by molecular imprinting technology. Essentially, template polymers can be employed directly in isolation media. Role of template polymers as the pertinent molecular recognition elements in various fields such as quartz crystal microbalance (QCM), molecularly imprinted solid phase extraction (MI-SPE) and molecular imprinting catalysts (MICs) has been analyzed in this study. Our results indicate that among other things the most critical field of molecularly imprinted polymers (MIP) is performance and construction of molecular imprinting catalysts which are synthesized only in a condition in which a substrate, a product or a compound like the transition state can be used as the template molecule. Concerning very close similarity between MIPs and antibodies, a catalytic antibody with similar activity can be prepared in the template polymer; so, an industrial catalytic antibody provided with useful features of industrial molecules can be achieved. P-nitro phenyl methylphosphonate, for instance, was used as the template to synthesize the first industrial catalytic antibody for hydrolyzing p-nitro phenyl acetate. Similarly, our findings represent that in spite of several conducted studies about construction of MICs, the synthesized catalysts almost always have been used lesser than their natural counterparts because of their heavy reliance on template molecules. Therefore, some deeper and more methodical studies were carried out to improve MICs which will be addressed in detail in this paper and all involving parameters including template molecules, functionalized molecules, cross-linking factors and other actors are separately dealt with.

Keywords: Molecular Imprinting ¸ Catalysts ، product ، Monomer ،industrial

Corrosion Protection of Copper by the Self assembled Layer of New Schiff base in Sodium Chloride Media

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Abstract

Copper is important metal that is largely used in industrial applications due to its good mechanical workability, high thermal and electrical conductivity. Prevention of copper oxidation is one of the major challenges. Among different approaches, self assembled monolayer (SAM) technique has recently attracted much attention in the coating and corrosion protection research area. SAM, spontaneous film that is formed through a simple chemisorptions process, is dense and ordered monolayer which act as effective barriers and protect copper against corrosion. The effect of MPMABT SAM is investigated on copper corrosion in 3.5% NaCl. The corrosion inhibition ability of MPMABT SAM is measured using Tafel measurements and impedance. Tafel curves of copper with MPMABT SAM show inhibiting for both cathodic and anodic processes about 95%. The adsorption isotherm and effect of temperature on efficiency inhibition is investigated, The E_a (19.57 kJ mol^{-1}) and ΔG°_{ads}(-41.77 kJ mol^{-1}) show chemisorption.

Keywords: Copper, EIS, Polarization, SAM, Sodium chloride

Utilization of Polyacrylamide/Silver Composite in Electrochemical Capacitor

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Abstract

The conductive polymers recently have been used in electrochemical capacitors as an electrode or as the electrolyte. In this paper, a polyacrylamide/Ag composite is synthesized by free radical polymerization. The resulting composite material is used in an electrochemical capacitor as electrode material. The characterization of the composite is performed by X-ray diffraction (XRD) and scanning electron microscopy (SEM). The electrochemical test is conducted by cyclic voltammetry (CV) method in KOH and Na_2SO_4 as electrolytic solutions. In comparison to other reported results, the polyacrylamide/Ag composite shows good and acceptable capacitance. In this application of the polyacrylamide/Ag composite, the polyacrylamide serves as the backbone, and Ag serves as the electro-active material. The composite produces higher specific capacitance in the KOH electrolyte than in the Na_2SO_4 electrolyte. This behavior is explained by the respective physical characteristics of the two electrolytes.

Key words; electrochemical capacitors; polyacrylamide/silver composite; electrolyte

Hg^{2+}-selective Electrode Using diethyldithiocarbamate as an Ionophore in PVC Matrix

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Abstract

A simple and fast method for determination of trace amounts of Hg(II) ions using poly(vinyl chloride) membrane, containing synthesized diethyldithiocarbamate as a membrane carrier, was used to fabricate a Hg(II) selective electrode. The optimum composition of the best performing membrane contained diethyldithiocarbamate : DBBP: NaTPB:PVC in the ratio 5:100:1:100 w/w. This electrode exhibited a near Nernstian slope of 250 ± 0.9 mV/decade of activity in the working oncentration range of 8.0×10^{-7}-8.0×10^{-1} M. It displayed a stable potential response in the pH range 2.0-4.2. The electrode exhibited a fast response time of less than 20 s and could be used for at least 10 weeks without any considerable divergence in potentials. This electrode showed very good selectivity over most of the common cations including Li^+, K^+, Na^+, Ni^{2+}, Co^{2+}, Cu^{2+}, Sr^{2+}, Ba^{2+}, Cs^+, Zn^{2+}, Mg^{2+}, Cd^{2+}, Al^{3+} and Fe^{3+}. The method is applied to the determination of Hg(II) ion from water samples.

Key Words : Hg^{2+} selective sensor, Calixarene, Ion selective electrodes, Chemical sensor

New techniques in preparing catalysts and evaluation of their structure and turnover in kinetic of chemical equations

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Abstract

Developing of leggy platen electro catalysts have been product because of widespread fundamental and practical investigation about electro catalyze (specially for solving kinetic problem in equation of oxygen reduction) and for making joinery of fuel cell with medium temperature like phosphoric acid fuel cells in last of 1960s and early of 1970s. In this paper, kinds of electro catalysts and methods of preparing them were surveyed between preparation methods like 1- methods of making prolific 2- exchange and surface suction of ion 3- methods of sol colloids. Results of surveys showed that spread of electro catalyst on a ductile carbonic bed became to improve situation of three kinds of polarizations (activation and convenience of mass). Decreasing in surplus potential of ohm and mass convenience were shape because of using carbonic past substance and increasing common surface of electrode- electrolyte. This event increase the using of catalyst and reactive. About phosphoric acid fuel cell this event was produce with changing of catalyst that was carrier of active layer. About fuel cells with proton exchange membrane this matter was slightly complication and was produced with changing in frame of ink in response layer that include of catalyst, junction and breakup.

Keywords: Technique ،electro catalysts ،kinetic ،structure

Electrochemical Oxidation of Catechols in the Presence of Nitrite Ion, a Green Method for Nitration

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Abstract

Electrochemical oxidation of some catechols has been studied in the presence of nitrite ion as the nucleophile in aqueous solutions, using cyclic voltammetry and controlled-potential coulometry. Diagnostic criteria of cyclic voltammograms indicate an EC mechanism for the electrode reaction. Electrochemical oxidation of catechols (E step) produces the related quinone, participation of the benzoquinones in Michael reaction (C step) cause to formation of nitrocatechols. The reaction conditions optimized considering the height of cathodic currents. Less reactivity or more stability of o-benzoquinone toward the Michael addition reaction appeared as increase in cathodic peak currents and vice versa. The optimum condition is neutral or slightly acidic conditions. The products of nitration are obtained by controlled potential electrolysis and the products were characterized by: IR, ^{1}H NMR, ^{13}C NMR and MS. In this work, nitration of catechols performs under controlled potential conditions in aqueous solutions, without toxic reagents and solvents at a carbon electrode.

Keywords: Cyclic voltammetry, Electrochemical synthesis, Nitration, Catechol

Study of electrochemical oxidation of 1,2-dihydroxybenzens in presence of 2-imidazolidinethione

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Abstract

1,2-dihydroxy benzene and some of its derivatives are memorable in medicine and pharmacy too.Also,electrochemical behavior of catechols and their electrochemical oxidation in controlled potential,Is an appropriate method,fast and greenchemistry in synthesis of new heterocyclic compounds.In this work,first 1,2-dihydroxy benzens(1a-1c) in presence of ethylenthiourea(3) in controlledpotential, were converted to corresponding o-benzoquinones(2a-2c),then nucleofile(3)in a(micheal)addition reaction formed new heterocyclic compounds(4a-4c). also,mechanism and progress of these reactions have been studied by cyclicvoltammetry and coulometry in controlled potential.

Keywords:1,2-dihidroxybenzens;cyclicvoltammetry;coulometry

Electrochemical Oxidation of 1,4-Dihydroxyantraquinone in the Presence of 2-Mercaptobenzoxazol. Application to Electroorganic Synthesis of New Compound

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Abstract

Thiols, as one of the intercellular reducing agents, generally protect biological systems against oxidative and inflammatory stress by serving as radical scavengers and/ or cofactors for intracellular enzymatic anti-oxidation functions [1]. On the other hand, Hydroxy-anthraquinones are of general interest as dyes and pigments [2] and as model chromophores for biologically active compounds, such as the anthracycline antitumor drugs. In recent years electrosynthesis provide its ability as reagent-free efficient method for selective synthesis of biological and pharmaceutical compondes [3]. Herein, following our previous works on electrochemical generation of quinons in the presence of various nucleophile [4], we investigated electrochemically oxidation of 1,4-dihydroxyantraquinone in the presence of 2-mercaptobenzoxazol as a possible nucleophile in water/ethanol solution using cyclic voltammetry and controlled-potential coulometry. The results indicate that aqntraquinone derived from 1,4-dihydroxyantraquinone participates in Michael addition reaction with 2-mercaptobenzoxazol. The efficient electrochemical synthesis has been performed using controlled-potential synthesis at carbon rod electrodes in a divided cell in green condition and in good yield and purity.

Keywords: Cyclic voltammetry, 2-mercaptobenzoxazol, electrosynthesis

Electrochemical oxidation of N,N,N’,N’-Tetramethyl-p-phenylenediamine in the presence of arylsulfinic acids.

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Abstract

The electrochemical oxidation of p-TMPD in the presence of arylsulfinic acids as nucleophile in aqueous solution have been studied in detail by cyclic voltammetry (CV) and controlled-potential coulometry (CPC) in various pHs (pH = 1-12). The results indicate that p-TMPD undergoes two well-defined, reversible one-electron oxidations in aqueous media.

Results shows that after oxidation, p-TMPD^{++} participate in the Michael addition reaction with aryl sulfinic acids. After synthesis products were purified and characterized by IR, ^{1}H NMR, ^{13}C NMR and MS. The homogeneous rate constants between p-TMPD^{++} and arylsulfinic acids were estimated by comparing the experimental cyclic voltammetric responses in various pHs with the digital simulated results.

Electrocatalytic Oxidation of L-Cysteine Using Iodide as a Mediator

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Abstract

The homogeneous electrocatalytic oxidation of L-cysteine by iodide as a redox mediator was studied in aqueous medium at the surface of a platinum electrode using cyclic voltammetry (CV), chronoamperometry and linear sweep voltammetry (LSV) methods. It was found that in the presence of L-cysteine at pH 5.0, the anodic peak current of iodide increased significantly while the cathodic current decreased, which is an indication of electrocatalysis. The catalytic current related linearly to L-cysteine concentration in the ranges of 1-20 μM and 20-330 μM. The LOD was determined to be 0.6 μM (S/N=3). The diffusion coefficient of L-cysteine was estimated to be 3.49×10^{-5} cm^2 s^{-1} using chronoamperometry. The method does not need to prepare a modified electrode.

Keywords: L-Cysteine, iodide, Homogeneous electrocatalysis

Fabrication of Ion Selective Electrode Using 2,9- Dihydroxy-1,10-diphenoxy-4,7-dithia decane as ionophore for Determination of Lead Ions

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Abstract

Lead is a poisoness element which can cause damage to the nervous system and the kidneys. In this research, a PVC based lead selective electrode was prepared based on 2,9-dihydroxy-1,10-diphenoxy-4,7-dithia decane as ionophore, NPOE as plasticizer, PVC as neutral matrix. The effect of membrane composition on the electrode performance was evaluated. Under the optimized conditions (PVC:30.3%; NPOE:61.6%; ionophore:8.1%), the electrode gave a nernstian response over a wide concentration range (1×10^{-5} to 1×10^{-1}M) with a slope of 29.2±2.2 mV /dec at 25°C. The detection limit for this electrode is 1×10^{-5} M. The electrode showed a fast response time (10 s) and could be used for 40 days without any appreciable change in its sensitivity. It was applicable in the pH range of 2-9 and was successfully used as an indicator electrode for potentiometric titration of Pb^{+2} with EDTA. The effect of the interfering ions on the selectivity of electrode were also studied.

Keywords: lead; ion-selective electrode; 2,9-dihydroxy-1,10-diphenoxy-4,7-dithia decane**;** PVC membrane**.**

silver role in measuring copper with self assemble monolayer(SAM) method by modified gold electrode

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Abstract

This study describes the formation of a Self assemble monolayer(SAM) of aromatic functionalized and hetroaromatic examined.Monolayer of an environment ethanol clean gold on surface and was absorbed in a buffered aqueous was studied in the presence of an electrochemical probe For this purpose, electrochemical techniques such as Differential pulse(DP) and cyclic voltammetry(CV), were used. then measuring the silver and copper were studied.

Keywords Self assemble monolayer (SAM) , silver(Ag) , gold electrode (AU) , copper (Cu),Cyclic voltammetry(CV) , Differential pulse (DP).

Nickle role in measuring copper with self assemble monolayer(SAM) method by modify gold electrod

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Abstract

In this study, the gold electrode surface, was modified by the ethanol solution by using electrochemical methodes,such as differential pulse Voltammetry(DP) , cyclic voltammetry,(CV) .the Electrochemical behavior of single layers in the right track and study its properties were described in a wide range of PH. then measuring the Nickle and copper were studied. ,then measuring the Nickle and copper were studied.

Keywords: Self assemble monolayer (SAM), alkanethiol, nickel, gold electrode, copper, cyclic voltammetry (CV), differential pulse voltammetr (DP).

Comparative investigation of potentiometric behavior of a multi-wall carbon nanotube based paste electrode including a newly synthesized ligand with graphite paste based one for determination of Fe^{3+} in aqueous solution

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Abstract

Form the first introduction [1], carbon-paste electrode (CPEs) and chemically modified carbon-paste electrodes(CMCPEs) are widely used in variousfields of analytical chemistry[2–4].Here, we have investigated the comparative potentiometric behavior of a multi-wall carbon nanotubes (MWCNT) based CPE with an incorporated newly synthesized ligand (19R)-2,17dimethyl-10,11-dihydro-9H-dibenzo[e,h] [1,4,10,7,13] -trioxathiazacyclopentadecine-7,12(16H,13H-ione19oxide)and a graphite based one to determine the Fe^{3+} content of an aqueous solution.The MWCNTbased electrode exhibits a much wider linear response to $Fe^{3+}$with aconcentration range from1.0×10^{-6}to1.0×10^{-1} M with a Nernstian slope of 58.23 ±1.5mV per decade. It shows a fast response time of about 40 s and can be used for a period of two months with good reversibility. The detection limit of this electrode is 1.0×10^{-6} M of Fe^{3+}. The proposed electrode showed a very good selectivity for Fe^{3+} over a wide variety of metal ions.This CMCPE was successfully used for the determination of Fe^{3+} in some real sample solution.

Keywordes:carbon paste electrode,Multi-Wall carbon nanotube,potentiometric,Fe^{+3}

Cobalt Ion Selective Electrode based on Polyhidroquinoline in Modified Nanotube Carbon Paste Electrode

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Abstract

A novel carbon paste ion selective electrode for determination of trace amount of cobalt was prepared. Multi-walled carbon nanotubes (MWCNTs) was used for improvement of a cobalt carbon paste sensor response. The electrode with optimum composition, exhibits an excellent Nernstian response to Co^{2+} ion with the slope of 29.8±0.2 mV dec^{-1}. The sensor exhibits excellent selectivity over a number of mono-, bi-, and tri-valent cations including alkali, alkaline earth metal, heavy and transition metal ions. It can be used as an indicator electrode for the end point determination in the potentiometric titration of cobalt ions against ethylenediaminetetraacetic acid (EDTA) as well as for the determination of cobalt ion concentration in real samples.

Keywords: Cobalt ion selective electrode, polyhydroquinoline, modified nano tube, carbon paste electrode

Determination of iodide/iodine and iodate in brine samples by voltmetric methods on thin mercury film electrod (TMFE)

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Abstract

The chlor-alkali process is the most economically important electrosynthetic process. The chlor-alkali (also called chlorine-caustic) industry is one of the largest electrochemical technologies in the world. In a membrane cell, an ion exchange membrane separates the anode and cathode compartments. The separator is generally a bi-layer membrane made of perfluorocarboxylic and perfluorosulfonic acid-based films, sandwiched between the anode and the cathode. The saturated brine is fed to the anode compartment where chlorine is liberated at the anode, and the sodium ion migrates to the cathode compartment. About 30-32% caustic soda is fed to the cathode compartment, where sodium ions react with hydroxyl ions produced during the course of the hydrogen gas evolution from the water molecules. The quality of feed brine to electrolyzer is very important from viewpoint of membrane damage and reduces the current efficiency. For example if the content of iodide be more than 1ppm, it cans precipitate in membrane layer as paraperiodat salt. Thus determination of iodide/iodine concentration is important for tracing of brine quality. In this work we are able to measuring of iodide/iodine and iodate ions by differential pulse cathodic voltametry of iodate (production of samples pretreatment containing iodide/iodine by sodium hypocholorite as oxidant) on thin mercury film deposited on glassy carbon electrode. The detection limit of this method is lower than ICP-OES in brine samples ($45\mu l^{-1}$). Friendly of environment and easily performance against voltametry on hanging dropping mercury electrode (HDME) are another perfection feature of this method. Samples have to be stabilized with NaOH: pH= 8–9. Cationic interferences can be eliminated by addition of EDTA 0.5M to samples before voltametric measurements. Iodate measurements carried out by differential pulse cathodic voltametry without addition of sodium hypocholorite and content of iodide/iodine calculated by subtraction of iodate from total iodate.

Electrodeposition of 4nitro-1,2diaminobenzene on solid electrodes and bisulphite measurment

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Abstract

The presence of electroacive functional groups in nitro and amino aromatic compounds caused the using of this components in different fields of applied electrochemistry such as electrocoating of the metals for prevention of corrosion, production of sensing and selective modified electrodes for quantitative and qualitative analysis of different analytes, consideration of cyclic voltametry of 4-nitro1,2diamino benzene (0.01 m in aceton and water,1:5)on different electrodes(Au, Pt, GCE) Shows that 4-nitro1,2diaminobenzene can be form a homogeneous orange film at surface of Au and platinium electrodes (see below fig). differential pulse measurements performed on the 4nitro1,2 diamino benzene modified platinium electrode showed that the anodic peak exhibited a good linear concentration dependence in the range 4×10^{-6} to 3×10^{-3} M (r^2=0.998). Various parameters have been optimized to get the highest current response such as the modifier concentration, pH, composition of electrodeposition of modifier and salt concentration. The detection limit was estimated to be 1.5×10^{-7} M. Results showed a very high accuracy with a value of 0.097±0.003 (n=4) for a sample containing 0.1 ppm of the bisulphite. Determination at lower concentrations (0. 5 ppm) of the bisulphite were also carried out and the results showed a high accuracy with a standard deviation of ±0.004 for n=5.

keywords: 4nitro-1,2diaminobenzene, bisulphate, differential pulse voltametry

Catalytic kinetic voltammetric determination of ultra trace of thiourea in fruits sample

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Abstract

Thiourea (TU) has found many applications in medicine, industry and other areas of chemistry [1]. These substances are known to be toxic and hazardous; their toxic and hazardous effects seem to arise from a disturbance of carbohydrate metabolism [2] and could result in chronic goitrogenic and other glandular difficulties in humans [3]. For these reasons, it has become increasingly important to monitor thiourea and related compounds, therefore appropriate methods for their determination in various media are worthy of development.

Various methods have been proposed for the determination of TU such as titrimetry with iodine, N-bromosuccinimdie or haloamines, Raman spectroscopy, spectrophotometry, polarography, voltammetry, high performance liquid chromatography, kinetic methods, ion selective electrode potentiometry, FTIR, flow injections methods, amperometric methods, chemiluminescence and tandem mass spectrometry. However, most of these methods are either insensitive, inselective or time consuming [4].

In current study, a new simple and highly selective and sensitive catalytic differential pulse voltammetry procedure for determination of trace amount of thiourea is described. Thiourea has a very strong catalytic effect on the oxidation of Janus green in hydrochloric acid media. The reaction monitored voltammetrically by measuring the decrease in current of the reaction mixture at +0.17 V vs. Ag/AgCl reference electrode. The differential pulse Voltammetric behavior of the Janus green at HMDE has been studied and selected as the indicator component for the reaction. The potential was scanned to the negative direction and the differential pulse voltammograms were recorded. The variation of peak current with concentration of hydrochloric acid, oxidant and Janus green, pulse several instrumental parameters such as pulse amplitude, pulse time and scan rate, were optimized. Under optimized conditions, the relationship between the peak current and concentration of thiourea is linear in the range of 0.01–6.00 µg/ml. The limit of detection was found to be 0.005µg/ml. The relative standard deviation for 6 replicates determination of 0.01, 0.50 and 2.00 µg/ml is equal to 2.25%, 1.52% and 1.03%; respectively. The method was applied to the determination of thiourea in fruit juices with satisfactory results.

A Novel Electrochemical Vapor Generation System for Production of Mercury Vapor

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Abstract

Cold vapor atomic absorption spectrometry (CVAAS) is one of the most widely used techniques for the selective determination of mercury in environmental, biological, clinical and industrial samples.

In this research, a new electrochemical cold vapor generation system with lead–tin alloy electrode as cathode material is developed for Hg (II) determination by atomic absorption spectrometry. A laboratory constructed batch cell with a Sn-Pb alloy cathode served as the cold vapor generator. The experimental parameters has been optimized to attain the maximum sensitivity for Hg determination and to minimize the limits of detection and determination. In the optimum conditions, the calibration curve is linear the range of 2-60 ng ml^{-1} mercury. The limit of detection for mercury determination was 2 ng ml^{-1} and the RSD was 2.8% (n=8) at the 40 ng ml^{-1} concentration level. The accuracy and recovery of the method were investigated by analyzing spiked tap water.

Keywords: Mercury; Electrochemical cold vapor generation, Sn-Pb alloy.

Effects of Organic Solvents on Electrochemical Generation of Mercury Cold Vapor

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Abstract

This research describes the effect organic solvents on electrochemical generation of mercury cold vapor. A laboratory constructed batch electrochemical cell with a Sn-Pb alloy cathode served as vapor generator coupled to an atomic absorption spectrometer.

In this system, the effects of solvents such as methanol, ethanol, iso-propanol and acetonitrile on the performance of mercury cold vapor generation were examined and investigated. The results showed that a solution of 10% methanol-water, would show the highest efficiency for cold vapor production. Optimum conditions were obtained for electrochemical generation of mercury cold vapor in 10% volume of methanol-water solution. The calibration curve was constructed under optimized operating conditions which was linear in the range of 1.5-60 ng ml^{-1} of mercury. Limit of detection of the method was 1.5 ng ml^{-1} and the RSD was 3% (n=8) for mercury determination. The accuracy and recovery of the method were investigated by analyzing tap water.

Keywords: Organic solvents; Electrochemical vapor generation; Mercury.

Electrocatalytic Oxidation of Hydrazine at Gold Nanoparticles/Nanotube Modified Sol-gel Electrode

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Abstract

Gold nanoparticles (GNPs) have been widely used in many electrochemical fields due to their advantages of catalysis, mass transport and high effective surface area [1]. Various metal nanoparticles deposited onto the surface of CNTs, some metals and their compounds, such as platinum, palladium, copper, nickel, ruthenium and so on, have been deposited on the CNTs successfully [2–5].

In this work, we have deposited gold nanoparticles at CNTs modified so-gel successfully in 0.05M H_2SO_4 solution containing 0.2mM $HAuCl_4$ through Chronoamperometry. Optimum condition was obtained in a overreduction potential E=0.20V and deposition time 1s. The modified electrode presented a good electrocatalytic activity toward the oxidation of hydrazine.

Keywords: Gold nanoparticles, Sol-gel electrode, Hydrazine, CNTs,

Electrochemical Determination of Hydrazine at Sol-gel Electrode Modified with Carbon Nanotube

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Abstract

Hydrazine is the simplest diamine. It is used in various area such as fuel in fuel cells and corrosion inhibitor in boilers derivatives [1]. Various methods have been reported for the determination of hydrazine, including spectrophotometry [2, 3], chromatography [4, 5], and electrochemical methods [6, 7]. Multi-walled carbon nanotubes(MWCNTs) are one of the more novel forms of carbon materials and due to their unique properties, such as their large surface area, mass transfer and excellent electrical conductivity, they have the ability to facilitate electron transfer that ensure a wide range of applications in electrochemical analysis.

In the present work MWCNT modified sol-gel electrode was fabricated and used for electrocatalytic oxidation of hydrazine. The experimental results showed that the catalytic oxidation peak current of hydrazine is linearly dependent on the concentration of hydrazine in the ranges of 3.0×10^{-6} M – 15.0×10^{-3} M with DPV method.

Keywords: Hydrazine, Electrocatalytic oxidation, MWCNTs, Sol-gel electrode

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Electrochemical Behavior of Homogentisic acid (HGA) at a Gold Nanoparticle Modified Glassy Carbon Electrode: Experimental and Theoretical Studies

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Abstract

Homogentisic acid (HGA) is an important intermediate in the metabolism of tyrosine in our body. In this study, electrochemical oxidation of HGA has been studied in a 0.1 M phosphate buffer solution at a glassy carbon electrode and Au nanoparticles modified glassy carbon electrode (nano-Au/GC), using cyclic voltammetry, as well as quantum chemical calculations. The effect of different parameters such as pH, HGA concentration, temperature and time window of the chosen electrochemical method has been studied for understanding the oxidation mechanism of HGA. The studies reveal that the electrochemical oxidation of HGA at bare and nano-Au/GC is a reversible process and its oxidation product is stable in acidic, neutral and weakly alkaline media, but the product oxidation in strongly alkaline media is not stable. Finally, the standard potentials of HGA have been calculated using standard ab initio calculations at the G3MP2 level of theory, in conjunction with continuum solvation model.

Keywords: Homogentisic acid, Electrochemical behavior, Standard redox potentials

Electrochemical Study of 4,4’-Biphenol in the Presence of Cysteine: Application to the Catalytic Determination of Cysteine

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Abstract

Cysteine is a non-essential amino acid and a precursor in the food, pharmaceutical, and personal care industries. The largest applications are the production of flavors, processing aid for baking and one of the important additives to cigarettes as a result of increasing the beneficial antioxidant glutathione [1]. The quantitative determination of cysteine is, therefore, very important in studies of biological and industrial process. On the other hand, many catalytic reactions have been developed as a result of need and interest from both academic and industrial settings. Indeed, the catalytic action is very frequent in many reactions in pharmacy, biochemistry, and in industrial processes [2-4]. Herein, electrochemical oxidation of 4,4’-biphenol has been studied in the presence of cysteine using cyclic voltammetry. The present data are indicative of the suitability of 4,4’-biphenol as a mediator for determination of cysteine. The reaction mechanism has been investigated and shown that the catalytic peak currents are linearity dependent on the cysteine concentration and solution’s pH. This paper introduces a simple and sensitive catalytic method of analysis for cysteine based on its reaction with electrolytically produced 4,4’- diphenoquinone.

Keywords: Cyclic voltammetry, Catalytic reaction, Cysteine, 4,4’-Biphenol

Electrocatalytic Reduction of Hydrogen Peroxide at Carbon Paste Electrode Modified by Bis(N-2-methylphenyl-salicydenaminato)Copper(II)

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Abstract

There is an increasing interest in determination of Hydrogen peroxide in chemical, food production, clinical, biological and medicine science.

In this work, a carbon paste electrode modified by bis(N-2methylphenyl-salicydenaminato)copper(II) (Cu–CPE) was used to the electrocatalytic reduction of hydrogen peroxide. The dependence of peak currents and potentials on pH and the potential sweep rates was investigated. The Cu–CPE exhibited a high electrocatalytic activity toward the reduction of H_2O_2 in a 0.1 M phosphate buffer solution (pH 5.0), with a diminution of the overpotential about 300 mV compared to the process at an unmodified electrode. The diffusion coefficient (D) and the kinetic parameters such as electron transfer coefficient (α) for hydrogen peroxide were also determined using electrochemical methodes. Differential pulse voltammetry (DPV) exhibits two linear dynamic ranges 1.0-10.0 μM and 10.0-250.0 μM. In addition, good reproducibility and long-term stability of the sensor make it valuable for further application.

Keywords: Carbon paste electrode, Hydrogen peroxide, Electrocatalytic reduction

A Potentiometric Copper Sensor Based on Polypyrrole doped with 8-hydroxyquinoline-5-sulfonic acid

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Abstract

Conductive electroactive polymers (CEPs) exhibit a number of useful properties including electrical conductivity and electroactivity. Among the various conjucted polymers, polypyrrole (PPY) is one of the most widely investigated conducting polymers due to its chemical and thermal staibility. In the present research, a potentiometric Cu^{+2} sensor was prepared on the basis of polypyrrole conducting polymer. Polypyrrole was deposited on a steel spinal needle using cyclic voltammetry and also constant potential technique. 8-hydroxyquinoline-5-sulfonic acid (HQS) was doped in the polymer during electropolymerization process which acts as active chelating agent and ionophore for copper recognition. Several factors affecting the sensor performance such as the ratio of HQS/PPY, number of cycles and electrode dimensions has been optimized. The analytical performance of the sensors was studied by potentiometric measurements which showed a near nernstian response. Also the effect of interfering ions has been studied. The sensor was applied for determination of Cu in tap water.

Keywords: Potentiometric sensor; polypyrrole; copper

Carbon composite coated wire electrode for selective determination of bicarbonate ion

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Abstract

The determination of bicarbonate ion is very important in the fields of process analysis, environmental analysis and also clinical analysis. This importance is relates to the acid-base and electrolyte balance in the human body [1,2], which is regulated by pulmonary and renal mechanisms. So, the introduction of the easy, fast and selective analytical methods for the determination of bicarbonate ion is very valuable [3,4].

In this study, the construction and evaluation of a novel nano composite ion-selective electrode with high selectivity toward bicarbonate anion based on PVC membrane was described. The electrode was constructed as coated wire electrode based on a new synthesing nano salan complex of molibden as ionophore. The electrode shows a Nernstian slope of 59.5 ± 0.3 mV/decade in a linear concentration range of 1.5×10^{-6} to 1.3×10^{-2} M for bicarbonate ions with low detection limit of time (more than two months) and exhibits stable response and, most importantly, good selectivities for carbonate ions with respect to a number of common foreign anions. The electrode was successfully applied as an indicator electrode in potentiometric titration and also potentiometric determination of bicarbonate ions in mineral and tap water and also blood serum.

Keywords: Bicarbonate, Potentiometric, Coated wire electrode

Modified carbon paste electrode for simultaneous determination of ascorbicacid,dopamine ,adrenaline

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Abstract

A novel modified carbon-paste electrode was employed for the simultaneous determination of dopamine (DA) , ascorbic acid (AA) and Adrenaline(AD) with good selectivity and high sensitivity. α -cyclodextrin and multi-walled carbon nanotube modified carbon-paste electrode displayed excellent electrochemical catalytic activities towards (DA) , (AA) and (AD). The modified-CPE was prepared by mixing MWCNT, graphite powder and paraffin liquid a mortar by hand until a homogeneous paste was obtained. The oxidation over potentials of DA, AD and AA were decreased significantly compared with those obtained at the bare CPE. Differential pulse voltammetry was used for the simultaneous determination of DA, AD and AA in their ternary mixture. The peak separation between AD and DA, DA and AA was 95mV and 270 mV. This modified electrode was very good at simultaneous study of dopamine in the presence of high concentrated ascorbic acid and adrenaline.

Keywords: Carbon paste electrode, Dopamine, Ascorbic acid, Adrenaline

Electrochemical detection of dopamine in the presence of ascorbic acid using modified carbon paste electrode

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Abstract

Electrochemical detection of dopamine in the presence of excess ascorbic acid on a carbon paste electrode modified with α –cyclodextrin is presented. for the detection of DA and AA have attracted considerable interest due to their fast response and high sensitivity. Among many methods for determination of DA in the presence of ascorbic acid in biological samples, α –cyclodextrin -modified electrodes have shown to be a powerful tool**.** the modified electrod is applied as a selective and sensitive voltammetric sensor for simultaneous detection of ascorbic acid (AA) and dopamine (DA). Under the optimum pH of 7 in 0.1M Phosphate buffer solution, the DPV anodic peak current showed a linear relation versus DA concentration in the range of 10^{-3}_10^{-6}M. The peak separation between DA and AA was 258 mV.

Keywords: Carbon paste electrode, Dopamine, Ascorbic acid,

Determination of epinephrine and ascorbic acid using carbon paste electrode modified α –cyclodextrin

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Abstract

A carbon paste electrode modified with α –cyclodextrin was developed. The modified electrode shows excellent electrocatalytic activity toward the oxidation of ascorbic acid(AA) and epinephrine (EP). Separation of the reduction peak potentials for ascorbic acid(AA) and epinephrine(EP) was about 328 mV in pH 7 phosphate buffer solution (PBS) and the character was used for the detection AA and EP simultaneously. The peak currents increase linearly with AA and EP concentration over the range of 10^{-3} to 10^{-6} mol/L and 10^{-3} to 10^{-6} mol/L with detection limits of 0.438 µg/ml and 0.31µg/ml, respectively. The interference studies showed that the modified electrode exhibits excellent selectivity in the presence of large excess of AA. The effective electrocatalytic property, excellent peak resolution and ability for masking the voltammetric responses of the other biologically reducing agents, make the modified electrode suitable for simultaneous and sensitive voltammetric detection of sub-micromolar amounts of AA and EP.

Keywords: Carbon paste electrode, epinephrine .α –cyclodextrin, ascorbic acid

Determination of epinephrine using carbon paste electrode modified multi-walled carbon nanotube

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Abstract

epinephrine (EN), [1-(3,4-dihydroxyphenyl)-2-methyloaminoethanol],plays important roles as a neurotransmitter and a hormone.It exists as an organic cation in the nervous tissue and biological body fluid. Among many methods for determination of EN in biological samples, MWCNT-modified electrodes have shown to be a powerful tool.In this work, a carbon paste electrode modified with MWCNT is preported and electrochemical behavior of EN at it is described. Differential puls voltammetry (DPV) measurements were performed in 0.1M phosphate buffer solution (pH=7), The DPV peak current was found to be linear with the EP concentration in the range 1×10^{-3} to 1×10^{-6}M . The lowest detection limits (S/N = 3) were 0.213µg/ml.

The modified electrode shows good selectivity, sensitivity, reproducibility and high stability.In general CPE are popular because CPE are easily obtainable at minimal costs. CPE is highly selective sensors for inorganic and organic electrochemistry.

Keywords: Carbon paste electrode, epinephrine .α –cyclodextrin,

Electrochemical detection of dopamine in the presence of ascorbic acid using modified carbon paste electrode

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Keywords: Carbon paste electrode, Dopamine, Ascorbic acid,

Determination of dopamine using carbon paste electrode modified α – cyclodextrin

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α- cyclodextrin deposition on electrode for 25N.Differential puls voltammetry(DPV) measurements were performed in 0.1M phosphate buffer solution (pH=7),DA was prepared 1×10^{-6}M stock solution by dissolving in double distilled water.The DP voltammetry peak current was found to be linear with the DA concentration in the range $1\times10^{-3}$to 1×10^{-6}M. The lowest detection limits (S/N = 3) were 0.۴۳µg/ml. In general CPE are popular because CPE are easily obtainable at minimal costs. CPE is highly selective sensors for inorganic and organic electrochemistry.

Keywords: Carbon paste electrode, Dopamine .α –cyclodextrin

Determination of epinephrine and ascorbic acid using carbon paste electrode modified α –cyclodextrin

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Abstract

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Keywords: Carbon paste electrode, epinephrine .α –cyclodextrin, ascorbic acid

Determination of epinephrine using carbon paste electrode modified multi-walled carbon nanotube

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Abstract

epinephrine (EN), [1-(3,4-dihydroxyphenyl)-2-methyloaminoethanol],plays important roles as a neurotransmitter and a hormone.It exists as an organic cation in the nervous tissue and biological body fluid. Among many methods for determination of EN in biological samples, MWCNT-modified electrodes have shown to be a powerful tool.In this work, a carbon paste electrode modified with MWCNT is preported and electrochemical behavior of EN at it is described. Differential puls voltammetry (DPV) measurements were performed in 0.1M phosphate buffer solution (pH=7), The DPV peak current was found to be linear with the EP concentration in the range 1×10^{-3} to 1×10^{-6}M . The lowest detection limits (S/N = 3) were 0.213µg/ml.

The modified electrode shows good selectivity, sensitivity, reproducibility and high stability.In general CPE are popular because CPE are easily obtainable at minimal costs. CPE is highly selective sensors for inorganic and organic electrochemistry.

Keywords: Carbon paste electrode, epinephrine .α –cyclodextrin,

Determination of Benzimidazole based on Electropolymerized-molecularly Imprinted Polypyrrole

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Abstract

In this work, molecularly imprinted polymer (MIP) of benzimidazole was prepared through electropolymerization and electrodeposition of pyrrole on a pencil graphite electrode in the presence of benzimidazole as template molecule. The ability of the fabricated MIP to act as a sensor of determining benzimidazole was investigated. Preparing of MIP and quantitative measurements were performed by cyclic voltammetry (CV) and differential pulse voltammetry (DPV), respectively. Several important parameters controlling the performance of the polypyrrole and the method efficiency were investigated and optimized. The molecularly imprinted layer exhibited selectivity and sensitivity toward benzimidazole. The calibration curve demonstrated linearity over a concentration range of 0.5 to 5mM with a correlation coefficient (r^2) of 0.9920. The detection limit of benzimidazole was obtained 7.0×10^{-7}M.

Keywords: Benzimidazole, pencil graphite, polypyrrole, molecularly imprinted polymer, voltammetry

Cobalt role in measuring copper with self assemble monolayer(SAM) method by modify gold electrode

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Abstract

In this project, the gold electrode surface was cleaned using physical and electrochemical methods. Clean gold surface modified with a monolayer in ethanol solution was correct.

Then the modified electrode for measurements of cobalt and copper by methodes Differential pulse(DP) and cyclic voltammetry (CV), were used.

Keywords: Self assemble monolayer (SAM) , thiol alkanes , Cobalt(Co) , Gold electrode (AU) , Copper (Cu) ,Cyclic voltammetry(CV) , Differential pulse (DP).

Conductivity study of 1-decyl-3-methyl imidazolium chloride in PrOH+H_2O mixed solvent system

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Abstract

In the present work, the conductometric investigations of 1-decyl-3-methyl imidazolium chloride in different mass fractions of propanol in propanol+water mixtures (0.2, 0.4, 0.6, 0.8, 1.0) at T= (298.2 and 303.2) K were performed. The experimental data were correlated by the Fuoss-Edelson equation. The parameters obtained, the limiting equivalent conductivity, Λ_0 and the association constant, K_A, were illustrated in Table1. The results show that the association constant is increased with the increasing of propanol mass fraction and temperature.

Keyword: 1-Decyl-3-methyl imidazolium chloride, Fuoss-Edelson, conductivity.

Application of a Carbon-Paste Electrode Modified with 2,7-Bis(Ferrocenyl Ethyl)Fluoren-9-One and Carbon Nanotubes for Voltammetric Determination of Levodopa in the Presence of Uric Acid and Folic Acid

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Abstract

A carbon-paste electrode modified with 2,7-bis(ferrocenyl ethyl)fluoren-9-one and carbon nanotubes was used for the sensitive voltammetric determination of levodopa (LD). The electrochemical response characteristics of the modified electrode toward LD, uric acid (UA) and folic acid (FA) were investigated. The results showed an efficient catalytic activity of the electrode for the electro-oxidation of LD, which leads to lowering its overpotential by more than 320 mV. The modified electrode exhibits an efficient electron mediating behavior together with well-separated oxidation peaks for LD, UA and FA. Also, the modified electrode was used for determination of LD in some real samples.

Keywords: Levodopa, Uric acid, Folic Acid, Carbon Nanotubes, Modified Electrode, Electrocatalysis

Application of a Carbon Paste Electrode Modified with 5-Amino-3',4'-Dimethyl-Biphenyl-2-Ol for Determination of Dopamine

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Abstract

In this study, a carbon paste electrode modified with carbon nanotubes and 5-amino-3',4'-dimethyl -biphenyl-2-ol (5ADB) was used to prepare a novel electrochemical sensor. The objective of this novel electrode modification was to seek new electrochemical performances for detection of dopamine (DA). Under the optimum pH of 7.0, the oxidation of DA occurs at a potential about 170 mV less positive than that of the unmodified CPE. The response of catalytic current with DA concentration shows a linear relation. The modified electrode was used for determination of DA in some real samples.

Keywords: Dopamine, Carbon Nanotube Paste Electrode, Modified Electrode, Voltammetry

Electrochemical Behavior of a Modified Carbon Nanotube Paste Electrode and its Application for Simultaneous Determination of Epinephrine, Uric Acid and Folic Acid

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Abstract

In this study, a carbon paste electrode modified with carbon nanotubes and 5-mino-3',4'-dimethyl -biphenyl-2-ol (5ADB) was used to prepare a novel electrochemical sensor. The objective of this novel electrode modification was to seek new electrochemical performances for detection of epinephrine (EP) in the presence of uric acid (UA) and folic acid (FA). The peak potentials recorded in a PBS of pH 7.0 were 270, 445 and 760 mV vs. Ag/AgCl/KCl (3.0 M) for EP, UA and FA, respectively. Under the optimum pH of 7.0, the oxidation of EP occurs at a potential about 170 mV less positive than that of the unmodified CPE. The response of catalytic current with EP concentration shows a linear relation in the range from 1.2×10^{-6} to 1.0×10^{-3} M with a detection limit of 6.2×10^{-7} M.

Keywords: Epinephrine, Uric acid, Folic Acid, Carbon Nanotube Paste Electrode, Modified Electrode

Selective Voltammetric Determination of Norepinephrine in the Presence of Acetaminophen and Tryptophan on the Surface of the Modified Carbon Nanotube Paste Electrode

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Abstract

A new electrochemical sensor for the determination of norepinephrine (NE), acetaminophen (AC) and tryptophan (TRP) is described. The sensor is based on carbon paste electrode (CPE) modified with 5-amino-3',4'- dimethyl -biphenyl-2-ol (5ADB) and takes the advantages of carbon nanotubes (CNTs), which makes the modified electrode highly sensitive for the electrochemical detection of these compounds. Under the optimum pH of 7.0, the oxidation of NE occurs at a potential about 170 mV less positive than that of the unmodified CPE. Also, Square wave voltammetry was used for simultaneous determination of NE, AC and TRP at the modified electrode.

Keywords: Norepinephrine, Acetaminophen, Tryptophan, Carbon Nanotube, Modified Carbon Paste Electrode

Electrochemical Determination of Betaxolol in the Presence of Acetaminophen by Gold Nanoparticles Modified Carbon Paste Electrode

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Abstract

A gold nanoparticles(GNs) modified carbon paste electrode has been used for determination of betaxolol in the presence of acetaminophen. Betaxolol is a selective beta receptor blocker used in the treatment of hypertension and glaucoma. The electrochemical behavior of GNs at the surface of a carbon paste electrode is investigated by Impedance spectroscopy. The prepared electrode shows a high sensitivity for the electrochemical detection of these compounds. Under the optimum pH (Britton-Robinson) of 9.5, the oxidation of betaxolol occurs at a potential about 36mV less positive than that of the unmodified electrode. Differential pulse voltammetry(DPV) of betaxolol at the modified electrode exhibited a wide linear dynamic range (0.45–116 µM) with a detection limit of 63nM. The diffusion coefficient ($D/cm^2\ s^{-1}=8.15\times10^{-5}$) and the kinetic parameters such as the electron transfer coefficient, ($\alpha=0.59$) for betaxolol were determined using electrochemical approaches. DPV was used for determination of betaxolol in some real samples by the standard addition method.

Keywords: Betaxolol, Acetaminophen, Gold nanoparticles, Modified electrode, Electrochemical Methods

First report for simultaneous determination of cysteamine and folic acid using voltammetric method

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Abstract

Cysteamine (CA) is an aminothiol compound used as a drug for the treatment of cystinosis. Because of cysteamine's important role in clinical settings and its potential future applications as an antioxidant, it has become necessary to develop an analytical method for detecting cysteamine in biological samples. Treatment with cysteamine is, however, associated with major problems. In an attempt to overcome these problems, Omrann et al. reported combination of folic acid (FA) and cysteamine as a folate pro-drug of cystamine in enhanced treatment for nephropathic cystinosis. Therefore, simultaneous determination of CA and FA is vital. To our knowledge, no study has reported the electrocatalyticand simultaneous determination of CA and FA by using modified electrodes. In this study, a carbon paste electrode chemically modified with multiwall carbon nanotubes and ferrocene was used as a selective electrochemical sensor for the simultaneous determination of trace amounts of CA) and FA.

Keywords: Cysteamine, Folic acid, Multiwall carbon nanotubes paste electrode, Sensor

Simultaneous determination of methyldopa and uric acid using modified multiwall carbon nanotubes paste electrode

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Abstract

Electrochemical sensing based on carbon nanotubes (CNTs) is now a developed research field. Drug analysis plays important roles in drug quality control, and has a great impact on public health. Therefore, a simple, sensitive and accurate method for the determination of active ingredient is very important.

In this study, a multiwall carbon nanotubes modified electrode (prepared by incorporating of p-chloranil as a mediator) was used as voltammetric sensor for the determination of methyldopa (MDOP) in the presence of uric acid (UA) for the first time. The results indicate that the electrode is efficient in terms of its electrocatalytic activity for the oxidation of MDOP, leading to an overpotential reduced by more than 250 mV. The proposed method is also used for the determination of MDOP in urine, drug and serum samples using standard addition methods.

Keywords: Methyldopa, Uric acid, Multiwall carbon nanotubes paste electrode, Sensor

determination of Copper(II) at a Cu(II)-IP modified carbon paste electrode by differential pulse stripping voltammetry

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Abstract

A simple and effective carbon paste electrode modified with Cu(II)- imprinted polymer (Cu(II)-IP) for the determination of Cu(II) via differential pulse voltammetry was developed in this work. The electrode was prepared by the addition of Cu(II)-IP into a carbon paste mixture. Cu(II) were preconcentrated on the surface of the modified electrode by complexing and reduced at a negative potential. In this study, A new Cu(II)-ion imprinted polymer (Cu(II)-IP) was prepared by formation of 1-(2-pyridylazo)-2-naphthol (PAN) complex for stripping and determination of Cu(II) in real samples. Polymerization was performed with 20 mmole ethyleneglycoldimethacrylate (EGDMA), as crosslinking monomer and 4 mmole methacrylic acid as functional monomer; in the presence 100 mg of 2,20-azobis(isobutyronitrile) (AIBN), as initiator, via bulk polymerization method. The imprint copper ion was removed from the polymeric matrix using 5M HNO_3 for 1 h (several times). The developed method was applied to silver determination in water samples.

Keywords: Cu(II), Ion-imprinted polymer, Carbon paste electrode, Voltammetry

Determination of Gd^{3+} by PVC membrane Potentiometric Sensor Based on a New Carrier

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Abstract

Gadolinium (Gd) is one of the lanthanides which is a silvery-white malleable and ductile rare-earth metal. Gadolinium is ferromagnetic at temperatures below 19 °C (66 °F) and is strongly paramagnetic above this temperature. Gadolinium has exceptionally high absorption of neutrons and therefore is used for shielding in neutron radiography and in nuclear reactors. Because of its paramagnetic properties, gadolinium is the most popular intravenous MRI contrast agents in medical magnetic resonance imaging. Gadolinium has been used to target tumors in neutron therapy. Gadolinium has microwave applications and Gadolinium compounds are also used for making green phosphors for colour TV tubes and compact discs. The main methods for Gadolinium analysis are spectrophotometery, atomic absorption spectroscopy (AAS) and inductively coupled plasma-atomic emission spectroscopy (ICP-AES), which are either time consuming or very expensive, while potentiometric methods are very simple and low cost techniques used for clinical, environmental and chemical analysis[1].

In this work the construction of a novel PVC membrane sensor based on Furan-2-carboxylic acid (2-oxo-1-phenyl-2-pyridin-2-yl-ethylidene)-hydrazide as a neutral carrier, DOP as a plasticizer and NaTPB anionic site is described. This sensor responds to Gd(III) activity in a linear range from (1.0 x 10^{-5} to 1.0 x 10^{-2})M with a slope of 20.7±0.3 mV per decade and a detection limit of 7×10^{-6}M at a pH range of 5-8. It has a fast response time in the whole concentration range and can be used for at least 4 weeks without any considerable divergence in the electrode potentials. The proposed sensor revealed comparatively good selectivity with respect to most common metal ions, and it was used as an indicator electrode in the potentiometric titration of Gd(III) ions with EDTA, and the recovery of the Gd(III) ions from various binary mixtures[2,3].

Electrochemical catalytic determination of biological Thiols with a 4-methylesculetin as a redox mediator in carbon paste electrode

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Abstract

Thiols are important in biological systems due to their widespread occurrence in many proteins and in natural compounds such as glutathione, cysteine, coenzyme A, and lipoic acid.[1] In particular, the reversible oxidation-reduction reactions between thiols and the corresponding disulfides are essential processes in many biological and chemical systems.

Numerous chemical and instrumental techniques for the determination of thiols have been reported. However, many suffer from difficulties with sample preparation, the need for derivatization, or the lack of sufficient sensitivity, all of which limit their utility. In contrast, electrochemical methods have been quite successful for the determination of free thiols. One initial challenge to the development of electrochemical methods for thiol detection was that direct oxidation of thiols at solid electrodes is slow and usually requires large overpotentials (≥+1.0 V) to proceed.[2,3]

The approach described here is use of the 4-methylesculetin as a mediator for the Electrochemical catalytic determination of biological thiols. For this, a carbon paste electrode modified with 4-methylesculetin was used for the determination of thiols.

keywords: 4-methylesculetin, thiol, carbon paste

Cd^{2+} Selective PVC Membrane Electrodes Based on Schiff base 2-propylpiperidine-1-carbodithioate (PPCD) Complex as an Ionophore

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Abstract

A novel reliable and simple method for determination of trace amounts of Cd^{2+} ions using with Schiff base **2**-propylpiperidine-1-carbodithioate (PPCD)has been synthesized and explored as ionophore for preparing PVC-based membrane sensors selective to the copper (Cd^{2+}) ion. Potentiometric investigations indicate high affinity of these receptors for Cd^{2+}ion. The best performance was shown by the membrane of composition (w/w) of ionophore: 1 mg, PVC: 33 mg, DOP: 66 mg and KT*p*ClPB as additive were added 50 mol % relative to the ionophore in 2 ml THF. The proposed sensor's detection limit is 5.0×10^{-7} M over pH 4 at room temperature (Nernstian slope 30.89 mV/dec.) with a response time of 15 seconds and showed good selectivity to Cd^{2+} ion over a number of interfering cations.

Keywords: Schiff base, Cd^{2+}selective electrode, Potentiometry, Ionophore, 2-propylpiperidine-1-carbodithioate (PPCD)

Simultaneous determination of 4-aminohippuric acid and uric acid at carbon nanotube modified glassy carbon electrode

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Abstract

4-aminohippuric acid (PAH) is useful for the measurement of renal plasma flow because it is secreted primarily by the renal tubules [1,2,3]. Therefor, a simple and rapid electrochemical method was developed for the determination of PAH, based on the excellent properties of multi-walled carbon nanotubes (MWCNTs). The applications of this electrode was investigated in simultaneous determination of PAH and uric acid (UA). The cyclic voltametric results indicates that MWCNT-modified glassy carbon electrode can remarkably enhance electrocatalytic activity towards oxidation of PAH in pH=6. The electrocatalytic behavior was further exploited as a sensitive detection scheme for the PAH determination by differential-pulse voltammetry.Under optimized conditions, the concentration range and detection limit are 10-1000 µM and 8µM, respectively for PAH, And 5-100 µM and 1µM, respectively for UA. The proposed method was successfully applied for PAH determination in real samples.

Keywords: 4-aminohyppuric acid, Modified glassy carbon, Multi-walled carbon nanotube

Electrocatalytic oxidation of cephalexin on Ni modified poly (o-toluidine)(SDS) carbon paste electrode in alkaline medium

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Abstract

β-Lactam antibiotics (e.g., ampicillin, amoxicillin) are traditionally used for the treatment of common bacterial infections in both humans and food–producing animals. β-Lactam residues in foods can result in the development of new strains of bacteria resistant to these antibiotics and in allergic reactions. As result, regulatory requirements for β-Lactam residues in food are fairly stringent, and their determination has become mandatory.On the other hand, the use of metallized polymers is gaining ascendance in recent years due to their varied applications in the field of electrodics, sensors and electrocatalysis.

In this study, electrolytically deposited Ni on poly (o-toluidine)(SDS) (POT(SDS)) film covered carbon paste electrode (CPE) is used for the electrooxidation of cephalexin in alkaline medium. The electrooxidation of cephalexin is found to be more efficient on CPE/POT(SDS)/Ni than on electrodeposited Ni on CPE/POT and electrodeposited Ni on CPE.

Keywords: Polymer, electrooxidation, modified electrode, Ni

Electro-oxidation of β-diketones and it's derivatives: experimental and geometric studies

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Abstract

Among many electrochemical techniques presented for study of chemical reactions, cyclic voltammetry has become a very popular technique for initial electrochemical studies of new systems and different groups compounds. β-diketones are very valuable compounds which have useful applications in chemical studies.

In this study, a training set of 19 β-diketone and β-ketoester derivatives has been studied using cyclic voltammetry on a glassy carbon electrode in water/ethanol (2:1 V/V) containing carbonate buffer as supporting electrolyte. For these compounds an irreversible anodic oxidation process was observed. Also, other related kinetic parameters such as the number of transferred electrons in oxidation process (n), diffusion coefficient (D), charge transfer coefficient (α) and heterogeneous rate constant were estimated by differential puls voltammetry, chronopotentiometry, Tafel plot and fitting the digitally simulated voltammograms to the experimental data, respectively.

In addition, the chemical structure and HOMO structural map of 14 β-diketone and β-ketoester derivatives have been optimized by using of Gaussian 98 program and Quantum Mechanical Calculation Ab Initio at #B3LYP/6-311+G** level. Referring to obtained results, studied molecules classified according to similarity between their electron density pattern and the Highest Occupied Molecular Orbital maps. The linear relationship between E_p^a and E_{HOMO} in each group was investigated and an interesting correlation was observed. This good correlation demonstrates that they have similar chemical and electrochemical behavior and the same electron transfer mechanism in oxidation process.

Electro-Oxidation of Fluoxetine Using Carbon Nanoparticles Modified Glassy Carbon Electrode

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Abstract

The main purpose in this study is to develop an electrochemical sensor for determination of the antidepressant drug fluoxetine (FLX) in pharmaceutical formulations using carbon nanoparticles (CNPs). This method was investigated in Britton-Robinson buffer solution by cyclic and differential pulse voltammetry. The effect of different parameters on peak currents and potentials including pH and scan rates were optimized for FLX on the surface of modified electrode and the bare glassy carbon electrode (GCE). The porous layer of CNPs improves the electroactive surface area and a remarkable increasing in the peak currents was observed. The best electrochemical response was obtained from DPV with a sensitive peak in pH 9. Linear calibration graphs were obtained in the range 1-25 µM with RSD values ranging from 0.3 – 5.7 %. The limits of quantification and detection were 1 and 0.4 µM, respectively. The CNPs modified GCE was successfully applied for FLX determination in capsules.

Keywords: Carbon nanoparticles, Modified glassy carbon electrode, Differential pulse voltammetry

Synergism of Polyaniline Nanowires and Sn Nanoparticles on Catalytic Activity of Pt in Direct Methanol Fuel Cells

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Abstract

The slow kinetics of the methanol oxidation reaction (MOR) due to poisoning of the DMFC anode catalyst by CO is a key problem to the commercialization of DMFCs. In this research a composite of 20% Polyaniline (PANI) nanowires and Vulcan (C) is prepared as a support of Pt-Sn (70:30) nanoparticles.

PANI nanowires is prepared by chemical interfacial method, doped with para toluene sulfonic acid and utilized for the fabrication of a C-PANI composite. Pt-Sn particles are subsequently deposited by reduction onto the C-PANI composite to produce a Pt-Sn/C-PANI electrocatalyst. Electro catalytic activity of Pt-Sn/C-20%PANI electrocatalyst is compared by Pt/C-20%PANI and Pt/C electrodes by cyclic voltammetry, impedance spectroscopy and chronoamperometry.CO stripping voltammetry tests show that incorporation of PANI nanowires and Sn particles in catalyst layer increases the CO tolerance of electrocatalyst. Electrocatalytic activity of Pt-Sn/C-20%PANI is more than Pt/C-PANI and the difference between them and Pt/C is so significant.

Keywords: DMFC, Polyaniline, Pt-Sn particles, CO tolerance

A new method for Pt nanoparticles deposition by EDTA ligand and it's performance in polymer electrolyte membrane fuel cells

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Abstract

Polymer electrolyte membrane fuel cells (PEMFCs) are considered as one of the most promising power sources due to their high energy densities. Pt-based materials are effective electrocatalysts for PEMFC electrodes. Many researches has been focused on reducing Pt loading at the cathode electrode by use of non platinum catalysts or modifying Pt nanoparticles deposition methods.

In this work, EDTA ligand and different ratios of water/methanol solution was used to deposition Pt nanoparticles on carbon support. The ratio of water/methanol solution was optimized. The catalytic activity of synthesized electrocatalyst was measured by cyclic voltammetry (CV), impedance spectroscopy and linear sweep voltammetry (LSV) tests in a conventional three electrodes system and the results were compared by commercial electrocatalyst (Pt/C E-Tek). Finally, this electrocatalyst was used as cathode electrocatalyst in a single PEM fuel cell. In this method Pt particles distributed more homogenously and it's catalytic activity is better than Pt/C (E-Tek).

Keywords: PEM fuel cell,EDTA,Pt nanoparticles ,single cell

A phenyl-sulfonic acid anchored carbon-supported platinum catalyst for polymer electrolyte fuel cell electrodes

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Abstract:

Polymer electrolyte-based fuel cells (PEFCs), have been considered as promising power sources for different applications. The commercialization of PEFCs, however, is still significantly restricted by the low platinum utilization in the catalytic electrodes. Usually, the electrocatalyst is supported onto a porous carbon support in order to increase its contact area with the reactants. The porous catalyst layer must conduct both the electrons and protons optimally.

In the present work, Sulfonic acid groups were grafted onto the surface of carbon substrates to increase platinum utilization.The 1:1 mixture of sulfonated Vulcan XC-72 and sulfonated MWCNT was used as a support for platinium nanoparticles. The sulfonation degree of Vulcan was a variable parameter. The modified carbon supported platinum catalysts were characterized via cyclic voltammetry, linear sweep voltammetry, electrochemical impedance spectroscopy and chronoamperometery studies. An optimum loading of phenyl sulfonic acid for sulfonated Vulcan XC-72 (7.5 w/o) is required to improve the performance of the PEFC.

Keywords: PEMFC, platinium nanoparticles, Sulfunated Vulcan XC-72 and MWCNT 1:1 Mixtures

A high-performance nanophase/conventional silver oxide electrode for high-rate silver zinc battery

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Abstract:

Electrochemical performance of the conventional divalent silver oxide electrode (with silver (II) oxide particle size in range of 1~0.1 µm) in silver-zinc battery has been optimized by mixing with a certain amount of divalent silver oxide nanoparticles with particle size in 50~5 nm. Both nano and conventional AgO powders were prepared chemically in our laboratory. Two zinc electrodes and one silver oxide electrode used in our typical cells to limit the capacity of the cell by AgO electrode. The cathode electrodes have been prepared by mixing various proportions of nanoparticles and conventional AgO. The given cells were discharged under different current densities to provide an obvious comparison of cathodes electrochemical behavior. Compared with the conventional cathode, the optimum mixed cathode can add an extra discharge capacity of 15.5-26.5% at higher current densities. Moreover, improvement of electrochemical behavior of the mixed AgO electrode increases average voltage of the cell at higher current densities.

Keywords: Nanopowder AgO, Silver (II) oxide, Silver zinc battery

Development of Pd and Pd_xCo electrocatalysts supported on multi-walled carbon nanotubes for oxygen reduction reaction

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Abstract

The promotion effect of Co in the electrocatalysts of Pd_xCo(x=10, 4, 3, 2 and 1)/MWCNT for oxygen electroreduction is confirmed. The X-ray diffraction (XRD) analysis showed well-defined reflections corresponding to a face centered cubic phase of palladium.Tafel plots are employed to examine the charge-transfer kinetics of oxygen electroreduction. The results suggest that the reaction kinetics is faster on Pd_xCo/MWCNT, except for the PdCo(1:1)/ MWCNT catalyst, than on Pd/MWCNT. The kinetic parameters such as the charge transfer parameter and the diffusion coefficient of oxygen electroreduction on Pd_xCo/MWCNT electrocatalysts are obtained under the quasi-steady-state conditions. Polarization data indicated Pd_3Co/MWCNT to have better oxygen reduction reaction (ORR) activity than the other Co combinations, in terms of shift in onset potential to a positive value of more than 75 mV and increased reduction current.

Keywords: Oxygen electroreduction; Pd_xCo nanoparticles; MWCNT

Synthesis and Characterization of Nickel Hexa Cyano Ferrate(NiHCF) and determination of N_acetylcystein and L_cystein by it.

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Abstract

Carbon composite electrodes of n-Fe2O3@KNi[Fe(CN)6] were prepared. (NiHCF) as a thin shell around cores of nanoparticles of iron(III) oxide, forming nanoparticles of iron(III) oxide@NiHCF (n-Fe2O3@KNi[Fe(CN)6]). The morphology and structure of the n-Fe2O3@KNi[Fe(CN)6] were characterized by the techniques of electron microscopies, X-ray diffraction measurements, infrared spectroscopy. The electrochemical behavior of the nanoparticles was evaluated using cyclic voltammetry. The redox couples of n-Fe2O3@KNi[Fe(CN)6] were investigated andthe diffusion coefficients of counter cation in the shell of NiHCF were obtained. The electrocatalytic oxidation of N-acetyl-l-cysteine (NAC) and L-cystein(cysH) were studied on nanoparticles of (Fe2O3@NiHCF)-modified carbon paste electrode (cs-MCPE). Voltammetric studies indicated that NAC and (cysH) were oxidized via a surface mediation electrocatalytic mechanism by Fe2O3@NiHCF. The catalytic rate constant, the electron-transfer coefficient and the diffusion coefficient involved in the electrooxidation process of NAC and (cysH)on Fe2O3@NiHCF were reported. Also, according to the proposed amperometry methods, detection limits of NAC and (cysH)were determined .

Keywords: Modified electrode, N-Acetyl-l-cysteine , L-cystein

Simultaneous Determination of Dopamine, Acetaminophen and Aspirin at a Ruthenium Oxide Nano-scale Islands Modified Glassy Carbon Electrode

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Abstract

Combination drugs consisting of acetaminophen (AC), dopamine (DA) and aspirin (ASA) are used to treat different pains. In the present work, the electrochemical oxidation of DA, AC and ASA has been studied at a ruthenium oxide nanoparticles modified glassy carbon electrode (RuON-GCE) surface. The reversibility of AC and DA at RuON-GCE surface is significantly improved in comparison with GCE alone. In differential pulse voltammetric measurements the linear range of 0.04 - 1.6 µM and 1.6 - 41.0 µM for DA, 0.04 - 0.8 µM and 0.8 - 400.0 µM for AC, and 0.04 - 25.6 µM for ASA are obtained. Detection limits of DA, AC and ASA are calculated by DPV. Also, we evaluated the analytical performance of the modified electrode in quantification of DA in the presence of AC and ASA. The RuON-GCE has been satisfactorily used for the determination of DA, AC and ASA in pharmaceutical formulations.

Keywords: Dopamine, Differential pulse voltammetry, Acetaminophen

Direct electrochemistry and electrocatalysis of hemoglobin entrapped in chitosan–sodium dodecyl sulfate–carbon nanotube nanocomposite

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Abstract

Hemoglobin (Hb) is a heme protein that can transport oxygen in blood of vertebrate animals. It has a molar mass of approximately 67,000 g mol^{-1}, and contains four polypeptide subunits, each of which has one iron-bearing heme as electron-transfer center. The direct electron transfer between redox proteins and electrode surface has received widespread attention in recent years. In this research, a simple, biocompatible sensing strategy based on chitosan, sodium dodecyl sulfate and carbon nanotube composite film for immobilizing the hemoglobin protein was found. The direct electron transfer and bioelectrocatalytic activity of hemoglobin after incorporation into the composite film were investigated. A pair of redox waves of hemoglobin was appeared, and hemoglobin could exhibit its bioelectrocatalytic activity toward H_2O_2. Such results indicated that carbon nanotubes, sodium dodecyl sulfate and chitosan composite could be a friendly biocompatible interface for immobilizing biomolecules and keeping their native structure. Hence, carbon nanotube and chitosan would be a promising platform for protein immobilization and biosensor preparation.

Keywords: Hemoglobin, Carbon nanotube, Sodium dodecyl sulfate, Chitosan

A Novel Sensor for Simultaneous Detection of Ascorbic acid, Epinephrine and Uric acid Based on New Modified Electrode with Nano-metallic Structure

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Abstract

A group of biogenic amines, such as epinephrine (EP), have important role in the mammalian central nervous systems [1, 2]. Quantitative determinations of them are important for developing nerve physiology [3]. EP, uric acid (UA) and ascorbic acid (AA) always exist together in biological environments and interfere in analysis of each other [4]. In this work, the development of a sensor for determination of AA, EP and UA has been described by a glassy carbon electrode modified with multi-walled carbon nanotubes and ruthenium oxide film. The modified electrode showed high catalytic activity following by well separated oxidation peaks of AA, EP and UA. The peaks currents of differential pulse voltammograms increased linearly with AA, EP and UA concentrations in the ranges of 0.2-15.0 µM, 0.1-10.0 µM and 0.90-250 µM with a detection limit of 0.087, 0.052 and 0.599 µM, respectively. The modified electrode satisfactorily used for simultaneous determination of AA, EP and UA in real samples.

Keywords: Epinephrine, Sensor, Nano structure, Modified electrode

Electrochemical Oxidation of Some Silylethers at Nanostructure nickel electrodes

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Abstract

The electrochemical oxidation of some silylethers was investigated using nickel coated anodes in acetonitrile solvent.

The effect of the presence of saccharin on nickel deposition in nano size and in Watts-type plating bath was investigated.Electroplated nickel was fabricated at (10 A/dm2) in the presence of saccharin (3-5 gr/lit) and time controlling.

The crystallite size of the deposits was evaluated by XRD technique and the morphology of the coated layers is clarified by means of SEM.

Silylethers are extensively used as protective groups for alcohols in synthetic chemistry Because of its low cost, efficiency of preparation, stability under the intended reaction conditions and easy and selective removal.

The use of Ni as a catalyst for the electro-oxidation of silylether was studied by cyclic voltammetry.

Keywords: Electrochemical oxidation of silylethers, nickel coated electrode, saccarin

A Modified Carbon Nanotubes Paste Electrode as a New Voltammetric Sensor for Determination of Levodopa

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Abstract

Levodopa (LD) a precursor of the neurotransmitter dopamine is the most widely prescribed drug in the treatment of Parkinson’s disease. People with Parkinson’s disease have depleted levels of dopamine, which causes tremor, muscle stiffness or rigidity, slowness of movement (bradykinesia) and loss of balance. Therefore, determination of this compound is vital. The present work presents a proposal for the application of a carbon paste electrode modified by carbon nanotubes and a new diamine compound as an electrochemical sensor for monitoring LD. Using the electrooxidation of LD at +0.370 in phosphate buffer pH 6.0 on a modified carbon nanotubes paste electrode it is possible to obtain a linear calibration curve from 2.0×10−6 to 5.0×10−4 M and a detection limit of 1.2 µM. The method was successfully applied to the determination of LD in urine sample without any pre-treatment.

Keywords: Levodopa, Multiwall Carbon Nanotubes paste electrode, Voltammetry, Sensor

Voltammetric Determination of Hydrazine Using Multiwall Carbon Nanotubes Paste Electrode

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Abstract

Hydrazine and its derivatives have been used as rocket fuel and as an oxygen scavenger in boilers. Other applications include the manufacture of metal films, blowing agents for plastic, photographic chemicals, insecticides, explosives, and 30 pharmaceuticals. Because this substance and its derivatives are applied in such a variety of different fields and has been recognized as a carcinogenic and hepatotoxic agent, their quantitative determination is of great analytical importance, attracting the interest of many researchers. In the present study, the use of a carbon paste electrode modified by 1,4-diaminobanzan and carbon nanotubes prepared by a simple and rapid method was described. The modified electrode showed an excellent character for electrocatalytic oxidization of hydrazine (HZ). Linear sweep voltammetric peak currents of HZ increased linearly with it concentrations at the range of 0.5 µM to 500 µM. Finally, this method was evaluated for the determination of HZ in some real samples.

Keywords: Hydrazine, Multiwall Carbon Nanotubes, Modified electrode

A New Catecolamine as a Mediator and Multiwall Carbon Nanotubes as a Sensor for Determination of L-Cysteine

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Abstract

l-Cysteine, a sulfur-containing amino acid, and its derivatives have attracted especial attention because of its involvement in many important biological processes, and its chemical activity in the formation of complexes with various ionic species and biomolecules. l-cysteine is a highly significant bioactive compound, and is known to be an active site in the catalytic function of certain enzymes known as cysteine proteases and in many other peptides and proteins. Therefore, the electrochemical behavior of l-cysteine studied at the surface of modified carbon nanotubes paste electrode in aqueous media using cyclic voltammetry, and double potential step chronoamperometry. It has been found that under optimum condition (pH 7.0) in cyclic voltammetry, the oxidation of l-cysteine occurs at a potential about 320 mV less positive than that of an unmodified carbon paste electrode. The kinetic parameters such as electron transfer coefficient, α, and catalytic reaction rate constant, k_h were also determined using electrochemical approaches.

Keywords: l-Cysteine, Double potential step chronoamperometry, Cyclic voltammetry, Modified electrode

Determination of Penicillamine in the Presence of Tryptophan Using Electrocatalytic Method

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Abstract

D-Penicillamine (PA), 3-mercapto-d-valine, is a pharmaceutically important thiol compound used as a medicinal agent against a number of diseases, i.e., rheumatoid arthritis, liver disease and cystinuria, and heavy metal poisoning. It may also inhibit the replication of the human immunodeficiency virus, the cause of acquired immune deficiency syndrome (AIDS). Tryptophan (TP) is one of the twenty amino acids and one of the essential ones in human diet. The oxidation peak currents of PA and TP overlap at the surface of unmodified electrodes. Hence, modified electrodes are necessary for their determination. Multiwall carbon nanotubes paste electrode was used as a voltammetric sensor for oxidation of PA and TP in the presence of naphtol green B. In a mixture of PA and TP, those voltammograms were well separated from each other with potential differences of 300 mV. The modified electrode was used for the determination of those compounds in real samples.

Keywords: D-Penicillamine, Tryptophan, Multiwall carbon nanotubes, Sensor

Naphthol Green B as New Mediator and Multiwall Carbon Nanotubes as a Sensor for Voltammetric Determination of *N*-Acetylcysteine

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Abstract

N-acetylcysteine (NAC) is rapidly metabolized to intracellular glutathione. Its action as an antioxidant and a glutathione precursor may also contribute to a protective effect against cancer. Therefore, determination of NAC is important. Several methods have been proposed for the determination of NAC, including chromatography, flow injection and electrochemical methods. In this work, a multiwall carbon nanotubes modified electrode was prepared using naphthol green B as a new mediator to be used as a voltammetric sensor for the determination of *N*-actylcysteine. The electrochemical behavior of NAC at this modified electrode was studied using cyclic voltammetry and chronoamperommetry. The kinetic parameters such as electron transfer coefficient, α and catalytic reaction rate constant, K_h were also determined using electrochemical approaches. It was successfully applied for the determination of actylcysteine in real samples such as drug and urine.

Keywords: *N*-acetylcysteine, Naphthol green B, Sensor, Real sample analysis

Methyldopa as Novel mediator and carbon nanotubes as a Sensor for Electrocatalytic Determination of Glutathione

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Abstract

Glutathione (GSH), which is present in virtually all mammalian tissues, provides reducing capacity for several reactions and plays an important role in detoxification of hydrogen peroxide, other peroxide, and free radicals. An essential part of the antioxidative system that prevents accumulation of lipid peroxides is GSH, found in virtually all cell types.

In this study, electrooxidation of GSH was studied at the surface of carbon nanotubes paste electrode in the presence of methyldopa as a mediator. The diffusion coefficient of GSH and the transfer coefficient (α) were also determined. The sensor showed good reproducibility, remarkable long-term stability and especially good surface renewability by simple mechanical polishing. The results showed that this electrode could be used as an electrochemical sensor for the determination of GSH in real samples, such as urine samples.

Keywords: Glutathione, Methyldopa, Sensor, Electrocatalysis

Electrocatalytic Oxidation of Glutathione at Modified Carbon Nanotubes Paste Electrode

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Abstract

Glutathione (GSH) plays an important role in detoxification of hydrogen peroxide, other peroxide, and free radicals. Synthesis and degradation of glutathione are controlled by reaction of the c-glutamyl cycle; a decrease in blood reduced GSH has been reported in patients affected by deficiencies of the enzymes involved in the synthesis of glutathione. As a consequence of the widespread involvement of GSH in many biological functions, much effort has been invested to develop sensitive and selective methods for its detection. In this study, a new sensitive voltammetric sensor was developed for electrochemical determination of GSH at a modified multiwall carbon nanotubes paste electrode in the presence of rutin as a suitable sensor. The proposed method may, thus, also be used as a novel, selective, simple, and precise method for the voltammetric determination of GSH in such real samples as hemolyzed erythrocyte.

Keywords: Glutathione, Rutin, Multiwall carbon nanotubes, Electrocatalysis

Determination of *N*-Actylcysteine in Some Real Samples Using Isoprenalin as a Mediator

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Abstract

Carbon nanotubes (CNTs) have gained considerable attention in recent years because of their remarkable electronic and mechanical properties. The unique features of CNTs make them extremely attractive for a wide range of sensing applications. The ability of CNT-modified electrodes to promote electron transfer reactions and resistance to surface fouling has been documented in connection to important biomolecules. An electrochemical method is described for the voltammetric determination of *N*-actylcysteine using isoprenalin as a mediator and carbon nanotubes paste as a sensor. Cyclic voltammetric, chronoamperometric, and linear sweep voltammetry methods have used to investigate the suitability of isorenalin as a mediator for the electrocatalytic oxidation of *N*-actylcysteine at pH=3.0. The diffusion coefficient and the kinetic parameters such as electron transfer coefficient and rate constant were determined for *N*-actylcysteine, using the electrochemical approaches. The proposed method was successfully applied to the determination of *N*-actylcysteine in both ampoule and urine samples.

Keywords: N-actylcysteine, Isoprenalin, Carbon nanotubes, Electrocatalysis

Voltammetric Measurement of Trace Amount of Glutathione in Hemolyzed Erythrocyte

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Abstract

Glutathione (GSH) is a tripeptide that contains an unusual peptide linkage between the amine group of cysteine and the carboxyl group of the glutamate side chain. Measurement of GSH in blood samples indicates the status of cells in relation to its protective role against oxidative and free radical-mediated cell injury. Moreover, GSH measurement is important for the diagnosis of c-glutamyl cycle disorders. Because of the widespread nvolvement of GSH in many biological functions, much effort has been invested in developing sensitive and selective methods for its detection. We, therefore, proposed on the basis of previous work, isoprenaline as a mediator for the rapid, sensitive, and highly selective voltammetric determination of GSH on the surface of a multiwall carbon nanotubes paste electrode. The results showed that the catalytic current depends on the concentration of GSH. Cyclic voltammetry and double potential step chronoamperometry are employed to establish the electrocatalytic behavior of isoprenaline.

Keywords: Glutathione, Isoprenaline, Voltammetric sensor, Cyclic voltammetry

Mercaptopurine Determination Using a Homogeneous Mediator in Aqueous Solution

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Abstract

Mercaptopurine (MP), is an immunosuppressive drug. It is a thiopurine and used to treat leukaemia. This drug is traditionally not recommended during pregnancy but this issue has been debated and current evidence indicates that pregnant women on the drug show no increase in foetal abnormalities. Few publications are available regarding electrochemical determination of just 6-MP in real samples using chemically modified electrodes. So, in this study, we have used cyclic voltammetry, linear sweep voltammetry and chronoamperommetry techniques to demonstrate the electrochemical behavior of 6-MP on modified multiwall carbon nanotubes paste electrode. The proposed sensor is highly selective and sensitive for the determination of 6-MP in some real samples such as drug and urine. The detection limit, linear dynamic range, and sensitivity to 6-MP with the sensor from this method are comparable to, and even better than, those from recently developed which use voltammetric methods.

Keywords: Mercaptopurine, Linear sweep voltammetry, Determination, Cyclic voltammetry

Modified Multiwall Carbon Nanotubes Paste Electrode as a Sensor for Determination of Penicillamine

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Abstract

Penicillamine is a pharmaceutical of the chelator class. It is used as a form of immunosuppressant in the treatment of rheumatoid arthritis. Its function is achieved by its macrophage inhibition function, which reduces the number of Tlymphocytes, prevents collagen from cross-linking, and reduces the rheumatoid factor. The use of penicillamine in Wilson's disease was first proposed by Walshe. Different electrochemical methods have been reported for the determination of PA using electrocatalytic methods. In this work, we propose chlorpromazine as a new mediator for the rapid, sensitive, and highly selective voltammetric determination of PA using multiwall carbon nanotubes paste electrode. Using linear sweep voltammetry and under the optimum conditions at pH 4.0, the electrocatalytic oxidation peak current of PA shows a linear dependence on PA concentration in the PA concentration range of 0.5 to 600.0 μM. The detection limit (3σ) is determined to be 0.2 μM.

Keywords: Penicillamine, Chlorpromazine, Electrocatalysis, Sensor

3,4-Dihydroxycinnamic Acid Modified Multiwall Carbon Nanotubes Paste Electrode for Determination of Vitamine C

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Abstract

Electrochemical methods traditionally have found important applications in sample analysis and in organic and inorganic synthesis. Ascorbic acid (AA) is known for its reductive properties and for its use on a wide scale as an antioxidant agent in foods and drinks. Therefore, recent advances in the food and pharmaceutical industries and a need for nutritional assessment have necessitated the development of a selective, simple and accurate method to determine of AA. Cyclic voltammetry, linear sweep voltammetry and double potential step chronoamperometry were used to investigate the electrochemical behavior of ascorbic acid at a chemically modified electrode prepared by incorporating multiwall carbon nanotubes into carbon paste matrix in the presence of 3,4-dihydroxy cinnamic acid. Under the optimized conditions (pH 6.00), the modified electrode showed high electrocatalytic activity toward AA oxidation; the overpotential for the oxidation of AA was decreased by more than 80 mV and the corresponding peak current increased significantly.

Keywords: Ascorbic acid, 3,4-Dihydroxycinnamic acid, Electrocatalysis, Electrooxidation

Novel Nanostructure-Based Electrochemical Sensor for Simultaneous Determination of Dopamine and Acetaminophen

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Abstract

A carbon-paste electrode modified with a novel molybdenum (VI) complex and carbon nanotubes have been applied to the electrocatalytic oxidation of dopamine (DA) which reduced the overpotential by about 125 mV with obviously increase the current response. Due to its strong electrocatalytic activity towards DA, the modified carbon-paste electrode can resolve the overlapped voltammetric waves of DA and acetaminophen (AC) into two well-defined voltammetric peaks with peak-to-peak separation in potentials of about 230 mV. In phosphate buffer solution of pH 7.0, the oxidation current increased linearly with two concentration intervals of DA, one is 0.1 to 40.0 μM and, the other is 40.0 to 800.0 μM. The detection limit (3σ) obtained by DPV was 76.0 nM. The proposed method was successfully applied to the determination of DA, and AC in some commercial pharmaceutical samples.

Keywords: Dopamine, Acetaminophen, Carbon nanotubes, Modified electrode, Electrocatalysis

Electrochemical Behavior of Isoproterenol in the Presence of Uric Acid and Folic Acid at a Modified Carbon Nanotube Paste Electrode

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Abstract

This work reports the selective determination of isoproterenol (IP) in the presence of uric acid (UA) and folic acid (FA) using 2,7-bis(ferrocenyl ethyl)fluoren-9-one modified carbon nanotube paste electrode (2,7-BFCNPE) in 0.1 M phosphate buffer solution (PBS) (pH 7.0). 2,7-BFCNPE resolved the voltammetric signals of IP, UA and FA with potential differences of 150, 325 and 475 mV between IP–UA, UA–FA and IP–FA, respectively. In PBS of pH 7.0, the oxidation current increased linearly with two concentration intervals of IP, one is 0.08 to 17.5 μM and, the other is 17.5 to 700.0 μM. The detection limit (3σ) obtained by DPV was 26.0 nM. The practical application of the modified electrode was demonstrated by determining IP in some real samples.

Keywords: Isoproterenol, Uric acid, Folic Acid, Modified Electrode, Electrocatalysis, Carbon Nanotubes

Electroanalysis and Simultaneous Determination of 6-Thioguanine in the Presence of Uric Acid and Folic Acid Using a Modified Carbon Nanotube Paste Electrode

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Abstract

The present work describes the preparation and characterization of a carbon nanotube paste electrode modified with 2,7-bis(ferrocenyl ethyl) fluoren-9-one (2,7-BF). This electrode showed an efficient catalytic activity for the electro-oxidation of 6-thioguanine (6-TG), which leads to lowering its overpotential by more than 610 mV. Also, the values of catalytic rate constant ($k=2.7\times10^{3}$ M^{-1} s^{-1})، and diffusion coefficient ($D=2.7\times10^{-5}$ cm^{2}/s) were calculated. In 0.1 M phosphate buffer solution of pH 7.0, the oxidation current increased linearly with two concentration intervals of 6-TG, one is 0.06 to 10.0 μM and, the other is 10.0 to 160.0 μM. The detection limit (3σ) obtained by differential pulse voltammetry (DPV) was 22.0 nM. DPV was used for simultaneous determination of 6-TG, uric acid (UA) and folic acid (FA) at the modified electrode.

Keywords: 6-Thioguanine, Uric Acid, Folic Acid, Carbon Nanotube, Modified Carbon paste Electrode, Voltammetry

Novel Electrochemical Based Sensor for Selective Determination of Isoproterenol in the Presence of N-Acetylcysteine

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Abstract

In the present work, the use of a carbon paste electrode modified by 5-mino-3',4'- dimethyl -biphenyl-2-ol (5ADB) and carbon nanotubes (CNTs) for the determination of isoproterenol (IP) and N-acetylcysteine (NAC) was described. Initially, cyclic voltammetry was used to investigate the redox properties of this modified electrode at various scan rates. Next, the mediated oxidation of IP at the modified electrode was described. At the optimum pH of 7.0, the oxidation of IP occurs at a potential about 320 mV less positive than that of an unmodified carbon paste electrode. Based on square wave voltammetry (SWV), the oxidation of IP exhibited a dynamic range between 0.4 and 1000.0 μM. SWV was used for simultaneous determination of IP and NAC at the modified electrode, and quantitation of IP and NAC in some real samples.

Keywords: Isoproterenol, N-acetylcysteine, Electrocatalysis, Carbon Nanotubes, Modified Electrodes

Voltammeric determination of morphine using Ionic liquid/multiwall carbon nanotubes paste electrode

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Abstract

Room temperature ionic liquids are solvents that may have great potential in chemical analysis. Ionic liquids have a great potential for possible electrochemical applications because these compounds possess as high thermal stability, no volatility, high polarity, large viscosity, high intrinsic conductivity, and wide electrochemical windows. In this paper, we present a new multiwall carbon nanotubes modified carbon ionic liquid electrode, which utilizes 1-butyl-3-methylimidazolium hexafluoro phosphate as a binder. To the best of our knowledge, there is not any report for the application of multiwall carbon nanotubes modified carbon ionic liquid paste electrode for the determination of morphine. The experimental results suggested that the modified electrode promoted electron transfer reaction for the oxidation of morphine. Under the optimized conditions at pH 8.0, the peak current was linear to morphine concentrations over the concentration range of 0.45-450.0 μmol L^{-1}, using differential pulse voltammetry.

Keywords: Room temperature ionic liquid, Morphine, Multiwall carbon nanotubes paste electrode

Fabrication and Electrochemical Properties of Cobalt Tungstate Nanostructures

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Abstract

The nanoparticles of Cobalt tungstate were prepared by precipitation method by adding the aqueous solution of $CoCl_2$ to a solution of $Na_2WO_4.2H_2O$ in a 1:1 molar ratio, while temperature and pH were fixed on 80˚C and 7, respectively. The final mixture was stirred and the precipitates were centrifuged and washed by de-ionized water for several times. Dried samples were calcinated subsequently at 500˚C for 5 hours. The obtained materials were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM). Electrochemical studies including cyclic voltammetry, galvanostatic charge-discharge curves and impedance spectroscopy, were performed in a 0.1M NaOH solution by a three-electrode standard cell containing of Ag/AgCl as the reference electrode, a platinum grid, as the counter electrode and a carbon paste electrode of samples as working electrode. Our studies showed a capacitive behavior in the potential range between -0.2 and 0.4 volts vs. Ag/AgCl.

Keywords: Cobalt Tungstate Nanostructures, Galvanostatic charge-discharge curves, Impedance spectroscopy

Effect of Catalyst Ink Solvent on the Palladium- Polyaniline Nano-Composites Hydrogen Adsorption

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Abstract

Pd and Palladium compound are used for hydrogen adsorption for many years. It has been recognized that conductive polymers can change hydrogen adsorption properties of Pd in its compositions. Polyaniline is one of the most attractive polymers on account of its properties. There are two methods for PANI-Pd composite making; one method is using of polyaniline as a substrate. In this method Pd nano-particles are precipitated on the polymer substrate by electro-deposition of Pd. Second method is electro-polymerization of PANI on electrodes containing palladium nanoparticles. In this study second method was employed. Two different alcohols were used as solvent for preparing of Pd catalyst ink; cyclopentanon and isopropyl alcohol. Cyclic Voltammetry has been employed for investigating of hydrogen adsorption of the Pd before and after synthesis of the polyaniline. Results show that cyclopentanon decreases the hydrogen adsorption, whereas isopropyl alcohol increases the hydrogen adsorption. It could be related to the effect of ink solvent on agglomeration and non homogeneous distribution of Pd particles on the surface of GC.

Key words: PANI-Pd composite, hydrogen adsorption, Ink solvent effect

Fabrication of chemiresistor sensor based on multi-walled carbon nanotube(MWCNT)/ poly aniline composite for nitro toluene detection

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Abstract

Chemiresistor sensor based on multi-walled carbon nanotube (MWNT) networks was fabricated and their sensitive properties for the nitro toluene vapor detection were investigated. The MWNT networks/poly aniline was deposited on silicon surface coated with gold layer. The effects of carrier gases, gases flow, adsorption/desorption process, temperature and time on the sensor response were studied. The excellent response is obtained under a nitrogen gases with 5 cm3 flow. The sensors exhibit high resistance response, fast response time, rapid recovery and good reproducibility for nitro toluene vapor. The deposited MWNT/poly aniline composite sensors will be potentially extended to large-scale fabrication.

Keywords: Chemiresistor sensor, Polyaniline, nitro toluene vapor detection.

Electrochemical Characteristics of GC Electrode Modified with Zn-Al-LDH Nanocomposite & Hexacyanoferrate

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Abstract

Zn/Al Layered Double Hydroxide nanocomposite (Zn-Al-LDH) can be reacted with hexacyanoferrate (HCF) through an ion-exchange reaction. At the first step of the present work, a thin film of Zn-Al-LDH-HCF was immobilized on the surface electrode. Then a nafion layer was used as a suitable coating to keep the electro active modifier on the electrode surface. The modifier, Zn-Al-LDH-HCF was easily prepared with direct interaction between LDH annoparticles and a solution of HCF. The electrochemical behavior of GCE modified with Zn-Al-LDH-HCF was studied and its ability in electro catalytic oxidation of hydrazine was investigated. The modified electrode with Zn-Al-LDH-HCF showed a perfect catalytic activity towards hydrazine over the range of 0.1-5 mM in 0.1 M KOH solution. Based on the electrochemical studies a suitable mechanism for electrocatalytic oxidation of hydrazine was proposed.

Keywords: Zn/Al layered double hydroxide, Nanocomposite, Electrocatalysis, Hydrazine

Voltammeric determination of cysteine at a surface modified multiwall carbon nanotubes paste electrode

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Abstract

Cysteine plays an important role in stabilizing extracellular proteins. It can also react with itself to form an oxidized dimer by forming a disulfide bond. The thiol residue of cysteine is readily oxidized in electrochemical reactions at the surface of various thiol-sensitive electrodes. So, determination of cysteine is important in biological study. We, therefore, proposed on the basis of previous work, chlorpromazine as a mediator for the rapid, sensitive, and highly selectivevoltammetric determination of cysteine on the surface of a multiwall carbon nanotubes paste electrode (MWCNTPE). The results showed that the catalytic current depends on the concentration of cysteine. Cyclic voltammetry (CV) and double potential step chronoamperometry are employed to establish the electrocatalytic behavior of chlorpromazine . The proposed method is selective, sensitive, and fast for the determination of cysteine in real samples.

Keywords: Cysteine, Chlorpromazine, Sensor

Kinetic Study of the Nitration of Esculetin by Digital Simulation of Cyclic Voltammograms.

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Abstract

Esculetin is a natural lactone that is used in some sunscreens and act as a photosensitizer for DNA damage.The aim of this work is electrochemical study of nitrite ion reaction with produced quinone from oxidation of this catechol containing lactone. Esculetin convert to corresponding quinone electrochemically, at the pHs more than 6, or chemically by nitrous acid at the pHs less than 5. Produced quinone can be attacked by nitrite ion to form the corresponding nitro-derivative of esculetin. The height of cathodic currents or cathodic to anodic current peak ratios of cyclic voltammograms are monitored as critical parameter of reactivity of produces quinone. The homogeneous rate constants were estimated by comparing the experimental voltammetric responses with the digitally simulated results under EC mechanism. The effects of pH and nitrite ion concentrations are studied on the reaction mechanism and reaction rates.

Keywords: Esculetin, Cyclic voltammetry, digital simulation, electrochemical nitration.

Determination of sulfite in water and waste water samples using voltammetric methods

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Abstract

Sulfites are commonly used in the food and pharmaceutical industries as preservatives and antioxidants and brewing industry as an antibacterial agent. In large quantities, sulfite and its oxidation products are pollutants. Sulfite is a typical example of sulfur oxoanions. In particular, sulfiting agents have received widespread attention, as a result of their allergenic effect on those individuals who are hypersensitive. This work describes a carbon paste electrode modified with ferrocene and carbon nanotubes as a sensor for voltammetric determination of sulfite at a pH 7.0. Under the optimized conditions, the electrocatalytic oxidation peak current of sulfite showed two linear dynamic ranges with a detection limit of 0.1 μM for sulfite. The proposed method was examined as a selective, simple and precise method for voltammetric determination of sulfite in some real samples such as water and waste water samples.

Keywords: Sulfites, Water and waste water, Carbon paste electrode

Arsenic Seperation from Arsenic-Copper Solutions via Electrowining

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Abstract

In order to maintain high operating current efficiencies and satisfactory cathode purity, it is necessary to control the concentrations of these impurities by continuously removing a portion of the electrolyte for purification. Electrochemical processing is one the potentiality possible procedures, for the sepration of arsenic from waste solutions, such as copper refinery bleed. An electrowinning study of arsenic from arsenic-copper aqueous solutions was carried out in order to assess the possibility of its recovery in the form of copper-arsenic deposition. Increasing As concentration increases the As removal efficiency while, a relatively sharp increase in Cu removal yield is observed. Removal yield of both species is influenced by increasing current density and copper: arsenic mass ratio. Positive response of Cu and As removal yield becomes much pronounced at higher current densities.

Keywords: copper-arsenic electrodeposition, arsenic-copper solution, electrowinning.

Electrocatalytic Oxidation of Methanol on Shimalite-Nickel modified Carbon Paste Electrode

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Abstract

Fuel cells are green source of energy, which can be used in many devices with different sizes. One fuel that is used in fuel cells is methanol. In fuel cells for electrochemical oxidation of methanol, Pt have been used extensively [1], but its cost is very high and its resources on crust is low [2]. Many attempts have been done to reduce the overvoltage of methanol oxidation on the anode electrode, increase the current density of this reaction, and decrease the cost of the electrode. There are many reports, which have been used Ni or Al_2O_3 containing mediators [3,4]. In this study the chemically modified carbon paste electrode with Shimalite-Nickel commercial catalyst was used for methanol oxidation. This catalyst contains Ni, SiO_2, iron oxide and alumina. To obtain the best results, pH effect, type of supporting electrolyte and the catalyst percentage were optimized. The lowest overvoltage (<0.3 V) and the highest current density were observed in 1.5 M KOH and 20% W/W catalyst. According to low cost of the proposed catalyst, and low over voltage for methanol oxidation on the mentioned electrode, it can be an acceptable candidate for anode electrode in methanol oxidation reaction.

Keywords: Methanol oxidation, Carbon paste electrode, Shimalite-Nickel

Comparison of New Electrochemical Methods of Corrosion Measurement and Qualitative Study of Different Corrosion Processes for Electrochemical Noise Data Analysis

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Abstract

The simplest method in measurement of corrosion is application of metal coupons which require great force and a lot of time. Another method used is electrical resistance methods but the limitation of such methods is high sensitivity toward temperature and also they can not identify localized corrosion from general corrosion. In contrast to these methods, there are other electrochemical tests such as Linear Polarization Resistance (LPR), Electrochemical Impedance Spectroscopy (EIS), Harmonic Distortion Analysis of Electrochemical Noise, and Electrochemical Frequency Modulation through which a major part of such obstacles can be removed.The electrochemical noise is used to study the corrosion issues in various sectors of heavy industries such as oil and gas industries, fossil power plants, petrochemical industries, nuclear energy as well as space industries. In this paper, different methods of corrosion measurement and evaluation are discussed. Besides, the differences of three main sources in electrochemical systems for electrochemical noise measurement are examined and the applications of this method are explained.

Keywords: Electrochemical Noise،Corrosion Measurement ،analysis،potansioestatic

Corrosion Study of Mild Carbon Steel and Platinum in the Presence of Zinc Oxide Nanofluid Solution in Different Rotation Speeds

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Abstract

Nanofluids, i.e. fluid suspensions of nanometer-sized solid particles, have been proposed as a route for surpassing the performance of heat transfer liquids currently available. Nanofluids have indicated significant increases in thermal conductivity compared with liquids without nanoparticles or larger particle(macro particles). In this investigation, the Zinc Oxide nanofluid was synthesized by chemical method and its spectrom was investigated by UV-vis spectrophotometer .Corrosion of Platinum and Carbon steel in nanofluids containing Zinc Oxide was studied by potentio-dynamic polarization method .The effect of electrode rotation speeds on the corrosion rate was also studied. Polarization measurements shows that increasing rotation speeds from 0 to 1000 rpm in Platinum and mild Carbon steel electrodes reduceses the corrosion current density of both metals.

Keywords: Nanofluid, Carbon Steel, Platinum, Corrosion

The Performance Mechanism of Inhibitors for Dealing with Sedimentation Phenomenon, and Developing Novel Approaches to Moderate and Protect Exchangers from Corrosion

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Abstract

The appropriate performance of heat exchangers, which are one of the essential equipments in process Unit, plays a significant part in the reduction of production cost. Two of major difficulties in applying these equipments are sedimentation phenomenon and microbial (or bacterial) corrosion, that significantly decrease the thermal efficiency of exchangers resulting in an increase in production cost, as well as the reduction in quality or quantity of production. Bacterial corrosion in interaction with normal electrochemical reactions (cathode-anode reactions, etc.) is a type of corrosion that is initiated or intensified via microorganism's activities. Microbial corrosion is usually exploited to show the increase-rate in corrosive activity caused by the presence of some bacteria. These bacteria increase the speed of cathode, anode, or cathode-anode corrosive reactions.

This article attempts to investigate the sedimentation phenomenon based on operational, processing, and liquid (water) analysis conditions, as well as available information about sedimentation creation and inhibitors' performance mechanisms. In addition, in order to moderate and protect against corrosion, it examines the effects of oxygenated bio-film and bio-films that produce anti-bacterial compounds on exchangers currently operating in Oil, Gas, and Petrochemical industries.

Keywords: Inhibitors ¸ Sedimentation ، Exchanger ، Corrosion

Investigation of Corrosion Behavior of Platinum Electrode in the Presence of CuO Nanofluid

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Abstract

Nanofluids are colloidal suspensions with nano-sized particles. Nanofluids have a higher thermal conductivity compared with conventional particle fluid suspensions. Furthermore large mass of microparticles can damage the pipe’s wall of cooling systems. In this sense, nanofluids have an important role in corrosion issues. In this research corrosion of Platinum electrode in presence of CuO nanocolloid was invstigated. The open circuit potential, linear sweep voltammetry and cyclic voltammetry diagrams were discussed and results showed that the corrosion rate of Pt electrode in presence of CuO nanocolloid decreased when the electrode rotation speed increased 0, 100, 1000rpm.

Keywords: Platinum Electrode, CuO Nanofluid, Corrosion

Preparation and Investigation of corrosion protective properties of nanostructured hybrid sol-gel coatings on AA2024

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Abstract

Titania-containing organic–inorganic hybrid sol–gel films have been developed as an alternative to chromate-based coatings for surface pretreatment of aluminium alloys. Sol–gels are organic–inorganic polymers formed by hydrolysis/condensation reactions of alkoxide precursors, which have found wide applications as electronic, solar collectors and protective coatings. These coatings possess important characteristics such as chemical stability, physical strength and scratch resistance. Incorporation of nanoparticles in the hybrid sol–gel systems increases the corrosion protection properties due to lower porosity and lower cracking potential along with enhancement of the mechanical properties. In this work, stable hybrid sols were prepared by hydrolysis of 3-Glycidoxypropyltrimethoxysilane (GPTMS), tetraethylortosilicate (TEOS) and titanium organic compounds. The sols were applied as coatings on aluminum alloy AA2024 and characterized by physical, microscopical and electrochemical techniques which improved to have good adhesive and corrosion protection properties.

Keywords: corrosion protection, hybrid coating, sol-gel, AA2024

Optimization and modification of sol-gel titania thin film

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Abstract

Aluminum and its alloys are important target materials for corrosion because of their widespread usage such as aerospace industries. Although chromate-based coatings provide suitable protective effects, Organic-inorganic sol-gels have been developed as an alternative due to strong toxic and carcinogenic properties of Chromium. In this paper, investigates optimization and modification of SNAP formulation with tetrapropylorthotitanate (TPOT) in the presence of a complexing agent on aluminum alloy AA2024. To improve the performance of coating, dilution effect of the final sol and different contents of acid, complexing agent and cross-linking agent are studied. Namely, when the sol was diluted, by a factor of 1.5, with water, coating was thinner and more uniform than the undiluted coating. Polarization diagrams show remarkable decrease of corrosion current due to this coatings.

Keywords: Sol-gel, Corrosion protection, Aluminum alloy

Application of 2-{[(2-sulfanelphenyl)imino]methyl}phenol in the Field of Corrosion Inhibition

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Abstract

The copper has high electrical, thermal conductivity and good mechanical workability. The tremendous applications of copper in different industries, especially where chloride containing waters are always used make the understanding of corrosion processes under the influence of chloride ions and the control of these processes important subject worthy of intensive investigations. Thus uses of inhibitor for protecting copper against corrosion have attracted attention of researchers. At this work 2-{[(2-sulfanelphenyl)imino]methyl}phenol has been tested as corrosion inhibitor for copper in HCl 15% solution using polarization and impedance methods. Tafel curves show, the inhibitor shifts corrosion potential towards more positive values and inhibition efficiency is about 96%. Impedance measurements show an increase of charge transfer resistance with increasing of the inhibitor concentration. The adsorption of the inhibitor on the copper obeys the Langmuir adsorption isotherm. ΔG°_{ads} and E_a are -34.8 and 42.7 kJ mol^{-1}. Quantum chemical calculations are applied to explain experimental results.

Keywords*:* Corrosion inhibition; Copper; HCl; Impedance; Polarization

Investigation of Anticorrosion Properties Of Polyaniline/Clay Nanocomposites

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Abstract

Among the conducting polymers, polyaniline (PANI) has been of great interest for many researchers, because of variety applications in electrical/electronic industry. Recently it has showed that can be applied on steel as corrosion protective coating and the mechanism of protection is formation of passive film on the metal surface. In the past decades Polymer-Clay nanocomposite materials used as enhanced anticorrosion coating have been reported. Therefore, in this paper we present the effect of Clay layers on corrosion protection and efficiency of PANI /Clay nanocomposites coating on steel electrode are investigated. We prepared PANI /Clay nanocomposites by in situ polymerization of aniline monomer in the presence of two kinds of Clays (Sodium montmorillonite (Na-MMT) and organically modified clay (Cloisite 30B)) under acid condition. The samples characterized by FTIR and XRD analysis. The nanocomposites coating containing 3wt% of Clay loading showed enhanced corrosion resistance as compared to the single component coating.

Keywords: Nanocomposite, PANI, Anticorrosion

Corrosion Behavior of Electro-Deposited Zn–Ni–Al_2O_3 Nano-Composite Coatings

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Abstract

Zn–Ni alloys have been widely used as high corrosion resistant coatings. Addition of dispersed nano-particles into these coating may result in an enhancement of corrosion properties. In the present work, Zn–Ni–Al_2O_3 nano-composite coatings were electrodeposited on plain carbon steel. A series of statistically designed experiments have been conducted to investigate the effect of the concentration of alumina nano-particles in the plating bath, bath stirring rate and current density on samples corrosion rate in NaCl media by means of polarization data. The microstructure and composition of Zn–Ni–Al_2O_3 nano-composite coatings were also studied using scanning electron microscopy. The results show that the concentration of alumina nano-particles in the plating bath is more influential than current density and agitation speed on the corrosion rate. Moreover, it was observed that the co-deposition of alumina nano-particles in the optimum condition could greatly enhance the corrosion properties of Zn–Ni coating.

Keywords: Zn–Ni–Al_2O_3 coatings, electro-deposition, nano-composite coatings, corrosion resistance.

Electrochemical investingation of (3-(4-chloro phenyl)isoxazol-5-yl)methanol as inhibitor for corrosion of steel in 1 M HCl

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Abstract

Corrosion of metals is a major industrial problem that has attracted a lot of investigators in recent years [1–3]. Acid solutions are generally used for the removal of rust and scale in industrial processes [4].Hydrochloric acid is a strong inorganic acid that is used in many industrial processes. The most important areas of applications are acid pickling, acid descaling and oil well acidizing. During these processes, metal such as steel is subjected to serious acid corrosion and inhibitors are often needed to reduce corrosion rates in this media [5]. The aim of this work is to study the inhibiting effect of newly synthesized (3-(4-chlorophenl)isoxazol-5-yl)methanol on steel in 1M HCl. For this work, first we synthesized the above compound. 3-4chloro phenyl (1) was transformed to 3, 4-chlorophenylbenzaldoxime (2) by using NH2OH in pyridine. The in situ generated nitriloxide from reaction between (2) and NaOCl, was reacted with propargylalcohol to produce (3-(4-chlorophenyl)isoxazole-5-yl)methanol (3) in a cycloaddition procedure. The molecular structure of this compound is shown below. The effect of (3-(4-chloro phenyl)isoxazol-5-yl)methanol(TMT) on the corrosion of steel in hydrochloric acid medium was studied using gravimetric, electrochemical impedance spectroscopy (EIS) measurements. The percentage inhibition efficiency was found to increase with increasing concentration of inhibitor to reach 96% at 10^{-3} M. TMT is an This compound is efficient inhibitor. The TMT molecule leads to the formation of a protective layer on the surface of steel. The adsorption of inhibitor on the steel surface is found to obey the Frumkin adsorption isotherm model. EIS measurements show that the increase of the transfer resistance with the inhibitor concentration. The rate of corrosion of steel in 1M HCl without the(3-(4-chloro phenyl)isoxazol-5-yl)methanol increases with the increase of the temperature range from 298 to 318K ,but with the isoxazol compounds ,the rate of corrosion of steel decrease

Electrochemical study on corrosion protection effect of polyoxometal/polypyrrole composite

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Abstract

Polymeric films that are synthesized by electrochemical methods can have a lot of applications in electrochemical sensors, solar cells and electro-chromic devices. The electrochemically synthesized polymer layers can act as insulator (physical blockage) coatings after full reduction and oxidation. In addition in conductive form these coatings act as passivator. Polypyrrole (PPy) is one of the most promising conducting polymers in view of its high conductivity, stability and ease of synthesis. PPy films on iron constitute a physical barrier to aggressive chemical reagents and can act as polymeric inhibitors and shift the potential of the coated material to values where the corrosion rate is lower. Hence the degree of corrosion protection afforded by a conducting polymer coating depends on both its structural and electronic properties [1-3]. The advantage of electrochemical synthesis is that it achieves the direct synthesis of a polymer on the metal surface without any organic additives.

Polyoxometalates (p) are large metal cluster anions formed mainly by transition metals and oxygen atoms that can adopt a variety of spatial structures. These can be incorporated as dopant anions into a conducting polymer matrix. Bonastre et al. used a compact hybrid PPy–PWO_4^{-3} and films which were electrochemically synthesized on carbon steel electrode in freshly prepared acetonitrile solutions. Their results showed that the composite, PPy–PWO_4^{-3} has a good protection against the corrosion of polymer coatings on carbon steel in different solutions.

In this work, first, compact hybrid PPy–(Mo_7O_{24}) composite film is electrochemically synthesized on mild steel electrode in aqueous solution by cyclic voltammetric method and then the protective performance against corrosion of these coatings is evaluated by using open circuit, potentiodynamic and impedance techniques to study their protective effect in 3.5% NaCl solution. The use of polyoxometal as doping ions has proved to be a great improvement in the performances of polypyrrole films for corrosion protection of iron samples.

Keywords: polypyrrole, polyoxometal, corrosion

Electrosynthesized Polyaniline-TiO_2 Nanocomposite Coating by Using the Galvanostatic Method for the Corrosion Protection of Aluminum

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Abstract

Electropolymerized polymer coatings on aluminum alloy 3004 (AA 3004) can replace the carcinogenic chromate coating. In this work, homogeneous, uniform and adherent polyaniline-TiO_2 nanocomposite coatings were electrosynthesized on AA 3004 by using the current density fixed in the under galvanostatic conditions method. The synthesized coatings were characterized by Fourier transform infrared spectroscopy (FT-IR), SEM-EDX, SEM and AFM. Optical absorption spectroscopy shows the synthesis polyaniline of the emeraldine state that is suitable for a corrosion purposes. The corrosion performances of coatings were investigated in 3.5% NaCl solution used by the potentiodynamic polarization technique and electrochemical impedance spectroscopy (EIS). The current corrosion decreases from 5.2 μA cm^{-2} for uncoated Al to 0.09 μA cm^{-2} for polyaniline-TiO_2 nanocomposite coating Al. The results of this study clearly ascertain that the polyaniline-TiO_2 nanocomposite has outstanding potential to protect the AA 3004 alloy against corrosion in a chloride environment.

Keywords: Nanocomposite, Corrosion, Electrosynthesized

Evaluation of Inhibition Activity of Carbol Fuchsin Towards Copper Corrosion in NaCl Solutions

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Abstract

Organic corrosion inhibitors are widely used to control the corrosion of different metals in various corrosive solutions. The inhibition performance of carbol fuchsine dye (Fig. 1) for copper corrosion was investigated in NaCl 3.5% solution. For this propose, two electrochemical methods including Tafel polarization and electrochemical impedance spectroscopy (EIS) measurements were used. The corrosion parameters as well as inhibition efficiencies were obtained for different concentrations of inhibitor. The inhibition efficiencies showed that the carbol fuchsin acts as a good corrosion inhibitor for copper in 3.5% NaCl sloution. The experimental results indicated that, the carbol fuchsin is effective inhibitor in very low concentration (9×10^{-5} M). EIS studies showed that the polarization resistance of copper increases as the inhibitor concentration decrease (Fig. 2). The polarization curves showed that this inhibitor behaves mainly as a mixed-type inhibitor.

Keywords: Corrosion, Copper, Carbol fuchsin

Some Considerations Regarding the Active Learning of Electrochemistry to Chemistry Students in Iran

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Abstract

The purpose of this article is to have a comprehensive view to the most effective ways to teach electrochemistry concepts to the chemistry students. It will be shown that there is a strong requisite that students do not need to learn about every single electrochemical technique. Instead, they are better served by cutting back the curriculum to add more depth and to place electrochemical (or electroanalytical) techniques in a relevant context. It will be discussed how process electrochemistry can bring real-world problems into the classroom. Also will be discussion on how advances in electroanalytical instrumentation have simplified data acquisition to allow students to perform more complex electrochemical experiments. It will be pointed out that what are challenges for the professors to bring new electrochemistry technology and chemistry into the laboratory and classroom, both on classical educational technology and virtual learning. Web methods for delivery of course content (including streaming video and audio) has been elicited considerable interest in today's electrochemistry education, what is our share in Iran? At the end, some aspects of the active learning of electrochemistry as new university methodological approach, based on Information and Communication Technologies educational methodologies will be presented.

Keywords: Education, Electrochemistry Learning

Analysis of measuring conductivity of proton conductive membranes

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Abstract

The PEM fuel cell performance is directly depend on proton transfer in the proton exchange membrane from anode to cathode, so proton conductivity measurement in this fuel cell is important. There are several well-known applied methods such as electrochemical impedance spectroscopy (EIS), current interrupt, nuclear magnetic resonance, etc. among the mentioned methods EIS and current interrupt methods attract attention of researchers. Among the different cases in EIS method, four probe approaches provide the most accurate measurement with elaborate pattern. Although, its application is expensive and time-consuming. Current interrupt method is a simple and less cost method but no more accurate measurement. Choosing a suitable method in conductivity measurement depends on person's objects, application and level of details.

Key words: impedance, EIS, fuel cell, proton conductivity

Graphene supported Pt electrocatalyst for oxygen reduction reaction for PEM fuel cell

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Abstract

Graphene is the name given to a two-dimensional sheet of sp^2-hybridized carbon. Graphen is attractive in the filed of electrocatalysis to be used as catalyst support due its high mobility of charge carriers (200,000 $cm^2\ V^{-1}\ s^{-1}$) and specific surface area (calculated value, 2,630 $m^2\ g^{-1}$). Recently several in works use of graphene nanosheets as Pt catalyst support has been reported . Seger and etal reported the deposition of Pt nanoparticles on reduced graphene oxide sheets and their utilization in proton exchange membrane assembly. In this work new graphen/ multi wall carbon nanotuobe (MWCNT) and graphene /carbon black (CB) supported electrocatalyst have been prepared, characterized and evaluated for oxygen reduction reaction catalysis.

GO(graphite oxide) was synthesized from fine extra pure graphite powder (Merck) by the method of modified Hummers and Offeman oxide.Pt nanoparticles were deposited on GO,GO/CB,GO/MWCNT sheets by a. The Pt/GNS, Pt/GNS/CB, Pt/GNS/MWCNT hybrids were finally separated by filtration and washed with deionized water. The resulting product was dried in a vacum oven at room temperature. For comparison, deposition of Pt nanoparticles on CB and MWCNTs was also achieved by the same procedure.

We report for the first time, the fabrication of Pt decorated graphene / MWCNT.

Electrochemical behavior of passive film on gamma titanium aluminide grown in 0.05M H_2SO_4 at different potential scan rates

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Abstract

The characterization of the passive oxide film anodically formed on gamma titanium aluminde alloy (Ti-51at%Al) in 0.05M H_2SO_4 has been investigated using a potentiodynamic polarization, electrochemical impedance spectroscopy and Mott-Schottky analysis. A linear relationship was found between the critical current density required for passivation and passive current density of γ-TiAl in 0.05M H_2SO_4 and the sweep rate. Anodic oxide films formed on titanium aluminide in 0.05M H_2SO_4 appear to consist of two layers, an inner compact layer, and a porous less protective outer porous layer. The growth of which continues to follow a high field growth law, and a porous less protective outer porous layer. The semiconducting properties of anodic passive film showed a significant dependence on potential sweep rate.

Keywords: Gamma titanium aluminide; Anodic oxide film; Film growth; Sweep rate; EIS.

Methanol electrooxidation on Ni alloy electrode

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Abstract

Investigation of electrooxidation processes of alcohols is critical in attaining a better understanding of the direct alcohol fuel cell (DAFC). Methanol is one of the interesting future fuels for fuel cell application. Compared with other cells, the direct methanol fuel cell (DMFC) has several advantages such as high efficiency, very low polluting emissions, a potentially renewable fuel source, fast and convenient refueling, simple operation and ease of fuel storage and distribution. The low operating temperature of a DMFC (typically <95 ◦C) allows for easy start up and rapid response to changes in the load or operating conditions [1–2]. However, compared to the hydrogen based fuel cells, DMFC still remains to be further developed. One of the problems still unsolved is the slow kinetics of methanol electrooxidation. Considerable efforts have been directed towards the study of methanol electrooxidation at high pH. The use of alkaline solutions in a fuel cell has many advantages such as increasing its efficiency, a wider selection of possible electrode materials, almost no sensitivity to surface structures and negligible poisoning effects in alkaline solutions [3].

The purpose of the present work is to study the electrochemical oxidation of methanol on a nickel-titanium modified graphite electrode in a solution of 1M NaOH and the usefulness of the electrocatalytic process.

Nickel-titanium electrode were examined for their redox process and electrocatalytic activities towards the oxidation of methanol in alkaline solutions. The methods of cyclic voltammetery (CV), chronoamperometry (CA) and impedance spectroscopy (EIS) were employed. In CV studies, in the presence of methanol NiTi modified electrode shows a significantly electrocatalytic response for methanol oxidation. The peak current of the oxidation of nickel hydroxide increase is followed by a decrease in the corresponding cathodic current in presence of methanol. The anodic peak currents show linear dependency upon the square root of scan rate. This behavior is the characteristic of a diffusion controlled process. Under the CA regime the reaction followed a Cottrellian behavior and the diffusion coefficient of methanol was found to be 5×10^{-7} cm^2 s^{-1}. A mechanism based on the electro-chemical generation of Ni^{3+} active sites and their subsequent consumptions by methanol have been discussed and kinetic parameters have been derived. The charge transfer resistance accessible both theoretically and through the EIS have been used as criteria for derivation of the rate constant.

Impedance spectroscopy analysis of methanol electrooxidation on NiTi alloy electrode

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Abstract

Investigation of electrooxidation processes of alcohols is critical in attaining a better understanding of the direct alcohol fuel cell (DAFC). Methanol is one of the interesting future fuels for fuel cell application. Compared with other cells, the direct methanol fuel cell (DMFC) has several advantages such as high efficiency, very low polluting emissions, a potentially renewable fuel source, fast and convenient refueling, simple operation and ease of fuel storage and distribution. The low operating temperature of a DMFC (typically <95 ◦C) allows for easy start up and rapid response to changes in the load or operating conditions [1–3]. However, compared to the hydrogen based fuel cells, DMFC still remains to be further developed. One of the problems still unsolved is the slow kinetics of methanol electrooxidation.

The purpose of this work is the analysis of impedance characteristics of electro-oxidation of methanol on NiTi electrode in NaOH solution in different methanol concentrations and potentials, aiming at the elucidation of the reaction mechanism. The analysis of the theoretical impedance function provides important information on the kinetic parameters. This information allows EIS spectrum simulation and therefore predicts the system behavior with regard to the variation of the methanol concentration and overpotential. Electrochemical studies were carried out in a conventional three electrode cell powered by an electrochemical system comprising of AutoLab potentiostat/galvanostat (PGSTAT 302N). The system is run by a PC via a GPIB interface.

Nickel-titanium electrode was examined for their redox process and electrocatalytic activities towards the oxidation of methanol in alkaline solutions. The methods of cyclic voltammetery (CV) and impedance spectroscopy (EIS) were employed. In CV studies, in the presence of methanol NiTi modified electrode shows a significantly electrocatalytic response for methanol oxidation. Two semicircles in the first quadrant of a Nyquist diagram were observed for electro-oxidation of methanol on NiTi electrode corresponding to charge transfer resistance and adsorption of intermediates. Electro-oxidation of methanol on NiTi shows negative resistance in impedance plots as signified by semi-circles terminating in the second quadrant. The impedance behavior shows different patterns at different applied anodic potential. The influence of the electrode potential on impedance pattern is studied and a mathematical model was put forward to quantitatively account for the impedance behavior of methanol oxidation. At higher potentials impedance patterns terminate in the second quadrant. The conditions required for this behavior are delineated with the use of the impedance model.

Determination of dopamine in the presence of ascorbic acid at Nickel (II) doped nano-zeolite modified carbon paste electrode

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Abstract

In this study determination of dopamine in the present of ascorbic acid was investigated using zeolite modified carbon paste electrode. For this propose the modified electrode was prepared through ion exchange of synthesized nano zeolite and mixing obtained solid with graphite powder. The catalytic oxidation and determination of dopamine was studied using cyclic voltametery and differential pulse voltammetric methods. Obtained results show that the oxidation peaks of ascorbic acid and dopamine were well separated and the linear dynamic range and limit of detection for dopamine and ascorbic acid through deferential pulse voltammetry were 8.0×10^{-5}-9.0×10^{-4}, 5×10^{-5}-5×10^{-4} and 1.09×10^{-5} and 3.4×10^{-6}M respectively.

Keywords: Zeolite modified electrode, nano- ZSM-5, electrooxidation, dopamine, ascorbic acid

Direct electron transfer of Myoglobin on nickel oxide Nanoparticles modified graphite electrode

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Abstract

The Convergence of biotechnology and nanotechnology, nanomaterial's are creating hybrids that produce and characterize bio-materials are selective catalysts. Combination of bimolecular with Nano-materials in Nano-biotechnology is a fascinating field. In many research centers, designing inorganic nanoparticles that the structure of the physical, chemical, biological and behavioral characteristics, in particular, It has a lot of attention. In this research project, direct electron transfer of myoglobin, immobilized on a nickel oxide nanoparticles modified graphite electrode, was studied. The prepared nanoparticles were characterized by SEM and TEM electron microscopes. The resulting electrode displayed an excellent redox behavior for the myoglobin. The myoglobin showed a quasi-reversible electrochemical redox behavior with a formal potential of -48±5 mV (versus Ag/AgCl) in 0/05 M phosphate buffer solution at pH 7.0 and temperature 25°C. The cathodic transfer coefficient was 0.45 and electron transfer rate constant was evaluated to be 1.98 s^{-1}.The modified electrode as a biosensor, good sensitivity to H_2O_2, showed. The linear range of this biosensor for H_2O_2 determination was from 15 to 650 μM while standard deviation in 40 μM H_2O_2 concentration was 2.8% for 4 repetitions, and the detection limit was 7 μM.

Key words: Electron transfer, myoglobin, biosensor, nanoparticles, nickel oxide

Designing a biosensor for determination of H_2O_2 by modified graphite electrode with nano-composite of nafion/nile blue/ peroxidase enzyme

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Abstract

Since exposed surfaces of electrode are not desirable in electrochemical analysis of proteins due to not only decrease in speed of electron transaction between electrode and protein, but also irreversible absorption of protein on the electrode surface resulting in confirmation changes and loss of protein activity. Thus, necessary groups facilitating active interaction between electrode surface and macromolecules are to be provided. The molecules that provide the groups are called facilitators. In this research project we studied Nafion-Nileblue mediator (catalyzing oxidation reaction and protein revival) nano-polymer composite and made it possible to see redox metaloproteins electrochemically by amending electrode surface, a process which may be helpful in bio-electrochemical applications. In this project, first, electrode surface was amended using Nafion-Nileblue polymer composite and then the structure of the nano-composite was studied using cycling voltimetry, DPV and electron microscope. The findings of at this level confirmed formation of Nafion-Nileblue nano-particles (70 nm). Next, peroxidase enzyme was stabilized and hydrogen peroxide, as the substrate of this enzyme, was measured and a biosensor with 0.28 µM sensitivity is introduced.

Key words: Biosensor, hydrogen peroxide, graphite electrodes, nano-composites, Nafion , nile blue

Investigation of electrochemical behavior of myoglobin by cdse nanoparticles modified electrode

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Abstract

Recently, the use of nanoparticles to facilitate electron transfer in electrochemical, bio electrochemical processes, due to its high sensitivity and efficiency, has been common. In this research, the modified electrode surface with cadmium-selenium nanoparticles allowed us to detect myoglobin. This sensing can be used in medicine as well as designing Biosensor. Glassy carbon electrode / selenium are reduced by the potential range of – 0.8 to 0 volts with a scan rate of 2 mV s under magnetic stirring. The electrolyte temperature is kept constant at 50 co. The synthesized nanoparticles are kept in the oven with a temperature of 70 Co to alter their size. Then characteristics and size of nanoparticles were recognized by using UV absorption spectrometry, AFM and SEM microscopes, and then by adding protein to the modified electrode surface and fixation, we analyzed the characterization of myoglobin redox reactions.

Key words: Myoglobin, electrochemistry, CdSe nanoparticles, biosensor

Direct Electrochemistry of hemoglobin Immobilized on Colloidal Gold Modified Carbon Paste Electrodes

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Abstract

The direct electrochemistry of redox proteins is an important foundation for biosensors.in this paper, Colloidal gold modified carbon paste electrodes were prepared by mixing 28-nm-diameter colloidal Au particles with carbon paste. Direct electrochemistry of hemoglobin in this paste electrode was easily achieved and a pair of well-defined quasi-reversible redox peaks of a heme Fe(III)/Fe(II) couple appeared with a formal potential (E0) of -0.435 V (vs. Ag/AgCl) in pH 7.0 phosphate buffer solution (PBS). Cyclic voltammograms showed small peak-to-peak separations at low scan rates. The adsorbed hemoglobin maintained its activity and could also electro catalyze the reduction of hydrogen peroxide. Since this behavior was quite pronounced the electrode was used for H_2O_2 detection. The KM app value for this sensor was found to be 2.1 mM, allowing measurements down to 0.015 mM H_2O_2. The fabricated modified bio electrode showed good electro catalytic ability for reduction of H_2O_2 and design biosensors.

Key words: Electrochemistry, hemoglobin, colloidal gold, CPE, biosensor

Design a hydrogen peroxide biosensor based on the immobilization of myoglobin on multiwall carbon nanotubes and gold colloidal nanoparticles

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Abstract

The unique chemical and physical properties of CNT have paved the way to electrochemical biosensors. The myoglobin was selected as model protein to fabricate third-generation H2O2 biosensor based on MWNT and GNPs. In the presence of nanomaterials, the direct electron transfer between the heme group of the myoglobin and the electrode surface improved significantly. The assembly of myoglobin and GNPs was characterized with cyclic voltammetry (CV), and transmission electron microscopy (TEM). The myoglobin exhibited a pair of well-defined quasi-reversible cyclic voltammetric peaks with a formal potential ($E^{0'}$) = -0.349 V vs. Ag/AgCl, in 50 mM phosphate buffer solution at pH 7.0. The electron transfer rate constant was evaluated to be 1.9 s^{-1}. and charge -transfer coefficient (0.444) were estimated by Laviron's model. The results show that myoglobin immobilized on nanomaterial modified electrodes shows excellent catalytic activity, high sensitivity and the lowest detection limit for H2O2 determination.

Keywords: electrochemistry, myoglobin, biosensor, carbon nanotube, gold colloidal nanoparticles

The branching effect of two structural isomers on inhibitory process of Schiff bases in acidic medium: Electrochemical studies

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Abstract

Using electrochemistry techniques (Tafel polarization and Electrochemical Impedance Spectroscopy (EIS)), we studied the inhibitory action of two schiff bases/ structural isomers, i.e. N, N´- bis (3- methoxy- salicyaldehyde)- 1, 2- propandiimine {MI} and N, N´- bis (3- methoxy- salicyaldehyde)- 1, 3- propandiimine {MP} [1] on mild steel corrosion in sulfuric acid medium (0.5 M). The investigations revealed that: the compound MI (the branched isomer) exhibits less inhibiting activity as compared with that of MP (Table 1), they are good mixed-type (mostly anodic) inhibitors, theirs interaction has a physicochemical nature [2] and mostly the performance increases with temperature (Table 2), and the molecules adsorption obeys the Langmuir isotherm [3-4]. The addition of iodide ions into this corrosive environment causes a synergistic influence [8], a substantial enhancement on inhibitory performance (Fig. 1). In this project, we also determined some thermodynamic and kinetic parameters of the phenomena through Eyring and adsorption isotherm equations, by performing the experiments at different concentrations and temperatures [2] (Table 3).

Keywords: Mild steel corrosion; structural isomers of Schiff base; Tafel polarization and impedance spectroscopy; Temperature and synergistic effect; Thermodynamic and Kinetic data

Optimizing the electrolytic formed zinc powder to use as an active material in the silver zinc battery

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Abstract

Our goal is to produce zinc powder via electrolytic method and optimizing it. This powder can be used as an anode active material for primary and secondary silver-zinc batteries. For this purpose, zinc powder was prepared in the alkaline zincate solutions through electrolysis way and we considered the effect of parameters such as current density, concentration of zincate and potash solutions, temperature, the anode electrode genus and maintenance time of powder in boric acid solution. Maintenance time of powder in boric acid solution was an important factor because if the formed zinc powder washed insufficiently, it would not be a suitable powder as an anode active material. So maintenance time was optimized carefully. To consider the quality of the zinc powders several primary cells were assembled containing two silver oxide electrode and one zinc electrode. These cells were discharged at current density of 235 mA/cm^2 and determined the best zinc powder with capability of use in the silver-zinc batteries.

Keywords: zinc powder, silver-zinc batteries, boric acid

Preparing of CdS thin film as a photovoltaic cell, by CBD technique and investigating of its physical characteristics

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Abstract

Cadmium sulfide (CdS) is a compound semiconductor which has extensively been studied and has been found different applications, including photovoltaic ones [1, 2]. Cadmium sulfide thin film was prepared by chemical bath deposition (CBD) method in an aqueous alkaline solution on glass substrates from a cadmium salt (chlorine or sulfate) and Thiourea as a source of sulfide ion. The band gap energy was determined by two methods; one through linear fitting extrapolation of T against photon energy $h\nu$, where h and ν are the Plank constant and light frequency and the other method is based upon the determination of the maximum position of the transmittance first derivation $dT/d\lambda$ in the absorption spectrum and there is a clear absorption edge near 500nm which is an agreement with the clear yellow orange color of CdS and an unclear one near 300nm

With controlling of time deposition between 30 to 40 minutes, a film thickness (that was accomplished from the density definition as film weight over its volume, $d=4.82 grcm^{-3}$) about 300 to 320 nm is achieved that its band gap energy is 2,402-2.42eV. With different ion ratio and changing of cadmium salt one can prepare thin films with especial characters.