



9th International Symposium on New Materials and Nano-Materials for Electrochemical Systems

XII International Congress of the Mexican Hydrogen Society

Mérida, Yucatán, México

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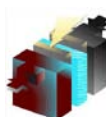
BOOK OF ABSTRACTS



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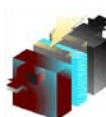
TABLE OF CONTENTS

00017 Study Annealing Effects On The Properties Of Electrodeposited CdSe Thin Films.....	1
00018 Comparative Electrochemical Characterization Of Pt/C And Pt-Au/C Catalysts Synthesized By Surface Redox Reactions	2
00019 Design and manufacture of a PEMFC stack using Pd5Cu4Pt/C as cathodic electrocatalyst.....	3
00020 Platinum Reduction Study On Pt/C As Electro-Catalysts For PEMFC.....	4
00023 Effects on Nafion ® 117 membrane using different types of strong acids in various concentrations	5
00025 Application of RuXMoYSeZ for Oxygen Reduction Reaction in Cathode and Two Anodic Material on the Performance of Two Single Chamber Microbial Fuel Cells	6
00027 Microwave Synthesis of Ru3Pd6Pt as Cathode in PEM Fuel Cells	7
00028 Biohydrogen Production through Solid Substrate Fermentation of Organic Municipal Wastes: a Multivariable Evaluation.....	8
00030 Trnsys Hybrid System Simulation for Home Electrifying	9
00031 Implementation Of The Bem Theory To The Rotor Of A Small Wind Turbine Under Wind Conditions At Istmo De Tehuantepec.....	10
00032 Remediation of a Soil Contaminated with Lindane in an Electrobiochemical Slurry Reactor.....	11
00033 Ionic conduction on ABPBI/ benzimidazole/H3PO4 proton exchange membranes.....	12
00034 Capacitance Improvement of Carbon Aerogels by the immobilization of Polyoxometalates Nanoparticles	13
00035 Capacitance improvement based on cell design	14
00036 Comparison of a Chemical and an Electrochemical Enrichment Methods of a Saline Inoculum for Microbial Fuel Cells.....	15
00039 Kinetic Study of Pt- H3PMo12O40 for methanol electro-oxidation.....	16
00040 Origin of oxygen reduction activity on tantalum oxide-based compounds as non-platinum cathodes for PEFC.....	17
00041 Starch Assisted Sol Gel Synthesis of Birnessite for an Electrochemical Capacitor Application.....	18
00042 Biohydrogen production in fluidized bed bioreactors: room temperature vs 35°C	19
00043 Study Of The Electrochemical Grown Of Polyaniline By Using Different Electrolytic System.	20
00044 Electrocatalytic activity of Pt-Re /C catalysts for methanol electrooxidation	21
00045 Evaluation of pre-treatment on the first stage of an anaerobic digester for enhancing bio-hydrogen production and its associated Energy Balance	22
00047 Design, Manufacture And Evaluation Of A 250W PEM Fuel Cell Stack.....	23
00048 Electrochemical Activity of Pt/oxide-C Composites on the.....	24
00049 Performance improve of a PEM electrolyzer, decreasing the ohmic resistance because of manufacturing and assembly processes	25
00050 Performace Of Supercapacitors Based On Graphene Oxide And Mesoporous Carbon	26
00051 Oxygen reduction reaction on Pt/C electrocatalysts obtained	27
00052 Biohydrogen Production through Solid Substrate Fermentation of Organic Municipal Wastes: a Multivariable Evaluation.....	28
00053 Characterization of a five-face parallelepiped microbial fuel cell equipped with sandwich electrodes and analysis of microbial diversity of inócula.....	29
00054 Photodegradation of hydrocarbons using nanostructured TiO2/Cu powder.....	30
00055 Au@Pt core-shell type catalyst for hydrogen oxidation in presence of carbon monoxide	31
00056 Synthesis and properties of styrene ionic liquid copolymers for high temperature anhydrous fuel cells	32
00057 Methanol Electrooxidation on Au-Pd/C in Alkaline Media: The Dissolution of Palladium in the Bimetallic Alloy - A Case Scenario	33
00058 Electrocatalytic Properties of NiMo Nanoparticles for the Hydrogen Evolution Reaction	34



**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00059 Roadmap for hydrogen technology in urban public transport in the metropolitan area of Merida, Yucatan.....	35
00060 Electrochemical characterization of Ni-based Alloys at the hydrogen evolution zone in alkaline media	36
00061 C-TiO ₂ and C-ZrO ₂ composite supports for Pt electrocatalyst to evaluate in ethanol anodic oxidation	37
00062 Design of bipolar plates for a PEM electrolysis cell	38
00063 Effect of Sb- Doped SnO ₂ Supports Heat Treatment on the Oxygen Evolution Reaction.....	39
00064 Stack fuel cell prototype used to power a LED system.....	40
00065 Coke Gasification As An Alternative To Produce Hydrogen For A New Petroleum Refinery	41
00066 Evaluation and comparative analysis of Pt-Mo/C catalysts synthesized by different methods for application as anodes in direct methanol fuel cells.....	42
00067 Design and development of a Direct Ethanol Fuel Cell (DEFC) stack	43
00068 ZnO Electrodeposition & Application in Dye-Sensitized Solar Cells.....	44
00069 Sustainable Hydrogen Production in Yucatan.....	45
00070 Hydrogen Storage in Metal Organic Framework	46
00071 Influence Of The Properties Of TiO ₂ Nanomaterials On The Performance Of Dye-Sensitized Solar Cells.....	47
00072 A Dye-Sensitized Brookite Solar Cell	48
00073 Use Of A Tryfunctional Crosslinking Agent In Styrene/Acrylic Acid Copolymers To Enhance Mechanical Properties For Their Use As Membranes In Fuel Cells	49
00074 ZnO nanorods functionalized with TiO ₂ nanoparticles for application in dye-sensitized solar cells	50
00075 Synthesis and Luminescence Properties of Sulfonated Poly-{Styrene-co-Acrylic Acid}	51
00076 DNA Gold Modified Electrodes for HPV Detection.....	52
00077 Synthesis and Characterization of Pyrochlore and Perovskite Potassium Tantalates for Water Splitting.....	53
00078 Photocatalytic Hydrogen Evolution from Pure Water Using a New Sm ₂ GaTaO ₇ Advanced Compound.....	54
00079 Electrochemical And Capacitive Properties Of Polyaniline Evaluated In H ₂ SO ₄ And NaNO ₃ Systems.	55
00080 Graphene Oxide For Application In Supercapacitors No- Faradaic	56
00081 Development of Polymeric Enzymatic Electrodes for Ethanol Oxidation	57
00082 Preparation and Study of Polymeric Catalysts for Electrolysis.....	58
00083 Design and Construction of a Demonstrative Hybrid System Consisting of a Solar Panel, a Stack of Regenerative PEM Fuel Cells and Supercapacitors.....	59
00084 Experimental and theoretical studies of Cu/Ni-base catalysts for H ₂ generation.....	60
00085 Synthesis of NaTaO ₃ by a new solvo-combustion method and its hydrogen production photoactivity.....	61
00086 Unsupported Pt-Ru-Ir And Pt-Ir As Bi-Functional Catalyst For Reduction Oxygen And Oxygen Evolution Reactions In Acid Media.....	62
00087 Nanostructured Ferrite as Photocatalysts for H ₂ Generation from Water Splitting and Sunlight	63
00088 Hydrogen Production by Steam Reforming of Ethanol over a Ru/Al ₂ O ₃ Catalyst.....	64
00090 Hydrogen Storage in Nanocomposite Materials of Polyaniline, Carbon Nanotubes and Titanium.....	65
00091 Development of a Low Power Backup System for Technology Demonstration	66
00092 Scooters electric motor characterization and the sizing of a PEMFC power plant required for its operation	67
00093 Development And Application Of Pt Black- Pt/IrO ₂ As Bifunctional Catalyst For URFC's	68
00E11 Design, Manufacture And Evaluation Of A 250W PEM Fuel Cell Stack	69
00E12 Feasibility Study To Use Hydrogen As Alternate Source Of Energy In Mexico.....	70
00E13 Microwave Assisted Polyol Synthesis of Nano-sized Pt and PtCr-based Electrocatalysts on Oxygen Reduction Reaction for PEM Fuel Cells.....	71
00E14 Life Cycle Assessment of Solar Selective Surfaces Produced by Continous Electrochemical Process from Cradle to Grave	72
00E15 Towards the understanding and controlling of the photo-deposition of metal nanoparticles on oxides.....	73
00E16 Effect of the Selection of Material on the Electric Power Generation and Costs PEMFC Experimental Designs...	74



**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00E17 Theoretical studies of Sulfonated Poly (ether-imide): A Promising Material for Proton Exchange Membranes in fuel cells.....	75
00E19 Fast synthesis of M@Pt (M=Ru, Pd, Fe ₃ O ₄) core-shell nanostructures and their evaluation as anodes for the oxidation of ethanol.....	77
00E20 Synthesis of unsupported Pt-based electrocatalysts and evaluation of their catalytic activity for the ethylene glycol oxidation reaction	78
00E21 Integration of solar-hydrogen technologies for sustainable housing.....	79
00E22 Hydrogen adsorption in isoreticular MOF.....	80
00E23 Synthesis of Ag/Pt-Pd Core/Shell Nanoparticles and Their Electrocatalytic Properties towards the Oxygen Reduction Reaction.....	81
00E24 Effects on Nafion ® 117 membrane using different types of strong acids in various concentrations.....	82
00E25 C-TiO ₂ and C-ZrO ₂ composite supports for Pt electrocatalyst to evaluate in ethanol anodic oxidation	83
00E26 Design of bipolar plates for a PEM electrolysis cell.....	84
00E27 Desarrollo Y Aplicación De Membranas Híbridas Por El Proceso Sol – Gel Para El Enriquecimiento De Metano En Un Biodigestor Anaerobio.....	85
00E28 Study of the Ni/WOx-Hydrotalcite catalysts to produce hydrogen by ethanol steam reforming	86
00E29 Decentralized Energy Planning Using Multicriteria Methods	87
00E30 Synthesis and Characterization of Magnetic Barium Ferrite-Silica Nanocomposites.....	88
00E31 Electrical Transport Studies of the Solid Electrolyte system xAgI-(95-x)[2Ag ₂ O-B ₂ O ₃]-5TeO ₂ , where 45 ≤x≤65	89
00E32 Structural and magnetic studies of undoped and strontium doped lanthanum manganite system.....	90
00E33 Bimetallic materials based in Ag for cathode/anode electrode in a glucose microfluidic fuel cell	91
00E34 New BLi clusters capable of storing molecular hydrogen	92
00E35 Electrochemical Synthesis of Au and Pd Electrodes for Glucose Oxidation.....	93
00E36 Design and development of a Direct Ethanol Fuel Cell (DEFC) stack	94
00E37 2 nd Harmonic Voltammetry Electrochemical Technique For Palladium Synthesis Of Dendritic Structures.	95
00E38 Hydrogen Storage in Metal Organic Framework.....	96
00E39 Hydrogen Releasing Examination During The Reaction Of Aluminum At Al ₅ Fe ₂ Intermetallic Powders With Water	97
00E40 Evaluation of a ZrO ₂ composite membrane operating at High Temperature (100 °C) for Direct Methanol Fuel Cells.	98
00E41 Development of a Dynamic Hydrogen electrode coupled to a hydrogen proton exchange fuel cell.....	99
00E42 Synthesis of Pd/C and Pd/Pani for formic acid oxidation.....	100
00E43 Synthesis And Photoelectrochemical Characterization Of WO ₃ Nanomaterials.....	101
00E44 Theoretic-experimental study of Pd-based electrocatalyst for fuel cells.....	102
00E45 Tungsten Effect Over Co-hydrotalcite Catalysts to Produce Hydrogen from Bio-ethanol (Analysis of the catalyst structure).....	103
00E46 Pt Nanoparticles Supported on Carbon Nanotubes for Direct Ethanol Fuel Cells (DEFC) Application.....	104
00E47 High Performance Electroactivity in Pt/MWCNT and Pt/NiMWCNT Electrocatalysts.....	105
00E48 Characterization of a fuel cell unitized regenerative stack based on IrO ₂ -Pt/ATO as dual material.	106
00E49 Synthesis of Au-based materials with electrocatalytic properties for the glucosa electro-oxidation reaction.....	107
00E50 Design and implementation of a hybrid power system (wind-solar-fuel cell) of 4kW	108
00E51 Biological production of CO ₂ -free hydrogen by anaerobic microbial mixed microflora in an upflow anaerobic sludge blanket (UASB) reactor coupled with a gas purification device.	109
00E52 Photocatalytic water splitting for hydrogen production from N-TiO ₂ -X/Pt prepared by Nitrogen gas plasma (AC) method	110
00E53 Hydrogen Generation in a Microbial Electrolysis Cell (MEC) using two configurations: Catalyzed by Platinum and Biocathode.....	111
00E54 Progress on the PdP alloy deposition onto a gas diffusion layer for a PEMFC application.....	112



**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00E55	ORR kinetics on carbon paper-supported PdP cathodes: electrochemical impedance spectroscopy and rotating disk electrode study.....	113
00E56	Hydrogen Production by Solar Energy in Tropical Conditions	114
00E57	Electrocatalytic activity of Pt-Re /C catalysts for methanol electrooxidation.....	115
00E58	High Altitude Platforms (HAP's) powered by PEMFC's: a technological advantages review and analysis of their implementation in Quintana Roo, Mexico	116
00E59	Production And Purification Of Hydrogen Coupled To A Photovoltaic System.....	117
00E60	Preparation and Characterization of Pt-Pd and Pt-CeOx Electrocatalysts for the Oxygen Reduction Reaction in Absence and Presence of Metanol in Alkaline Medium	118
00E61	Thermodynamic Analysis of the Absorption Enhanced Autothermal Reforming of Ethanol.....	119
00E62	PREPARATION OF Coteta/MWCNT ORR ELECTROCATALYST.....	120
00E63	Absorption/Desorption Hydrogen Process In A Material Type Hidrotalcite	121
00E64	Platinum loading variation in MEAs to compare PEM Fuel Cell performance	122
00E65	Revisiting alkaline electrolysis: Challenges and opportunities for the production of hydrogen	123
00E66	Preparation and study on CoTETA/MWCNT catalyst as ORR electrocatalyst	124
00E67	Effect of carbon porosity on the electrochemical properties of carbon/polyaniline supercapacitor electrodes.....	125
00E68	Enhancement of oxygen reduction activity on carbon-supported Co-phthalocyanine modified with pyridine as nitrogen precursor in alkaline electrolyte.....	126
00E69	Studies of electrochemical properties and active sites of carbon-supported nickel phthalocyanine (NiPc/C) catalysts for oxygen reduction reaction.....	127
00E70	Carbon-supported copper phthalocyanine (CuPc/C) as novel cathode catalyst for polymer electrolyte membrane fuel cells --- Effect of Nafion ionomer as for alkaline electrolyte.....	128
00E71	High catalytic performance of Pt/C for the ethanol electrooxidation using sonochemically-treated XC-72R carbon support.....	129
00E72	Synthesis and evaluation of Pt-Sn/C and Pt/C nanomaterials for the ethanol oxidation reaction	130
00E73	Synthesis and Characterization of Pt-Au/C for Ethanol Tolerant ORR Electrocatalyst.....	131
00E74	Method for Water Electrolysis in Acid Medium.....	132
00E75	The Oxygen Reduction Reaction on Pt/TiOxNy Based Electrocatalyst for PEM Fuel Cell Applications.....	133
00E76	Correlation between the Physico-chemical Properties and the Oxygen Reduction Reaction electro catalytic activity in acid medium of Pd-Co Alloys synthesized by Ultrasonic Spray Method	134
00E77	Electrochemical investigation of Pd-Co thin films binary alloy for the oxygen reduction reaction in acid medium	135

00017

Study Annealing Effects On The Properties Of Electrodeposited CdSe Thin Films

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ABSTRACT

CdSSe is a ternary chalcogenide semiconductor whose bandgap varies from 1.7 eV (CdSe) to 2.5 eV (CdS). It's widely used as material photoconductors but with increasing interest focused on their use in photovoltaic and photoelectrochemical devices [1]. We report the annealing effect of electrodeposited CdSSe thin films on indium tin oxide (ITO) coated glass substrates by potentiostatic mode. The structural, morphological and optical properties of the prepared thin films were studied using X-ray diffraction (XRD), scanning electron microscopy (SEM) and optical absorption techniques. A standard three electrodes cell was used for the electrodeposition. ITO was used as working electrode, graphite rod as counter electrode, and a saturated calomel electrode (SCE) as the reference electrode. The electrodeposition of CdSSe was carried out cathodically from an aqueous bath composed of CdSO₄, Na₂SO₄ and SeO₂. The deposition was carried out from an aqueous electrolyte containing different concentrations of CdSO₄. It's shown that the annealing carried out at 200 °C, 300 °C and 400 °C has influence on the physical parameters of the grown structures. The XRD results reveal that the deposited thin film has a polycrystalline hexagonal structure. On the films as-deposited the crystallite size are lower than those films annealed. The direct band gap energy was increased from 1.81

00018

Comparative Electrochemical Characterization Of Pt/C And Pt-Au/C Catalysts Synthesized By Surface Redox Reactions

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ABSTRACT

Pt-M/C systems (M= metal from groups VIII or IB) are potential electrocatalysts for the fuel cells technology. This work aims to study the oxygen reduction reaction over Pt-Au/C catalysts. The preparation of the monometallic Pt/C catalysts was carried out by means of the impregnation of platinum over graphite. The bimetallic catalyst Pt-Au/C was prepared by selectively depositing Au on supported monometallic Pt/C catalysts by means of the reduction *in-situ* of AuCl₄⁻. Hydrogen was used as the reducing agent for the Direct Redox Reactions, while the second Redox method used was the Refilling method, which consisted in adsorbing hydrogen first on the metal (Pt), and subsequently reducing the AuCl₄⁻ species by contact with the Pt-H interface at low temperature. The catalysts were characterized by X-ray diffraction (XRD), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM), whereas for the electrochemical tests the catalysts were supported on Vulcan XC-72 carbon and they were evaluated by linear and cyclic voltammetry. The composition of the individual metal particles of the solids indicated the presence of both metals, Pt and Au. A partial Au coating of certain Pt facets is possible, which indicates that the coating mechanism is selective and could influence the catalytic properties of the bimetallic Pt-Au/C catalysts. The electrochemical characterization showed a Tafel slope of - 94 mV dec⁻¹ for the Pt-Au/C sample, with a 0.62 transfer coefficient, that means a catalytic activity towards the Oxygen Reduction Reaction (ORR).

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Electrochemical Systems
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00019

Design and manufacture of a PEMFC stack using Pd5Cu4Pt/C as cathodic electrocatalyst

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ABSTRACT

This work presents the design, manufacture and performance evaluation of PEMFCs. The Pd5Cu4Pt/C cathodic electrocatalyst was synthesized by chemical reduction of PdCl₂, CuCl₂ and H₂Cl₆Pt₆·6H₂O with NaBH₄ in THF and supported on Vulcan carbon by sonochemistry (J. Power Sources, 196(2011) 6199). The electrocatalyst was characterized by X-ray diffraction (XRD) and transmission electron microscopy (TEM). The design of the fuel cell stack was done using AutoCad software. Manufacture of the fuel cell was carried out by CNC router and CNC laser cutter. 8 MEAs were prepared by spraying the Pd5Cu4Pt/C ink on the cathodic side of the Nafion® NR 212 membrane. Then the gas diffusion layer (carbon cloth) at the cathodic side and the commercial electrode (Pt/C E-tek) at the anodic side of the Nafion membrane was placed, followed by hot-pressing of the assembly at 120 °C and 11 kg cm⁻² for 1.5 min. The characterization of PEMFC stack was performed by potentiostatic polarization tests. The operation conditions of the stack were: feeding the fuel (H₂) an oxidant (O₂) at room temperature and a pressure of 0.1 atm, operating temperature varied from 25 to 42 °C. Open circuit voltage (EOCV) of the stack was 7.2 V, obtaining a maximum power density of W_{max}= 527 Mw cm⁻².

00020

Platinum Reduction Study On Pt/C As Electro-Catalysts For PEMFC

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ABSTRACT

Many research efforts on proton exchange membrane fuel cells (PEMFCs) are aiming at the development of Pt/C catalysts with enhanced electrocatalytic activity and low cost. The deposit of the metallic phase on the catalyst surface is a critical step in the synthesis of the catalytic materials, so that in this work different methods of the platinum reduction were tested, modifying the preparation parameters such as: Pt precursor, reducing agent, and synthesis conditions, in order to find the higher dispersion of the platinum nanoparticles over the support, as well as the optimal particle size. The catalysts were characterized by X-Ray Diffraction (XRD), High Resolution Transmission Electron Microscopy (HRTEM) and lineal and cyclic voltammetry. The results show that by using NaBH₄ as reducing agent the total reduction of the platinum precursor is not possible, and the electrocatalytic activity diminishes significantly, probably due to the formation of NaBO₂; whereas the higher activity was found by the reduction with hydrogen at 400 °C. The results of characterization by lineal and cyclic voltammetry show that catalyst has a high electrochemical activity, stability in acidic medium and a high distribution of the active sites on the electrode surface. Electrochemical parameters were obtained, as a Tafel slope of -65.39 mV dec⁻¹, a transfer coefficient of 0.9 and an exchange current of 7.5859x10⁻⁶ mA cm⁻². This means that this catalyst is considered as a possible candidate to be used as a cathode in the Membrane-Electrode Assembly (MEA) in a Proton Exchange Membrane Fuel cell (PEMFC).

00023

Effects on Nafion® 117 membrane using different types of strong acids in various concentrations

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ABSTRACT

This study proposes a pre-treatment to Nafion® 117 membrane with different acids in various concentrations. The objective is to increase the membrane hydration, which is determined by the amount of water molecules it incorporates. It is well known that the membrane hydration directly affects its conductivity. Even though many studies were published regarding this issue, none of them explains the procedure in detail, justifying the election of a particular acid in a determined concentration; in addition, Perchloric acid is also studied. Our work was developed using five strong acids treatments -Nitric, Sulphuric, Perchloric, Phosphoric and Hydrochloric acid- in six different concentrations -0.025 M, 0.05 M, 0.25 M, 0.5 M, 0.75 M and 1 M. Analyzing the results after an exhaustive study, the membrane shows a similar behaviour when it is treated with different strong acids, incorporating between 16 to 21 molecules of water depending on the concentration of the acid that was chosen. The effect of the different concentrations is remarkable, which leads to the conclusion that the best treatment is to use solutions 0.025 M and 0.05 M (twenty times more diluted than the other concentrations tested in the experience). Another effect to be taken into account when the Membrane Electrode Assembly (MEA) is joined in a following step, is the fact that after membrane hydration its size increases by 10 percent (average).

00025

**Application of RuXMoYSeZ for Oxygen Reduction Reaction in Cathode and Two Anodic Material on the
Performance of Two Single Chamber Microbial Fuel Cells**

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ABSTRACT

The objectives of our work were to evaluate (i) the application of calcogenide catalyst of the type RuxMoySez for oxygen reduction reaction (ORR) in the cathode, and (ii) the effect of the type of the two anodic materials on the performance of two microbial fuel cells (MFCs). A new design of a single chamber MFC-A was built with a plexiglass cylinder, the two extreme circular faces were fitted with PEM-cathode assemblage, i.e., left and right faces. The anode consisted of 65 triangular pieces of graphite filling the anodic chamber. The single chamber MFC-B had a sandwich arrangement anode-PEM-cathode. The cathodes were made of flexible carbon cloth containing 1mg/cm² RuxMoySez catalyst. The cell was loaded with a sulfate-reducing inoculum and a mixed organic substrate. The MFC was characterized by linear sweep potential method. First, each face (left and right) of the MFCs was characterized by separate. The PV-max values for MFC-A were 1 200 and 1 125 mW/m³ and those of MFC-B were 43 mW/m³ for both separate faces. The values of Rint obtained were 146 and 167 ohms for MFC-A and MFC-B were 2 075 and 2 017 ohms, respectively. The MFC-A showed higher values of PV-max by a factor of 27.9 and 26.1. The Rint decreased by a factor of 27.9 and 26.1 for MFC-A. Parallel connection significantly decreased the internal resistance of the cell and almost doubled volumetric power for both cells. Power derived by cell A with calcogenide catalyst was a light inferior to that of a similar cell with Pt although the cost of the catalyst is significantly power that Pt. Finally, application of graphite anode made of small triangular pieces significantly improved the performance of a MFC-A that used RuxMoySez as a cathodic catalyst for ORR.



00027

Microwave Synthesis of Ru₃Pd₆Pt as Cathode in PEM Fuel Cells

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ABSTRACT

Different routes of synthesis and characterizations of nanocatalysts have been developed and published in literature recently, where the tendency is to decrease the energy consumption, solvent and precursors usage and the time of synthesis, in order to enhance the stability and reduces the environmental effect, and increase the massive production as possible. The microwaves are usually employed for the production of nanostructured materials because are easiest and faster to implement than others, although the specialized equipment are expensive. However, with a conventional microwave it is also possible to synthesize electrocatalysts, with minimum set up modifications. These features motivate us to utilize the microwaves in the synthesis of multi-metallic catalysts for PEM fuel cells. In this communication a tri-metallic electrocatalyst was produced by the reduction of the corresponding metallic salts, RuCl₃ (Aldrich), PdCl₂ (Aldrich), and H₂PtCl₆ (Aldrich) in ethylene glycol (EG/Aldrich) in a modified conventional microwave oven. Kinetic parameters for the oxygen reduction reaction in 0.5M H₂SO₄ conducted to determine a Tafel slope, (-b), a transfer coefficient, (alpha) and exchange current density (i₀) 0.046 V dec⁻¹, 0.56 and 4.7 x 10⁻⁵ mA cm⁻², respectively. This electrocatalyst presents good activity and stability in acid media, candidate to be used as cathode catalyst in H₂/O₂ PEM fuel cells.

00028

Biohydrogen Production through Solid Substrate Fermentation of Organic Municipal Wastes: a Multivariable Evaluation

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ABSTRACT

Municipal solid waste (MSW) generation is a constant problem on growing cities and its organic fraction (OFMSW), ca. 60% of MSW, is being literally `wasted, despite its applicability on energy production. Therefore, this work was focused on hydrogen production from the OFMSW with a double purpose: (i) to evaluate the effect of the total solids content (20.9 and 35% TS), temperature (35 and 55 °C) and mass retention time (MRT, 21 and 14 d) on semi-continuous fermentation, and (ii) to test the supplementation with nutrient nitrogen in the form of waste activated sludge. Firstly, it was found that factors were significant in the order: total solids > temperature > MRT. Significant interactions amidst factors were only observed between TS and temperature or MRT. Indeed, best hydrogen productivity I_{H_2} averaged up to 123 NmL H_2 /(kgw_{mr} d) at 20.9 %TS, 55 °C and 21 d MRT. Secondly, supplementation with nitrogen did not show a significant effect. Highest results were P_{H_2} = 1575 μ mol H_2 /gVS and R_{H_2} = 68.3 μ mol H_2 /(gVS h) in the mini-reactors with no addition of alkalinity nor sludge. No significant lag phase could be observed in none of the experimental units. Microorganisms introduced through supplemented sludge might have affected fermentation, particularly boosting hydrogen consumption. In general, variations and inhibition of hydrogen production were related to low pH and lactic acid and solvent deviation of the fermentation. This was in agreement with reports of a strong correlation between high lactic acid concentrations and inhibition of hydrogenesis.

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00030

Trnsys Hybrid System Simulation for Home Electrifying

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ABSTRACT

Wind and solar renewable sources are abundant in the Isthmus of Tehuantepec. Not only energy companies, but people can also take advantage of these resources for their benefit. Simulations allow the sizing, evaluation and testing of energy systems to ensure their adequate performance when they are in operation. In this paper the input variables (wind speed, irradiance, and annual energy consumption) are used in an initial sizing system to cover the annual energy need. A simulation of the system follows and the results are observed. Subsequently, the projected system is optimized in order to reduce costs and to adjust the energy supply. Finally, the optimized system is simulated. The results ought to meet the energy needs of the load, its power and the grid's voltage. Authors information: P.A. Urbano-Arcila¹, J.R. Dorrego-Portela², A. Núñez-Rodríguez², O. Lastres-Danguillecourt², R.E. Moreno-De la Torre¹. Estudiante de la Maestría en Ciencias de la Energía Eólica, División de Posgrado Universidad del ISTMO, Santo Domingo Tehuantepec, Oaxaca, México C.P. 707602. Instituto de Estudios de la Energía de la Universidad del ISTMO, Santo Domingo Tehuantepec, Oaxaca, México C.P. 70760

00031

**Implementation Of The Bem Theory To The Rotor Of A Small Wind Turbine Under Wind Conditions At
Istmo De Tehuantepec**

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ABSTRACT

An aerodynamic analysis to the rotor of a small wind turbine, by the BEM (Blade Element Momentum) theory is implemented in a MATLAB. Through wind resource assessment in the region of the Istmo de Tehuantepec, we determined the mean wind speed and the Weibull PDF parameters k y c for three levels of measurement, then the cut-in, nominal and cut-out velocities was determined, which were used in the code. Once the geometric parameters of the blade was calculated these was related with the performance of the rotor according to these speeds, performing the calculation of axial induction coefficient (a) and tangential (\hat{a}) by applying a correction due to the effect of blade tip (Prandtl factor), which show reduced induction coefficients (a and \hat{a}) with regard to the data without using the Prandtl correction. Also the torque for each section of the blade as a function of radial distance, the total torque induced by the wind on the rotor, the force developed by each blade section besides the radial force variation were determined. Been determined these parameters the power coefficient and power thrust were calculated.

00032

Remediation of a Soil Contaminated with Lindane in an Electrobiochemical Slurry Reactor

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ABSTRACT

Lindane is a chlorinated pesticide known for its toxicity and persistence in the environment. Recently, it has been proposed that soil microbial fuel cell technology (SMFC) could be applied to enhance the removal of organic matter, phenol, and petroleum hydrocarbon in contaminated soil with simultaneous electricity output. Yet, there is no information on the application to remediation of soils polluted with pesticides. The purpose of this research was to evaluate the biodegradation of lindane with simultaneous electricity generation in an electrobiochemical slurry reactor (EBCR). The EBCR was inoculated with a sulfate reducing inoculum acclimated to lindane, characterized, and further batch operated for 30 day at room temperature. No external carbon source was supplemented; the substrate was the soluble native organic matter (NOM). Results from electrochemical impedance spectroscopy characterization showed that the equivalent circuit had an anodic resistance $R_1=2064\Omega$, cathodic resistance $R_3 = 192 \Omega$; and electrolyte/membrane resistance $R_2 = 7\Omega$, totalling a relatively high overall internal resistance R_{int} of 2263Ω . During the batch operation, the EBCR showed a 30% lindane removal efficiency along with a maximum volumetric power volumetric of 165 mWm^{-3} . This value compares favorably with results corresponding to sediments microbial fuel cells that are used to power weather monitoring systems. The organic matter removal was very high (72% as soluble COD, NOM) whereas the coulombic efficiency was low (5.4%). The latter, although, was higher than values reported for microbial fuel cells that degraded leachate-like effluents. Finally, it can be concluded that our EBCR showed a low-to-moderate lindane removal capability.

**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00033

Ionic conduction on ABPBI/ benzimidazole/H₃PO₄ proton exchange membranes

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ABSTRACT

Polymer electrolyte membrane fuel cells (PEMFCs) are promising power sources for electric vehicle applications. The practical use of these electrochemical devices, however, is still prevented by a series of drawbacks, mainly associated to the polymer electrolyte. This work reports the preparation of 3-butyl-1-ethyl-benzimidazole dihydrogenphosphate (BEBz-HP) ionic liquid (IL) and its effect on the addition of phosphoric acid (H₃PO₃) and poly(2, 5-benzimidazole) or ABPBI. We present structural characterization by infrared spectroscopy (FTIR), thermal stability by thermogravimetric analysis (TGA), electrochemical stability by cyclic voltammetry (CV) and ion conductivity by impedance analysis. Those polymer electrolytes showed good thermal and electrochemical properties in the temperature range of interest for PEMFC applications. Acknowledgement: We thank financial support from the Universidad Autónoma de Nuevo León (PAICyT) and Consejo Nacional de Ciencia y Tecnología.

00034

Capacitance Improvement of Carbon Aerogels by the immobilization of Polyoxometalates Nanoparticles

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ABSTRACT

A Hybrid material was prepared by the immobilization of H₃PMo₁₂O₄₀ polyoxometalate nanoparticles (POM) on to the surface of a carbon aerogel matrix, in order to determine its potential application as electrode material for a supercapacitor cell. Several aerogels matrices with different microstructure properties and activation degree were exposed to a POM solution 1.15mM to determine the key properties for the immobilization of POM nanoparticles. All matrices and hybrid materials were characterized by ATR, nitrogen isotherms, and TEM analyses. For the electrochemical characterization our materials were grounded with 10% of Teflon and 20% conducting carbon to make a film that was pressed onto a stainless steel grid and cyclic voltammetry was used as the electrochemical technique, using 0.5 M H₂SO₄ as electrolyte. The highest degree of activation and smaller pore size of the aerogel matrix were the key factors influencing the immobilization and dispersion of POM nanoparticles, which improved the capacitance behavior making this material suitable for its application as supercapacitor electrode material.

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Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00035

Capacitance improvement based on cell design

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ABSTRACT

In the present work we show results related with the influence of the type of binder used to elaborate active electrodes made of activated carbon (DLC), for the assembly of supercapacitor cells. A Nafion 5%w solution and/or Kinar Flex (Polyvinylide fluoride, PVDF) were used as binders at different concentrations, using DLC carbon as the active material to make the electrodes by aerography, and carbon paper as support and current collector. Thickness of the electrodes was controlled by the weight of active material (DLC carbon). Cyclic voltammetry technique was used to characterize these electrodes in a 3-electrode cell assembly, using as counter electrode a Pt mesh, a SSE reference electrode, and a 0.5M H₂SO₄ solution as the electrolyte. The electrodes made with binder were assembled in a symmetric supercapacitor cell and for comparison a similar cell was constructed with binder-free electrodes. These cells were electrochemically characterized by galvanostatic cycling, showing capacitance values of 38F/g for binder-free electrode symmetric cell, and a stable behavior during 7000 charge-discharge cycles.



00036

**Comparison of a Chemical and an Electrochemical Enrichment Methods of a Saline Inoculum for Microbial
Fuel Cells**

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ABSTRACT

In microbial fuel cells (MFCs) efficient extracellular electron transfer microbes, also known as anode-respiring bacteria, are known to play an important role on cell performance. These type of microbes can be developed by application of enrichment procedures. The objective of this study was to compare a chemical (only C, final terminal electron acceptor $\mu\text{Fe(III)}$) and an electrochemical (only E) enrichment method of a saline-sodic soil inoculum. In the electrochemical enrichment procedure in an electrolysis cell, the inoculum was subjected to a continuous electrical stress continually by posing the cell at -150mV/SCE . The only C enrichment method delivered powers superior to the only E one (higher values of $P_{\text{An,max}} = 49 \text{ mW/m}^2$ and $P_{\text{V,max}} = 558 \text{ mW/m}^3$ of C compared to 33 and 379 of only E). Interestingly, overall resistance as determined by EIS was lower for only E (1240Ω) than for only C (1632Ω). Yet, the hybrid E method (E followed by C as given by three serial transfers after the enrichment in the electrolysis cell), showed electrochemical characteristics consistently superior to only C (higher $P_{\text{An,max}}$ and $P_{\text{V,max}}$, lower internal resistance). Further detailed electrochemical studies of only E-method showed that the anodic resistance decreased with the time of operation of the electrolysis cell, that would be consistent with the adaptability/enrichment purpose of the method. Also, Cyclic Voltammetry peaks with values close to those reported for bacterial cytochromes appeared with time of cell operation. In general, serial transfer studies with Fe(III) as electron acceptor to an inoculum previously enriched in an electrolysis cell, lead to improved characteristics of microbial fuel cell and increased Fe(III) -reducing capability of the inoculum.

**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00039

Kinetic Study of Pt- H3PMo12O40 for methanol electro-oxidation

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ABSTRACT

Composite materials based on 30%w of Pt dispersed on vulcan carbon XC-72, using 5%w of Nafion® ionomer and phosphomolybdic acid (H3PMo12O40) were prepared for their application as co-catalyst for the electro-oxidation of methanol. Different amounts of H3PMo12O40 were incorporated in order to determine the optimum amount to form the electrocatalytic layer. All composite materials were characterized by XRD, SEM, and Raman. The electrochemical characterization was carried out by cyclic voltammetry and impedance (EIS), using the composite materials over a glassy carbon electrode, and solutions of 0.5M H2SO4 and 0.5M MeOH + 0.5M H2SO4 as electrolytes. Methanol oxidation is favored by the presence of H3PMo12O40. Methanol electro-oxidation over-potential peak decreases around 150mV and a current increase of 15% is observed. These results open the opportunity to incorporate H3PMo12O40 as part of the electrode-membrane assembly (MEA).

**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00040

Origin of oxygen reduction activity on tantalum oxide-based compounds as non-platinum cathodes for PEFC

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ABSTRACT

Polymer electrolyte fuel cells are expected for the residential and transportable applications, especially for the automobile use, due to their high power density and low operating temperature. However, the estimated amount of Pt reserve is too small to supply for the huge number of fuel cell systems, especially fuel cell vehicles. Thus, in order to commercialize the fuel cell systems, the development of a non-precious cathode is strongly required. We think that alternative non-precious cathodes must have both high stability and high catalytic activity for the oxygen reduction reaction (ORR). In particular, we believe that high stability in cathode condition is essentially required for the cathode catalyst. Group 4 and 5 metal oxides, which are well known as valve metals, are stable even in acidic and oxidative atmosphere. In particular, partially oxidized tantalum carbonitrides (Ta-CNOs) has been attracting a great deal of attention as non-platinum-group cathode catalysts, which has a high onset potential for ORR that is comparable to those of platinum-based catalysts and rather high stability than platinum. In this study, in order to gain insights into catalytically active sites and to elucidate factors that improve catalytic activities of Ta-CNOs, we conducted x-ray absorption and Raman spectroscopy measurements. The results from X-ray absorption spectroscopy measurements indicated that Ta-oxide phases formed from partial oxidation of TaC_xN_y had only orthorhombic Ta₂O₅ structure and oxygen-vacancy defects were introduced in surface-phase. These oxygen-vacancy defects are most likely work as catalytically active sites. In addition, the results from Raman spectroscopy revealed that carbon could be deposited in the oxidation process of TaC_xN_y. Such carbon would media

00041

Starch Assisted Sol Gel Synthesis of Birnessite for an Electrochemical Capacitor Application

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ABSTRACT

Starch Assisted Sol Gel Synthesis of Birnessite for an Electrochemical Capacitor Application M. A. Velasco-Soto, N. Pineda-Aguilar and L. C. Torres-González* In the present world the energy demands are increasing every day urging the optimization of existing energy storage technologies performance. One of these technologies is the electrochemical capacitors, which stores energy by charge separation and reversible superficial faradic reactions. In this work, we developed a method for increasing specific surface area by the addition of a natural polysaccharide. A redox sol-gel reaction was carried out between KMnO_4 and glucose solutions in the presence of starch; the resulting gel was calcined at 400°C . Results from XRD analysis of samples containing starch confirmed the presence of birnessite-type structure. The adsorption-desorption profile from BET analysis result in about a 100% increase on the specific surface area ($36\text{ m}^2/\text{g}$) this outcome could be assigned to the presence of starch that improved pore formation. SEM analysis showed the formation of spherical grains an effect that could be explained by the morphological structure directing action of starch. Cyclic voltammetry was used in order to study the electrochemical stability of the birnessite used as an electrode. A charge-discharge cycle-test at constant current was employed to measure the capacitance of the electrodes up to 200 cycles in Na_2SO_4 1M. A capacitance of 186 F/g was obtained with 97% of the initial capacitance retained at the 200 cycle, making this material promising as an electrochemical capacitor.

**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00042

Biohydrogen production in fluidized bed bioreactors: room temperature vs 35°C

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ABSTRACT

Hydrogen has been considered a versatile and clean bio-fuel and research on biological production of H₂ has boosted in the last years. Two key issues on biohydrogen production from organic substrates in submerged fermentation are (i) type of bioreactor, and (ii) temperature of operation. Anaerobic fluidized bed reactors (AFBR) exhibit attractive features for the production of H₂ although their application for this purpose is scarce. On the other hand, use of room temperature of operation could help to decrease the use of energy to maintain the temperature at higher levels; yet little is known on dark fermentation in the psychrophilic range. Thus, the aim of this work was to compare the H₂ production in a lab scale AFBRs at two levels of operational temperature: room temperature (R) and 35 °C (M). Sucrose (8 g /L) was used as substrate whereas the hydraulic residence time was 1 day. The average performance of AFBR-R was superior to that of AFBR-M: 1.8 times for the H₂ concentration in the biogas (54% and 31% respectively) and 2.3 times for the H₂ productivity (1330 and 580 mLH₂/(Lbed day), respectively). The volatile fatty acids (VFA) contributed to most of the soluble microbial products at both temperatures with ratios VFA/SP of 26.3 and 4.2 for R and M, respectively (ratio of total volatile fatty acid/total solvent products). In conclusion, the H₂ production in an AFBR at room temperature showed encouraging results for H₂ production in submerged fermentation of moderate-to-high concentration of carbohydrates.



00043

Study Of The Electrochemical Grown Of Polyaniline By Using Different Electrolytic System.

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ABSTRACT

The electrochemical polymerization of conducting polymers has been studied in order to improving the mechanical properties of these polymers so as to use them as electrodes in different applications, such as: energy storage systems (battery, supercapacitor), electrochromic and electroluminescent devices. Polyaniline (Pani) is a conducting polymer largely studied for supercapacitors applications due to its high pseudo-capacitance, easy polymerization in aqueous media, good stability, and low cost. However there exist a few studies about the relationship of electrochemical condition related with the kinetic grown of the Pani that allow associate with the influence of the electrolytes in the formation of the films of Pani. In this work we present a systematic study of the electrochemical grown of Pani on Indium tin oxide (ITO) by using different electrolytes (1M H₂SO₄, 1M HCl and 1M KOH) an different concentrations of aniline (0.1M, 0.2M and 0.3M). Cyclic voltammetry (CV), chronoamperometry (CA) and electrochemical impedance spectroscopy (EIS) were used to describe the different grown stages of the Pani films and the influence of the electrodeposition conditions on the properties of the Pani. The surface morphology of Pani was characterized by atomic force microscopy (AFM) and scanning electron microscopy (SEM). The electrochemical responses are strongly influenced by the electrolyte system used.

00044

Electrocatalytic activity of Pt-Re /C catalysts for methanol electrooxidation

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ABSTRACT

The following research has the objective to develop electrocatalysts for DMFC. It is a metal very little explored as electrocatalyst like the rhenium. Some particles of rhenium were synthesized starting from $\text{Re}_2(\text{CO})_{10}$. It was studied the N, N-Dimethylformamide at different times and temperatures, to find out if there would be any change in the molecular composition of the N, N-Dimethylformamide during the changes of the stages liquid-gas-liquid that was evaluated at the presence of a visible change when it was heated up and confirming with a spectroscopic analysis after being boiled the reagent at different times. Selecting the temperature at 30 degrees with moderated agitation to dissolve the carbonyl. The solution and particles of synthesized Rhenium were characterized by spectroscopy FTIR. Also the particles of Rhenium in Vulcan were endured. The particles were characterized by sweeping spectroscopy observing its distribution in lengths of 50 micrometers and the formation of oxide of Rhenium was determined by EDX. The particles were studied in the agglomerate (composite) nafion/Vulcan/Re by cyclic voltammetry using as media the sulfuric acid 0.5 M with and without methanol. The results show that there is few electrocatalytic activity. In another hand due to the lack of information that exists of electrocatalytic of Re, some agglomerated (composites) of nafion with metallic dust from this metal were prepared. The behavior of Re and few electrocatalytic activity was observed. Therefore it is being studied the electrodeposition of Re on Pt because is stated that the adatoms of Re increase the activity of Pt. The electrodeposition of $\text{Re}_2(\text{CO})_{10}$ dissolved in N, N-Dimethylformamide has not been reported. Our approach to greatly change the electrocatalytic



00045

**Evaluation of pre-treatment on the first stage of an anaerobic digester for enhancing bio-hydrogen production
and its associated Energy Balance**

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ABSTRACT

Wastewater Treatment Plant (WWTP) is an essential public service, but, at the same time, it consumes a large amount of energy. However, there is excellent conservation potential through the use of biogas in-situ. To increase the conservation potential, the use of pre-treatment provides a brand new focus to anaerobic digestion (AD) and its by-product (sludge) by increasing the amount of Hydrogen produced in the first stage of the process. Of interest, each cubic meter (m³) of biogas produced without pre-treatment contains the equivalent of 7-9 kWh of calorific energy, if the composition of CH₄ lies between 60-80% of the total biogas composition. With pre-treatment, studies indicate that the production of calorific energy will increase approximately two-fold because hydrogen has the highest energy content per unit weight of any known fuel (120,21 MJ/kg), [3]. The aim of this case study is to select the most suitable pre-treatment for enhancing the bio-H₂ production in a two-stage AD. Several pre-treatments have been identified such as temperature shock or chemical addition [2]. With pre-treatment, studies indicate that the production of bio-hydrogen could increase bio-H₂ production at least 20%, ensuring the energy neutrality of the two-stage process and therefore use part of the produced energy in-situ. This has been already observed in WWTP in Switzerland (Genève). This is of particular interest because there are additional socio-economic benefits to using bio-H₂ as a source of energy such as the reduction of green-house gas emissions and the creation of a viable alternative energy source. Some challenges to overcome, include to understand the metabolic pathway that drives the production of hydrogen, the cost and mass production of certain pre-treatments [1].

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XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00047

Design, Manufacture And Evaluation Of A 250W PEM Fuel Cell Stack

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ABSTRACT

The interest of this work is to build and develop an Eco friendly device from the renewable energy sources. In order to achieve our goal, we construct a hydrogen-oxygen fuelled 250W PEM fuel cell stack. The stack were designed and constructed on high density carbon with the aid of Auto CAD software and CNC router. Later on the stack was evaluated following a potentiostatic polarization perturbation with a fuel cell tests station. The operation conditions of a fuel cell stack was maintained by feeding the fuel (H₂) and oxidant (air) at room temperature and a pressure of 0.1 atm (1.5psi). Operating temperature was varied from 20 °C to 70 °C with gases at 100%RH. Experimental results reveal that a constant production of 250 W was achieved. Also in this work the auxiliary systems for the operation of the fuel cell stack is presented. Keywords: Design; Manufacture; PEM; System; Stack.

**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00048

Electrochemical Activity of Pt/oxide-C Composites on the

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ABSTRACT

Pt-TiO₂-C composites have been synthesized by photo-deposition and vapor-phase impregnation-decomposition methods. These electrocatalysts were characterized by XRD, H₂ chemisorption, TEM and XPS techniques. The main objective of this work was to compare the electrochemical activity of both composite materials with low metal loading (10 wt.%) on the oxygen reduction reaction taking a 10 wt.%Pt/C sample as reference electrocatalyst. X-ray diffraction permitted to identify the crystallographic planes of Pt (fcc). TEM images showed Pt particle size less than 10 nm in all synthesized samples. Surface composition results (XPS) revealed a modification of Pt electronic properties depending of the preparation method. The platinum-oxide interaction on the Pt-TiO₂-C samples promoted the electrocatalytic activity for oxygen reduction reaction compared with Pt supported on carbon.

00049

Performance improve of a PEM electrolyzer, decreasing the ohmic resistance because of manufacturing and assembly processes

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ABSTRACT

Proton Exchange Membrane Electrolyzer (PEME) can be coupled to Renewable Energy Sources (photovoltaic panel, wave energy conversion device, wind turbine, etc) to obtain the necessary electricity for splitting the water. The ideal thermodynamic voltage for hydrogen production by water electrolysis is 1.23 V; however the difference between actual electrolyzer voltage and the reversible electrolyzer voltage for the reactions is called overvoltage. One of the sources of overvoltage in an electrolyzer is ohmic overpotential, which arising due to the resistive losses from wrong manufacturing and assembly processes. The study goal was manufacture a high efficiency and performance PEME to produce hydrogen as an energy carrier, minimizing the ohmic overpotential. More suitable processes for the manufacture of a PEME were analyzed and proposed. Prototype methodology was used to design the electrolyzer and specify assembly processes. This methodology validates the final prototype when it was built. The PEME performance was obtained by Chrono-potentiometric technique. The experiments were carried out by applying the current pulse and determining the potential as a function of time. It is connected to a galvanostat in order to obtain its response Voltage vs time. Experiments were recorded in the current range of 1 to 300 mA at 300s. The PEME constructed had a current efficiency of 74% and an energy efficiency of 61% with overpotential of 1.8 V, generating 1.456 mLH₂ min⁻¹ at 200 mA. The current efficiency of the previous prototype with the same features was 11% and an energy efficiency of 3% with overpotential of 4.7 V generating 0.21 mLH₂ min⁻¹ at 200 mA. The energy efficiency improved from 3 to 61% and production of hydrogen in mLH₂ min⁻¹ increased by 593% in performance.

00050

Performace Of Supercapacitors Based On Graphene Oxide And Mesoporous Carbon

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ABSTRACT

Recently, it has begun to see the potential of graphene in multiple applications over all in energy conversion and storage, for example, photovoltaic solar cells, hydrogen storage for fuel cells, electrodes for batteries and supercapacitors. Graphene has presented good properties for use as electrodes in energy storage devices, especially for supercapacitors due to a theoretical superficial area of $2930 \text{ m}^2\text{g}^{-1}$ and the highest conductivity electric of $0.96 \times 10^6 \text{ S cm}^{-1}$. Although the graphene oxide it not presents the properties of graphene, the graphene oxide also was presented as an alternative material for the electrodes, because the presence of functional groups on your surface contributes the hydrophilicity between carbon and electrolyte. On the other hand, the mesoporous carbon it's an economical and conventional material used as electrodes for supercapacitors. In this work supercapacitors have been prepared based on graphene and mesoporous carbon to study the contribution for each material in the performance of supercapacitors. Graphene oxide was obtained by the Hummer's modified method. This was exfoliated by the ultrasonic technique used ethylene glycol as solvent. The material obtained was characterized by mean of Raman spectroscopy and SEM. Supercapacitors have been made using graphene oxide on cloth carbon and later were deposited mesoporous carbon by screen printing. Supercapacitores were evaluated by electrochemical techniques as cyclic voltammetry, cyclic galvanostatic and electrochemical impedance spectroscopy.



00051

Oxygen reduction reaction on Pt/C electrocatalysts obtained

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ABSTRACT

Platinum nanoparticles with homogeneous dispersion on carbon Vulcan was obtained at room temperature by irradiation of an alcoholic solution of $C_{10}H_{14}O_4Pt$ with UV-light. The electrocatalysts were characterized by X-ray diffraction and transmission electronic microscopy techniques. TEM micrographs and XRD results confirmed the formation of platinum nanoparticles (4 nm) with a high dispersion onto the carbon. The electrochemical active surface area was determined by CO stripping and hydrogen-adsorption/desorption reactions. The electrochemical activity and stability of Pt/C for the oxygen reduction reaction (ORR) were determined by rotating disk electrode (RDE) at different temperatures. An apparent enthalpy of activation $\Delta H^\ddagger = 58.7 \text{ kJ mol}^{-1}$ was calculated from the electrochemical results from 25 to 50°C. The main reaction pathway was quantified by rotating ring-disk electrode (RRDE). The maximum amount of hydrogen peroxide produced in the ORR reaches a value of 3.8% at 0.36V/NHE following preferentially the four-electron transfer mechanisms to water formation. The current density results reveal that Pt catalysts with high activity and selective for the ORR can be obtained by the photo-deposition method.

00052

Biohydrogen Production through Solid Substrate Fermentation of Organic Municipal Wastes: a Multivariable Evaluation

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ABSTRACT

Municipal solid waste (MSW) generation is a constant problem on growing cities and its organic fraction (OFMSW), ca. 60% of MSW, is being literally `wasted`, despite its applicability on energy production. Therefore, this work was focused on hydrogen production from the OFMSW with a double purpose: (i) to evaluate the effect of the total solids content (20.9 and 35% TS), temperature (35 and 55 °C) and mass retention time (21 and 14 d) on semi-continuous fermentation, and (ii) to test the supplementation with nutrient nitrogen in the form of waste activated sludge. Firstly, it was found that factors were significant in the order: total solids > temperature > MRT. Significant interactions amongst factors were only observed happened between TS and temperature or MRT. Indeed, best hydrogen productivity I_{H_2} averaged up to 123 NmL H_2 /(kgw_{mr} d) at 20.9 %TS, 55 °C and 21 d MRT. Secondly, supplementation with nitrogen did not show a significant effect. Highest results were $P_{H_2} = 1575 \mu\text{molH}_2/\text{gVS}$ and $R_{H_2} = 68.3 \mu\text{molH}_2/\text{gVS/h}$ in the mini-reactors with no addition of alkalinity nor sludge. No significant lag phase could be observed in none of the experimental units. Microorganisms introduced through supplemented sludge might have affected fermentation, particularly boosting hydrogen consumption. In general, variations and inhibition of hydrogen production were related to low pH and lactic acid and solvent deviation of the fermentation. This was in agreement with reports of a strong correlation between high lactic acid concentrations and inhibition of hydrogenesis.

00053

Characterization of a five-face parallelepiped microbial fuel cell equipped with sandwich electrodes and analysis of microbial diversity of inocula

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ABSTRACT

This work had a double purpose: (i) to design and characterize a novel, multiface parallelepiped microbial fuel cell (MFC) in the perspective of decreasing the internal resistance (R_{int}) and increasing volumetric power (P_v) output, and (ii) to analyze the bacterial communities in cells operated with either sulphate-reducing inoculum (SR) or enriched inoculum (E). The multiface MFC consisted of a parallelepiped built in plexiglass with a capacity of 270 mL. Five faces of this cell were fitted with sandwich cathode-membrane-anode assemblages (CMA). The anodic biofilms derived from either SR or E inocula were used for DNA extraction. Total genomic DNA was used as template for PCR amplification of approximately 1500 bp of 16S rDNA. The PCR products were purified, cloned, transformed into competent cells of *E. coli* XL1-Blue, and further sequenced. The R_{int} were 400 and 84 Ω and P_v were 655 and 1800 mW/m³, for the faces connected in series and parallel, respectively. Anode density powers of the MFC connected in series and parallel were 18.4 and 50 mW/m², respectively. Clostridia predominated in the biofilm derived from the SR inoculum; this class is believed to be responsible for the direct electron transfer to the anode according to other literature reports. Predominant microbes in the biofilm derived from the E inoculum belonged to *Deferribacteres* class; this class is known to contain c-type cytochromes. Shannon indices were 1.27 and 1.38 for the community derived from SR and E inoculum, respectively. As conclusion, parallel connection of cell faces significantly improved the electrochemical characteristics of the cell. Also, the SR-derived community was slightly diverse than the E-derived one. Both communities harbored microbes that are electrochemically active.



00054

Photodegradation of hydrocarbons using nanostructured TiO₂/Cu powder

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ABSTRACT

Nanostructured Titanium oxide is one of the most promising materials in photocatalysis [1]. An increasing interest has generated its application in the photodegradation of hydrocarbons, due to the growing concern in relation of all kind of oil spills challenging the health of our environment [2]. However the effectiveness of TiO₂ alone has been shown to be very limited [3]. Several methods have been devised to increase the photodegradation ability of nanostructured TiO₂ [3]. However the process involved are expensive and complex. In this work we explore the photodegradation of hydrocarbons using a novel nanomaterial TiO₂/Cu generated by nitrogen plasma discharge. The process is studied in samples in which heavy oil obtained from Dos Bocas in the state of Tabasco in Mexico is dissolved in a mixture of acetone-methanol-water, with nanostructured TiO₂/Cu powder. The samples were irradiated with UV/Vis light using a Xenon lamp operating at 400 W to simulate the radiation of the sun. In order to prevent the evaporation a system consisting of Erlenmeyer's balloon modified with a refrigerant was developed. The study of the evolution of the samples after the irradiation was done using Uv-vis emission, IR spectroscopy and photoacoustic piezoelectric detection. The results obtained with these techniques show an important effect after 1 hrs of irradiation. Those changes indicate that the degradation of compounds with complex structure is occurring.[1]S.Sakthivel, M.C.Hidalgo, D.W.Bahnmann, S.U.Geissen, V.Murugesan and A.Vogelpohl, A fine route to tune the photocatalytic activity of TiO₂,Applied Catalysis B:Environmental (2006) 63, 31,40. [2]Hidrocarburos: Derrames y efectos ambientales. Argentina 1998 [3]X.Chen and S.S.Mao, Titanium Dioxide Nanomaterials...

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XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00055

Au@Pt core-shell type catalyst for hydrogen oxidation in presence of carbon monoxide

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ABSTRACT

Pollution problems have led researchers to look for new energy sources that produce low to zero emission of contaminants; proton exchange membrane fuel cells (PEMFC) are a feasible alternative. At the anodic side of a PEMFC, the hydrogen oxidation reaction (HOR) takes place generating protons and electrons; the generated electrons travel by an external circuit to produce electrical work while the protons pass through the proton exchange membrane to the cathode compartment; at the cathode, the protons and electrons combine with oxygen to produce water. Up to date, platinum (Pt) is the best material ever found to be used as catalyst in PEMFC, however, it is very susceptible to pollutants (such as CO) and, also, very expensive due to its scarcity. An effective way to reduce the cost of PEMFC is by decreasing the amount of Pt without compromising the performance of the cell; this can be achieved by using nanoparticulated catalysts that increase the area vs. volume relationship. The enrichment of Pt on the surface of core-shell materials allows to position it where needed, while the interior of the particle is made of a cheaper material. Also, the electrochemical activity of Pt on core-shell materials (M@Pt) is affected by the core metal (M), the stress due to compression or tension of Pt atoms on core-shell materials can be used as a tool for the generation of new anodic electrocatalyzers with high selectivity for the HOR, even in presence of CO. In this work, it will be presented the first performance results of a proton exchange membrane fuel cell fed with oxygen from air and poisoned hydrogen (it contains 1-10% of CO w/w) which react on a nanoparticulated catalyst core-shell type (Au/Pt), supported on carbon Vulcan XC-72R.



00056

Synthesis and properties of styrene ionic liquid copolymers for high temperature anhydrous fuel cells

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ABSTRACT

Polymer electrolyte membrane (PEM) is the key material in polymer electrolyte membrane fuel cells (PEMFC). Commonly used polymer membranes in PEMFC are perfluorosulfonated membranes, such as Nafion®. However, there are two major drawbacks in Nafion® membranes. First, they rely on water for proton conductivity, so they cannot operate at high temperatures ($>80\text{ }^{\circ}\text{C}$). Second, methanol crossover occurs when used in direct methanol fuel cells, which causes the poisoning of electrodes. Proton-conducting membranes based on the imidazolium has shown good heat resistance, chemical stability and mechanical strength. The properties related to PEM materials for fuel cell applications, including thermal stability, mechanical properties, methanol permeability and proton conductivity were thoroughly evaluated. Aimed at elucidating the structure-property relationships, another series of styrene- N-alkyl imidazolium doped with silver nanoparticles have been synthesized. Nanoparticles with average size of 20A were used. The comonomers percentage was controlled by the mol ration of the styrene and vinylimidazoles. The obtained membranes had excellent thermal stability, high mechanical property and low methanol permeability. The proton conductivities were higher than 0,065S/cm at 80oC.

00057

**Methanol Electrooxidation on Au-Pd/C in Alkaline Media: The Dissolution of Palladium in the Bimetallic Alloy
- A Case Scenario**

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ABSTRACT

Among the familiar types of fuel cells, a new technology is emerging. The alkaline direct alcohol fuel cells (ADAFc) have attracted much attention, since they overcome many of the major issues of its predecessors, such as carbonation and alcohol crossover. Historically, either in acid or alkaline media, Pt has shown the best catalytic activity for methanol electrooxidation. Unfortunately, the high price and limited supply of Pt make it prohibitive for large scale production. In ADAFC, the weaker specific adsorption of spectator ions in basic media; and higher coverage of adsorbed OH at low potential permit superior catalytic performance of other noble catalysts for methanol electrooxidation. In this context, the present work is concerned with two different carbon supported alloys, AuPd and Au₂Pd. These alloy compositions were chosen for comparison, but also, in the case of the latter, to set a scenario where Pd is depleted due to its unavoidable dissolution during continuous operation of an alkaline direct methanol fuel cell (ADMFC). Thus, the bimetallic catalysts were synthesized by chemical reduction with NaBH₄; supported in commercial carbon black; and later fully characterized to obtain parameters such as chemical composition, alloying degree, particle size, and electrocatalytic activity. Exclusively, the AuPd/C demonstrated capability to promote the electrooxidation of methanol. This proved that, within these bimetallic alloys, in conditions of dissolution of Pd and ensuing enrichment of Au, a null catalytic activity is attained.

00058

Electrocatalytic Properties of NiMo Nanoparticles for the Hydrogen Evolution Reaction

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ABSTRACT

Non-renewable energy sources (coal, oil and natural gas) presently satisfy the world's energy needs; however, their inherently high environmental costs, makes it imperative finding alternative resources. Hydrogen is a clean fuel that can be produced by direct electrolysis of water, making use of an electrocatalyst that lowers the overpotential. Noble metals, such as Ag, Pt, and Au have shown excellent properties for this purpose, however, a main drawback of these materials is their high cost and scarcity. Consequently, some alloys of Ni, Co and Mo have been studied as cheaper alternatives for H₂ generation. This work investigates the performance of NiMo nanoparticles for the hydrogen evolution reaction (HER). The nanoparticles were fabricated from a Ni-Mo binary salt solution by means of current pulses. The deposition time was kept constant at 2 seconds in all cases, whereas the pulse current density was varied in the range of 15 and 100 mA/cm². The material's catalytic performance was estimated from current-potential graphs, where the generated current was taken directly proportional to the ability to carry out the HER. Compositional and morphological features of electrodeposited nanoparticles were obtained from scanning electron microscopy and energy-dispersive X-ray spectroscopy. The catalytic activity of nanoparticles was affected by their composition, which in turn depended on the intensity of the current pulse.

**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00059

Roadmap for hydrogen technology in urban public transport in the metropolitan area of Merida, Yucatan

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ABSTRACT

This work is a first step towards a road map for hydrogen technology in the transport sector in the city of Merida, Yucatan, Mexico. In the case of the Metropolitan Area of Merida (MAM) approximately 34.3 % of the mobility is by public transport, with approximately 750,000 trips and moving 352,262 habitants every day. For this reason, it is important to improve the efficiency of the local transport system, in order to supply the demand with a high quality service. In addition, the public transport system consists of an obsolete fleet of approximately 1,700 units. As a consequence it is generating high operation costs due to maintenance and serious environmental pollution.. The local public transport system indeed is one of the major causes of carbon emissions. In this study it is proposed to replace part of the existing transport system by hydrogen-based technology, in order to achieve a more sustainable public transport infrastructure. This road map includes the selection of a specific route and estimation of the required hydrogen production, from clean renewable energy sources connected to the grid according to the potential of natural resources. Also, the challenges that need to be overcome along the implementation of the hydrogen technology are analyzed. Based on an interpretation of environmental, economical and social benefits, the most adequate chain for production, d



**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00060

Electrochemical characterization of Ni-based Alloys at the hydrogen evolution zone in alkaline media

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ABSTRACT

Nickel-based alloys such as $\text{Ni}_{0.8}\text{Co}_{0.1}\text{Zn}_{0.05}\text{Mn}_{0.02}\text{Ti}_{0.01}\text{Y}_{0.01}\text{Al}_{0.01}$ (M1), $\text{Ni}_{0.8}\text{Co}_{0.1}\text{Zn}_{0.05}\text{Mn}_{0.02}\text{Ti}_{0.01}\text{Y}_{0.01}\text{Al}_{0.01}$ (M2) and $\text{Ni}_{0.6}\text{Co}_{0.35}\text{Zn}_{0.025}\text{Ti}_{0.025}$ (M3) were synthesized from high purity powders by means of high-energy mechanical milling. The hydrogen evolution reaction (HER) kinetic-performance of the as-prepared materials was evaluated using linear sweep voltammetry (LSV) and electrochemical impedance spectroscopy (EIS) at alkaline media and room temperature. The impedance data obtained at -1, -1.1 and -1.2V/SCE and from 0.1 to 100000 Hz showed only one semicircle in the Nyquist spectra and one time constant in the Bode plot. At this conditions, the charge transfer resistance decreases as the applied potential increases due to the effective proton adsorption-desorption as the potential become more cathodic. The sample M2 presented the lower resistance during hydrogen evolution. These results are in good agreement with the kinetics parameters obtained by LSV.

00061

C-TiO₂ and C-ZrO₂ composite supports for Pt electrocatalyst to evaluate in ethanol anodic oxidation

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ABSTRACT

The commercial application of Direct Ethanol Fuel Cells (DEFC) devices has been limited because of the poor Pt tolerance to the intermediate species formed in the complex mechanism of the ethanol oxidation reaction. Bimetallic and multimetallic active phases have been extensively studied in the last decades, however, the catalyst activity is still insufficient. As alternative, the support modification could upset the interaction between both the intermediate species and Pt sites. In this work C-TiO₂ and C-ZrO₂ supports were synthesized using 5, 23, 50 and 100 wt % of TiO₂ or ZrO₂. The prepared materials were characterized by N₂ adsorption-desorption, XRD, SEM, DRS-UV-VIS, Cyclic Voltammetry and Electrochemical Impedance Spectroscopy. With the exception of TiO₂ support, all samples presented macroporous with a bi-modal pore distribution ranging from 1500 to 2000 Å; TiO₂ support shows a mesoporous behavior and C-TiO₂ (5%) support showed the largest area, 277 m²/g, close to that of vulcan carbon XC72R (322 m²/g). Electrochemical analysis showed that Pt/C-ZrO₂(5%) and Pt/C-TiO₂(5%) were the synthesized materials with higher active areas.

00062

Design of bipolar plates for a PEM electrolysis cell

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ABSTRACT

Hydrogen demand will increase in the near future due to the development of different energy conversion technologies like fuel cells or new internal combustion engines. Water PEM electrolyzers are devices capable of produce hydrogen with a high purity and one of its important components are the water distributor plates, which are called end plates and bipolar plates in a multiple cells configuration stack. Its primary functions are: distribute the water evenly over of the electrodes surface, connecting the cells electrically in series, to separate water from adjacent cells and provide a support structure to the stack. Bipolar plates performance is affected by architecture of the flow channel fields, because it could exists stagnant zones generating pressure and speed losses. Produced hydrogen bubbles can be trapped in the channels and this would reduce the contact reactive area and therefore, a loss in PEM-WE efficiency. This work focus in the flow channels fields design for a PEMWE-bipolar plate. Several prototypes are simulated in ANSYS FLUENT 12.0 solving through of the finite element method the pressure drops, loss of speed, and the evacuation of the gases generated from the electrochemical reactions. The authors acknowledge the financial support for this work from CONACYT project 116157

00063

Effect of Sb- Doped SnO₂ Supports Heat Treatment on the Oxygen Evolution Reaction

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ABSTRACT

It has been recognized the role of supports in electrocatalysis as a way to increase both specific activity and lifetime of electrocatalysts. Due its stability, some doped SnO₂ supports could be used as an alternative to carbon black in PEM water electrolysis. In this work, IrO₂ catalyst was mixed in a colloidal mini-mill with SnO₂ supports doped with antimony (ATO) in a fixed proportion (50:50 wt %) and the mixtures were used as anode material for Oxygen Evolution Reaction (OER). ATO supports were obtained by reaction between Sn and Sb chloride precursors in alcoholic medium at moderate temperature, followed by an annealing procedure at 500 °C and different times of treatment (between 3 h and 15 h). The electrodes were evaluated in terms of OER by Linear Scan Voltammetry (LSV) and Electrochemical Impedance Spectroscopy (EIS) techniques. Electrokinetic parameters as Tafel Slope and Exchange Current Density for OER were obtained as a function of the different annealing times material support. Furthermore, the Charge Transfer Resistance (R_{ct}) for oxygen evolution obtained from the Nyquist impedance spectra were compared

**9th International Symposium on New Materials and Nano-Materials for
Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00064

Stack fuel cell prototype used to power a LED system

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ABSTRACT

Petroleum supply will be in increasingly higher demand as heavily populated developing countries expand their economies and become more energy intensive. Air quality and global climate impact are other major concerns with this continuing dependence on fossil energy sources. Widespread use of hydrogen as an energy source in Mexico could help address concerns about energy security, global climate change, and air quality. Fuel cells is an important enabling technology for the hydrogen future and it has the potential to revolutionize the way we power our nation, offering cleaner, more efficient alternatives than fossil fuels. In this work, a stack fuel cell prototype was designed and manufactured with three single assemblies. The combination of anode/membrane/cathode is referred to as the membrane/electrode assembly, MEA. The three MEA_s were prepared by placing the gas diffusion electrode (GDE, standard carbon cloth with 0.5 mgPt_lcm⁻²), at both sides of the Nafion 115 membrane, followed by hot-pressing of 10 kg_lcm⁻² at 120 °C for 2 min. The effective area for each single MEA was 28 cm² being 84 cm² the total anodic and cathodic geometric area. The MEA_s were tested with a commercial fuel cell system (Compucell GT, Electrochem) at 25°C and atmospheric pressure. The performance achieved was a 2.7 V open circuit voltage, achieving 7.4 W peak power, the optimum performance is at 2 V_l2 A. The lamp was integrated by 16 LED's connected in parallel.



00065

Coke Gasification As An Alternative To Produce Hydrogen For A New Petroleum Refinery

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ABSTRACT

Hydrogen is indispensable in modern refineries. For the most part it is employed in hydrotreating processes to remove pollutants, such as sulfur and nitrogen, from liquid hydrocarbons that are then mixed to produce cleaner fuels. Hydrogen is usually obtained through the reforming of naphtha and/or natural gas, which is an expensive and energy intensive process that generates large amounts of sulfur dioxide that are emitted to the atmosphere. As modern refineries have incorporated coking processes to convert heavy hydrocarbons into valuable fuels, an interesting alternative can be considered. Coke is produced at a ratio of 30% of the original feed and normally sent to cement plants where it is used as fuel. Nevertheless, coke is hydrogen-rich, containing between 4-8% in weight. Estimating a new refinery's needs, the design requires the construction of a reforming plant that uses natural gas to produce 170 000 ft³/day of hydrogen. In this paper, an alternative option is proposed: to obtain the same amount of hydrogen via a 7 500 tons/day coke gasification plant, which consumes one third of the total coke production. The energy, environmental and economic data obtained is compared to the natural gas reforming process originally considered for the new refinery. Interestingly, the results show that excluding the initial investment factor, the coke gasification process can be a reasonable option.

00066

Evaluation and comparative analysis of Pt-Mo/C catalysts synthesized by different methods for application as anodes in direct methanol fuel cells

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ABSTRACT

Pt-Mo catalysts can play an important role in direct methanol fuel cell systems. This activity is explained in terms of different mechanisms such as the bifunctional mechanism, the ligand effect, the hydrogen spillover and it has also been proposed a physical blocking effect of Pt sites by Mo species. In this work, constant composition materials (Pt_{0.8}Mo_{0.2})_{0.25}/C_{0.75} were synthesized in two different ways, in order to have different surface structures and to compare their activities towards methanol oxidation. The first catalyst consists of two active phases (Pt and Mo) simultaneously deposited on the carbon support. The second catalyst is obtained by the synthesis of monometallic materials (Pt/C and Mo/C) that are mixed and stirred in suspension, in diethyl ether. Monometallic and bimetallic materials were synthesized by a carbonyl thermolysis method using, as precursors, molybdenum hexacarbonyl, hexachloroplatinic acid and XC-72 carbon as support. The materials were studied by cyclic voltammetry and current-sampled voltammetry tests to evaluate their activities. X-ray diffraction and transmission electron microscopy were carried out in order to determine the relationships between the active phases. An analysis of cyclic voltammetry curves showed that the active phases simultaneously deposited present methanol oxidation current peaks higher than the material obtained from suspension mixing. Much higher electrical charges transferred per VC cycle are obtained in the bimetallic catalyst. The presence of molybdenum allowed the decrease of reaction potentials, which results in a higher catalytic activity. The transferred charge is greater in the material obtained by simultaneous synthesis. This suggests that the promoting role of Mo is due to a short distance effect.

00067

Design and development of a Direct Ethanol Fuel Cell (DEFC) stack

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ABSTRACT

The global increasing energy demand and its environmental consequences make necessary to find new alternatives of electrical power supplies or fuels. Ethanol from lignocellulosic raws has been considered as a sustainable fuel because its local production, the use of residual biomass, can be transported, handling using the actual infrastructure and possesses a lower toxicity. The chemical energy of this low molecular weight alcohol can be transformed directly and efficiently through electrochemical reactions in a Direct Ethanol Fuel Cells (DEFC). It is not required a previous reformed process and by its high flexibility, DEFC can be used in transport and portability applications. This work presents the DEFC stack design using computational fluid dynamics and structural strength analysis. The prototype was built with catalysts loads of 1 mgPt cm^{-2} in both anode and cathode, an active area of 64 cm^2 . Cell was operated at 333 K with 1 mL min^{-1} of $1 \text{ M CH}_3\text{C}_2\text{OH}$ at the anode and, 140 mL min^{-1} of wet air at the cathode. CFD analyses established that lower pressure drop achieved in the designed flow fields was 1.43 Pa . Stress analyses of the end plates data help to determine the compressive force for stack and have a better efforts distribution on the screws. The cell current density achieved was 9.5 mA cm^{-2} with an OCP of 650 mV . The maximum stack power attained was 8 W with 56% efficiency. The authors acknowledge the financial support for this work from CONACYT project 116157 and Ing. Gustavo Martinez Tapia by laboratory support.

00068

ZnO Electrodeposition & Application in Dye-Sensitized Solar Cells

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ABSTRACT

Dye sensitized solar cells (DSSCs) employ a mesoporous and nanostructured film of titanium oxide (TiO₂) as the substrate for dye adsorption. TiO₂ is the semiconductor oxide that shows the best performance in the DSSCs, however, zinc oxide (ZnO) is an interesting alternative material because of its excellent electrical properties and ease of preparation. Electrodeposition is an inexpensive and low equipment cost method for the fabrication of ZnO films for DSSCs. The morphology of electrodeposited films is key to the success of the solar cell, with as most important parameters the internal surface area, porosity and pore size distribution. The high surface area is needed to anchor sufficient dye, and the film should be mesoporous, homogeneous and around 10 μ m thick. The electrode porosity and homogeneity may be improved using additives or surfactants in the electrodeposition bath. In this work we report on the study of galvanostatically electrodeposited ZnO films from a bath 0.5 M Zn(NO₃)₂ and 150 μ m polyethylene glycol (PEG), in order to modify the properties of electrodeposited ZnO films. The presence of PEG in the bath resulted in an improved morphology, and PEG adsorption during film growth increases the active surface area of the ZnO films; thermogravimetric analysis showed that a small amount of PEG was incorporated in the films. As consequence of the improved film morphology, dye-sensitized solar cells prepared with electrodeposited ZnO films using PEG as an additive in the bath showed higher conversion efficiency.

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00069

Sustainable Hydrogen Production in Yucatan

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ABSTRACT

More than 90 % of the hydrogen production in the world depends on carbon compounds, principally fossil fuels, and its use as energetic vector is only justified in some applications as fuel for spaceships or demonstrative buses or cars. The goal of this proposal is to compare different approaches for sustainable hydrogen production as a commercial activity in rural communities in Yucatan. The Yucatan peninsula is a particular region at the Southeast of Mexico, where a fragile environment is present in combination with poor rural Mayan communities. Moreover, energy supply in this region depends mainly on fossil fuels provided from other regions. However, in Yucatan, solar radiation and winds have an important potential application that has not been exploited yet. An application of these renewable energy sources could be hydrogen production as an economic activity promoting rural development of the region. According with meteorological analysis, as well as with the consideration of energy requirements and efficiency of commercial electrolysis systems, an estimation of the hydrogen production is evaluated, considering both investment and maintenance costs. This estimation may be a reference in order to propose small industries for the production of hydrogen in specific rural communities in Yucatan. A transportation network organized by the regional government could be a solution to consume this hydrogen as fuel, although a number of other applications may be proposed depending on the regional energy requirements. Finally, the bioproduction of hydrogen is explored in order to compare it with the simple hydrolysis systems.



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00070

Hydrogen Storage in Metal Organic Framework

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ABSTRACT

The decreasing fossil fuel supply and climate change caused by carbon dioxide emission have spurred an initiative to develop alternative fuels. Hydrogen is one of the most promising candidates for the replacement of current carbon-based energy sources. Hydrogen has an energy density much greater than gasoline and emits no carbon dioxide after burning. Free hydrogen does not occur naturally in quantity, and it should be generated from some other energy source by steam reformation of natural gas or other methods. Hydrogen is therefore an energy carrier, not a primary energy source. For the advancement of hydrogen and fuel cell power technologies in transportation, stationary, and portable application, the research on hydrogen production, delivery, storage, and fuel cell technologies should be fully developed. In particular, hydrogen storage is considered to be a key enabling technology. This adsorption has been studied in materials as zeolite, carbon nanotubes, hydrides metallic and currently in metal organic framework (MOF). In this context, in the present work, the recently results around the world, about the hydrogen adsorption in different MOF are showed. We discussed the different strategies (as elongation of ligands, catenation, mixed ligands, open metal sites, impregnation, doping and fictionalization) employed for increased the storage in this materials.

00071

Influence Of The Properties Of TiO₂ Nanomaterials On The Performance Of Dye-Sensitized Solar Cells

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ABSTRACT

The dye-sensitized solar cell (DSC) is a third generation solar cells with a promising efficiency for the conversion of solar energy to electricity using low-cost materials and production processes. The morphology of the nanomaterials used to prepare the cell is a key parameter in determining the cell performance. The most promising method for large scale production of dye-sensitized solar cells (DSC) is screen printing, related to the large degree of control over the morphological properties of the deposited films. The screen printing process has been demonstrated to result in reproducibly high efficiency solar cells [1]. In this work, we have prepared solar cells based on TiO₂ films deposited by the screen printing process, using a novel formulation of the terpeneol-based paste. The solar cell performance was determined as a function of the film thickness, controlling the film thickness from of 2 - 14 microns, before sintering at 500°C. The electrode was immersed into N-719 dye solution in order to sensitize the film. Using this method, solar cells with efficiencies larger than 7% were obtained for thicknesses between 8 - 12 µm. In addition, the stability of the performance was investigated, and the influence of film thickness on the transport and recombination properties was determined using electrochemical impedance spectroscopy.

00072

A Dye-Sensitized Brookite Solar Cell

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ABSTRACT

Titanium dioxide nanomaterials for application in the dye-sensitized solar cell (DSC) are commonly prepared using sol-gel synthesis, which involves the forced hydrolysis of dissolved titanium (IV) precursors. The three most commonly encountered TiO₂ polymorphs are anatase, rutile and brookite. The nucleation and growth of the different polymorphs of TiO₂ are determined by the materials energetic properties and precursor chemistry, which depends on the reactants used. In general, anatase is the preferred material for DSC fabrication, but the use of different polymorphs may provide unique insights into the dependence of the interfacial processes on the surface chemistry of the metal oxide. We have prepared nanocrystalline brookite using amorphous titania as a starting material. The phase formation in aqueous colloidal solution was studied using hydrothermal treatment with HCl as a reactant [1]. The fraction of brookite obtained in the synthesis was found to depend on experimental parameters such as the reactant concentration, temperature, time and pH. Essentially pure nanocrystalline brookite (> 97%) was obtained with only a very small rutile contamination. The surface area of the brookite nanopowder was 38 m² g⁻¹, as determined by nitrogen adsorption and BET analysis. The average particle size from X-ray diffraction and high resolution SEM was around 25 nm. We have prepared dye-sensitized solar cells from pure brookite nanomaterial, utilizing a terpeneol-based screen printing paste, and the cell performance was obtained. An efficiency of up to 4% was achieved using nanocrystalline brookite. References[1] D. Reyes-Coronado, G. Rodriguez-Gattorno, M. E. Espinosa-Pesqueira, C. Cab, R. de Coss and G. Oskam; Nanotechnology 19, 145605 (2008).

00073

Use Of A Tryfunctional Crosslinking Agent In Styrene/Acrylic Acid Copolymers To Enhance Mechanical Properties For Their Use As Membranes In Fuel Cells

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ABSTRACT

Polymer electrolyte membranes used in hydrogen fuel cells need some mechanical resistance in order to stand for the humid environment observed into a cell in operation. Alternative copolymers to the well-known Nafion membranes are the styrene/acrylic acid copolymers; with advantages in cost and availability of raw materials to prepare them. Previous attempts to improve mechanical properties of such materials involved crosslinking with divinyl benzene, but in this work we are reporting the use of the tryfunctional monomer TMPTMA (trimethylol propane trimethacrylate) for such purpose. Copolymers with a PS/AA ratio of 94/6 were prepared by radical polymerization reaction, including TMPTMA at 0.1, 0.01 and 0.001 %mol concentrations. Reactions were followed by FTIR and crosslinking level by gel percentage evaluation (soxhlet extraction) with three different solvents (water, THF and dicloromethane). Thermal transitions were followed by DSC, stability by TGA and mechanical properties by DMA. FTIR spectra show typical bands from the copolymer while the corresponding bands to crosslinking are overlapped; however, gel percentage evaluations show higher level of crosslinking for the 0.1% TMPTMA copolymer and lack of solubility in water. DSC thermograms indicate increment of T_g and TGA a small increment in thermal stability for crosslinked copolymers. Elastic modulii suggests a rubbery material for 0.001% TMPTMA while the 0.01 % TMPTMA shows an enhanced mechanical property recovering E' values of PS homopolymer and 0.1 % TMPTMA does not even form a membrane due to insolubility and infusibility.

00074

ZnO nanorods functionalized with TiO₂ nanoparticles for application in dye-sensitized solar cells

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ABSTRACT

Dye-sensitized solar cells (DSC) are third generation solar cells with a promising efficiency for the conversion of solar energy to electricity using low-cost materials and production processes. The morphology of the nanomaterials used to prepare the cell is a key parameter in determining the cell performance. A large surface area is needed to allow for efficient adsorption of the dye, and the electrical properties of the nanomaterial determine the efficiency of collection of injected photoelectrons. TiO₂ has been the most successful material for use in the DSC, however, ZnO is a promising alternative, mainly because of its better electrical properties. A disadvantage of ZnO is that it is less stable, and tends to be attacked by the dye solution. In addition, it appears that the electron injection efficiency for typical dyes for ZnO is lower than for TiO₂. In this work, we present a novel nanomaterial for use in the dye-sensitized solar cell, combining the advantageous properties of both TiO₂ and ZnO. We used ZnO nanorods functionalized with TiO₂ nanoparticles as a substrate: dye adsorption and electron injection takes place mainly at the TiO₂ nanoparticles, while efficient electron collection is envisaged through the highly conductive ZnO nanorods.

00075

Synthesis and Luminescence Properties of Sulfonated Poly-{Styrene-co-Acrylic Acid}

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ABSTRACT

Since the discovery of organic electroluminescent devices (OLED) and in particular with the development of polymeric electroluminescent devices (PLED) efforts have expanded toward developing new materials and systems that include new polymers, copolymers or mixture of components. The use of polymer blends represents a less expensive approach to prepare materials for new polymeric electroluminescent (EL) devices with improved performance. Various copolymers have been prepared, aiming at achieving color tunability over the visible spectrum and tuning of the frontier levels energetic position in order to minimize (possibly eliminate) the anodic and cathodic injection barriers of LED structures. Here, we present the synthesis, characterization and properties of sulfonated poly-{styrene-co-acrylic acid}. The copolymers were prepared by mass polymerization employing different styrene acrylic acid ratios and sulfonated with concentrated sulfuric acid for 85 minutes. The materials were characterized by Fourier transform infrared spectroscopy (FTIR), thermal analysis by Differential scanning calorimetry (DSC) and Thermogravimetric analysis (TGA). Fluorescence (or photoluminescence) spectra, for both copolymers solutions and solid films, were obtained on a Spex Fluorog F112A spectrofluorimeter, by exciting the polymer samples at the wavelength corresponding to the absorption maximum (500 nm). Solution fluorescence quantum yields (or photoluminescence efficiencies, FPL) were calculated by the relative method, based on the comparison of the areas of the fluorescence spectra of a reference and of the sample. The fluorescence quantum yield were about 80% in chloroform solutions and 2,5% in solid state. In the presence of silver nanoparticles, the luminescent properties of sulfon

00076

DNA Gold Modified Electrodes for HPV Detection

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ABSTRACT

The human papillomavirus (HPV) is one of the most common sexually transmitted infections and some aggressive genetic HPV strains have been detected in virtually all invasive cervical cancers. The modification of the conductive surfaces for the purpose of immobilization of DNA has the finally goal of construct biosensors that can be used in the detection of variants of pathogens that cause infections. In this work the possibility to detect HPV using electrochemical techniques with impedimetric detection (label-free) was explored. As a working electrode was used a gold wire with of 0.5 mm of diameter that was electrochemically cleaned by cyclic voltammetry in 50 mM phosphate buffer + 100 mM K₂SO₄ pH 7.0. Gold electrodes were functionalized with a DNA probe which was designed as an oligonucleotide thiolated at 5' end, this oligonucleotide corresponds to the sense strand of the major capsid protein L1 of HPV. DNA probe was immobilized at a high ionic strength and then subsequently exposed to a mercaptohexanol solution. The modified electrodes were characterized by EIS using a solution of 2 mM K₄[Fe(CN)₆] + 2 mM K₃[Fe(CN)₆], the electrochemical impedance spectra was measured over the frequency range of 100 kHz to 100 mHz with a 10 mV a.c. voltage superimposed respect to the formal potential of the redox couple. The immobilization conditions were defined, then spectra were obtained before and after attaching DNA probe, and using the redox pair K₄[Fe(CN)₆] / K₃[Fe(CN)₆] the charge transference r

00077

Synthesis and Characterization of Pyrochlore and Perovskite Potassium Tantalates for Water Splitting

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ABSTRACT

Since the discovery in 1971 of the first artificial system for the water splitting, a large variety of inorganic materials that photo-decomposes water have been found. Among of them, alkali tantalates have shown a high catalytic activity in direct water splitting, where KTaO_3 seems to show the best relation between efficiency and stability, which appears to be related to its structural features. Beyond the development of new photocatalyst materials there is a general consensus about the necessity of gaining deeper understanding of the essential factors that modulate the photocatalytic activity of these materials. In the present work it's explored a systematic study on the solvothermal synthesis of potassium tantalates obtained from the forced hydrolysis of tantalum chloride in an organic solvent. The obtained products are characterized by UV-Vis spectroscopy, X-Ray diffraction, SEM and HRTEM. The water splitting process was characterized by measuring the generated gases under irradiation of solids dispersions prepared in distilled water with an UV-Vis light lamp. The results show that the product structure can be manipulated from pyrochlore to perovskite by modulating the water and potassium hydroxide concentrations. The hydrogen production efficiency is analyzed as function of the crystallographic phase, particle sizes and morphology.

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00078

Photocatalytic Hydrogen Evolution from Pure Water Using a New Sm₂GaTaO₇ Advanced Compound

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ABSTRACT

Overall water splitting to produce hydrogen over a semiconductor photocatalyst is a promising process for clean and sustainable hydrogen production. In this work, a new compound Sm₂GaTaO₇ was successfully synthesized by a conventional solid state reaction. NiO and RuO₂ nanoparticles were loaded as cocatalysts onto Sm₂GaTaO₇ surface. X-ray powder diffraction and Rietveld refinement characterization results revealed that Sm₂GaTaO₇ crystallized in the monoclinic system with space group C2/c. The energy band gap (E_g) was obtained using UV-Vis spectroscopy, and it was calculated by Kubelka-Munk formula. The result showed an E_g value of 4.6 eV. By scanning electron microscopy and nitrogen physisorption analysis, it was observed that material presents particle size around 2-3 μm and a specific surface area of 1m² g⁻¹. The photocatalytic activity for water splitting reaction was investigated and results were explained in terms of the physicochemical properties. The Sm₂GaTaO₇ compound showed good activity for hydrogen evolution from pure water. The hydrogen production activity was highly enhanced by using both cocatalysts.

00079

Electrochemical And Capacitive Properties Of Polyaniline Evaluated In H₂SO₄ And NaNO₃ Systems.

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ABSTRACT

Electrochemical capacitors (EC) are novel energy storage devices that possess high power density, exhibit excellent pulse charge/discharge property and very long life. The Polyaniline (PANI) is considered the most promising material in the supercapacitors due to its high capacitive characteristics, low cost and ease of synthesis. In this work we present a comparative study of charge storage in acid and neutral electrolytic systems 1M H₂SO₄ and 1M NaNO₃. The electrodes were prepared by electropolymerization of polyaniline (PANI) on the vitreous carbon. The surface morphology of electrodes was characterized by scanning electron microscopy (SEM) and atomic force morphology (AFM). The electrochemical properties of electrodes and the capacitive behavior of the electrodes were systematically studied using cyclic voltammetry (CV), ac impedance and constant current charge/discharge tests. It is important to mention that the specific capacitance of PANI electrodes is strongly influenced by the electrolytic system used and is manifested in the responses obtained.

00080

Graphene Oxide For Application In Supercapacitors No- Faradaic

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ABSTRACT

Graphene oxide was a precursor of graphene, which is the material with unique properties how electrical conductivity, thermal conductivity, mechanical etc. Nevertheless, graphene has attractive properties by energy storage due to your compatibility with different electrolytes. In the literature, have been reported different methods for the obtention of graphene oxide. However in this work, the synthesis of graphene oxide (GO) was realized by Hummer's modified method, this for be an obtention method great scale. The process of synthesis consist of four steps: 1.-Pre-thermal oxidation with oxygen flow, 2.- Chemical oxidation of precursors, 3.- Chemical oxidation for the obtainment of graphite oxide, 4.- Exfoliation of graphite oxide by ultrasonic to obtaining the sheets of graphene oxide (GO). For realize the characterization of GO, this was evaluated by SEM, EDAX and RAMAN. Also, the graphene oxide was evaluated electrochemically by voltammetry cyclic at different scanning rates at 5, 10, 20, 30 and 50 mV/s and limit potential of 0 to 1 V. For realize to the electrochemical characterization of material, this was deposited on carbon cloth electrode of 1 cm². Using two electrodes with graphene oxide and solid electrolyte was made an ensemble by hot press the supercapacitors. Supercapacitors were characterized by cyclic voltamperometry, galvanostatic charge-discharge and EIS.

00081

Development of Polymeric Enzymatic Electrodes for Ethanol Oxidation

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ABSTRACT

Enzymatic fuel cells are devices in which enzymes are located in the electrode in order to catalyze fuel oxidation. These biological catalysts, unlike inorganic ones, have the advantage of being selective, renewable and clean. The enzymes are supported onto an electronically conducting material, compatible with the enzymes, for example conductive polymers such as polypyrrole. In this project, polymeric anodes are prepared by immobilizing the enzyme alcohol dehydrogenase from *S. cerevisiae* in polypyrrole potentiostatically electrodeposited onto carbon paper. The applied enzymatic immobilization procedures are direct adsorption and crosslinking with glutaraldehyde. The characterization of electrodes is made by cyclic voltammetry using a phosphate buffer solution with ethanol and β -NAD⁺ as supporting electrolyte. Tests show that reversible ethanol oxidation and reduction occurs at around 0VSCE and that for the polypyrrole electrodes, recorded current values due to polymer oxidation and reduction are higher by two orders of magnitude than those recorded for ethanol oxidation in carbon enzyme electrodes. Furthermore, the polymeric enzymatic electrodes crosslinked with glutaraldehyde show higher current values than those with adsorbed enzyme, which reflects a better retention of the protein in the electrode. Also, electrodes with crosslinked enzyme preserve catalytic activity for longer than those with adsorbed enzyme. Spectrophotometric and fluorescence measurements are performed in order to determinate enzymatic activity and quantify protein, respectively. Fuel cell performance will be presented for an enzymatic direct ethanol fuel cell.

00082

Preparation and Study of Polymeric Catalysts for Electrolysis

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ABSTRACT

PEM (Proton Exchange Membrane) electrolyzers form an interesting alternative to produce hydrogen from water. Conventional catalysts for these systems are based on platinum and platinum-ruthenium supported on carbon. However, in these systems the carbon support is degraded under the anode operation conditions. In this work, we report on the preparation of electrocatalysts based on electroconductive polymers for PEM electrolyzer anodes, which is where the oxygen evolution reaction (OER) occurs, and where important losses of overpotential and problems in the durability may be expected. Specifically, catalysts based on polythiophene and poly(3-methyl)thiophene, as well as their modifications with Co and/ or Pt, are prepared and studied. The samples are characterized physicochemically (FTIR, SEM, AFM) to determine their morphology and composition, and electrochemically (CV and potentiostatic tests) to determine their electrocatalytic activity, the oxidation and reduction potentials and electrochemical stability, in order to show the viability of application of these materials at the PEM electrolysis anode.

00083

**Design and Construction of a Demonstrative Hybrid System Consisting of a Solar Panel, a Stack of
Regenerative PEM Fuel Cells and Supercapacitors**

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ABSTRACT

The continuous search of improvements for the different systems and processes of clean energy generation have led to the development of techniques with improved production efficiency and electrical energy storage. Some examples are represented by regenerative fuel cells and supercapacitors. In this work, we report on a small-scale hybrid prototype, which uses sunlight through a photovoltaic panel to provide electricity (2.3 V) to a regenerative fuel cell stack and also to a bank of supercapacitors. This allows to perform the process of water electrolysis in order to generate the reactive gases (H_2 and O_2) that will be stored in small tanks (51.46 cm³ and 17.15 cm³, respectively). In fuel cell mode, these gases are fed to the regenerative cell in order to produce electrical energy, which may be increased for short times by energy stored in the supercapacitors. The electrical energy is sent to a DC motor which allows for the movement of a small car (1.2 kg). The supercapacitors supply power to the motor (1.6 V) at the moment of start when the fuel cell is not able to provide sufficient energy for initial movement. The supercapacitors are rapidly discharged (about 10 s) by the motor, and operating depends on the fuel cells (1.35 V) until completion of the stored hydrogen. The fuel cells and supercapacitors were also prepared in our laboratory. The fuel cell stack was integrated by two membrane-electrode assemblies (MEA) of 4 cm² active area, we applied ink loading by drop method using Pt/Ru catalyst for the cathode and Pt catalyst for the anode. The supercapacitors electrodes were prepared as 50 mg tablets containing mesoporous carbon, binder and synthetic coal, and a liquid electrolyte of sulfuric acid is used.

00084

Experimental and theoretical studies of Cu/Ni-base catalysts for H₂ generation

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ABSTRACT

Cu and Ni were supported on ZrO₂ by co-impregnation and sequential impregnation methods, and tested in the oxidative steam reforming of methanol (OSRM) reaction for H₂ production as a function of temperature. Surface area of the catalysts showed differences as a function of the order in which the metals were added to zirconia. Among them, the Cu/ZrO₂ catalyst had the lowest surface area. XRD patterns of the bimetallic catalysts did not show diffraction peaks of the Cu, Ni or bimetallic Cu-Ni alloys. In addition, TPR profiles of the bimetallic catalysts had the lowest reduction temperature compared with the monometallic samples. The reactivity of the catalysts in the range of 250-350 °C showed that the bimetallic samples prepared by successive impregnation had highest catalytic activity among all the catalysts studied. These results were also confirmed by theoretical calculations. The reactivity of the monometallic and bimetallic structures obtained by molecular simulation followed the next order: NishellCu_{core}/ZrO₂ > CushellNi_{core}/ZrO₂ > Ni/Cu/ZrO₂ > Cu/Ni/ZrO₂ > Cu-Ni/ZrO₂ > Cu/ZrO₂ > Ni/ZrO₂. These findings agree with the experimental results, indicating that the bimetallic catalysts prepared by successive impregnation show a higher reactivity than the Cu-Ni system obtained by co-impregnation. In addition, the selectivity for H₂ production was higher on these catalysts. This result could be associated also to the presence of the bimetallic Cu-Ni and core-shell Ni/Cu nanoparticles on the catalysts, as was evidenced by TEM/EDX analysis, suggesting that the OSRM reaction may be a structure-sensitive reaction.

00085

Synthesis of NaTaO₃ by a new solvo-combustion method and its hydrogen production photoactivity

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ABSTRACT

Significant attention has been paid on the photocatalytic production of hydrogen from water by using semiconductors. The NaTaO₃ has been regarded as one of the most promising material for water splitting, since it has shown remarkable water splitting activity due to its high potential to generate charge carriers by absorbing the photons energy. This work reports for the first time the NaTaO₃ synthesized through a new solvo-combustion method, in this case the acetylacetone was used as template and fuel for the combustion reaction. The DRX analysis results showed that NaTaO₃ phase could be obtained from the as-grown material. The SEM micrographs revealed that NaTaO₃ has hierarchical cubic morphology in the nanometer level. The materials possess a high specific surface area around 50-90 m²g⁻¹, which is one of the highest reached when compared to other synthesis methods. The UV-visible analysis shows a band gap value (E_g) close to 3.9 eV. The material exhibited attractive photocatalytic activity for water splitting reaction to produce hydrogen. An enhanced of the hydrogen production was obtained by annealing the material at 600 °C from 418 to 644 μmol, because of the higher crystallinity degree.

00086

**Unsupported Pt-Ru-Ir And Pt-Ir As Bi-Functional Catalyst For Reduction Oxygen And Oxygen Evolution
Reactions In Acid Media**

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ABSTRACT

Unitized Regenerative Fuel Cell (URFC) is an electrochemical cell that works as polymer electrolyte fuel cell and a polymer electrolyte water electrolyzer into the same unit. The structure and composition of electrocatalytic layers in URFCs are of particular importance and strongly impact current/voltage performances and cell efficiencies. Electrocatalysts materials used for Oxygen Reduction Reaction (ORR) have demonstrated low activity for Oxygen Evolution Reaction (OER) and some of them apply for OER have poor ORR performance. In order to improve this activity for these reactions it possible to use Pt-Ru-Ir and Pt-Ir alloys. These alloys were studied in acid media for Reduction Oxygen (RRO) and Oxygen Evolution Reactions (OER). The materials were prepared by NaBH₄ chemical reduction and characterized by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray (EDX) and Transmission Electron Microscopy (TEM). The Ruthenium was added in Pt-Ir mixture in order to make a solid solution formation. Kinetic electrochemical analysis of catalyst was studied by Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV) and Rotating Disk Electrode (RDE) techniques. All electrochemical analysis was carried out in 0.5 M of H₂SO₄ in a three electrode cell at 30°C. CV technique results on Pt-Ru-Ir catalyst showed a potential shifting for ORR. RDE technique data showed that both catalysts carried out by four electrons reduction path ($O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$). Pt-Ir catalyst showed a better electrochemical behavior for ORR and Pt-Ru-Ir for OER.

00087

Nanostructured Ferrite as Photocatalysts for H₂ Generation from Water Splitting and Sunlight

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ABSTRACT

Materials with higher efficiency and activated under the sunlight spectrum (band gap energy from 1.5 to 3.0eV) are today's trends in newer photocatalysts for the hydrogen generation. The aim of the present study is to investigate alternative semiconductor materials to titanium dioxide for the generation of hydrogen with band gap energy values lower than that of TiO₂ (<3.2eV). Examples of these are some transition metal ferrites such as CuFe₂O₄, CoFe₂O₄ and NiFe₂O₄. These ferrites were prepared by co-precipitation and heat treatment. Characterization was performed by XRD, BET, SEM, TEM and UV-Vis spectroscopy. Photocatalytic activity evaluation of the materials for hydrogen generation from water splitting under visible light was followed by gas chromatography. Results indicate that these materials showed corresponding spinel crystalline phases and nanometer particle sizes. Photocatalytic evaluation of these ferrites under visible light showed H₂ yields up to 10.8 mmol/gcat. These yields compared with those reported in the literature indicate that these materials can be considered as promising photocatalysts for hydrogen generation.

00088

Hydrogen Production by Steam Reforming of Ethanol over a Ru/Al₂O₃ Catalyst

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ABSTRACT

The present work aims the evaluation of a ruthenium catalyst supported on alumina (Ru/Al₂O₃) in the reforming of ethanol for the production of hydrogen. The selection of a suitable synthesis method, support and appropriate reagents proportions, play a major role in the catalyst performance within this reaction. Catalyst was synthesized by the incipient impregnation method from a solution of Ruthenium (III) chloride hydrate to get a loading of 10% W, and deposited on γ -alumina as support. The catalyst was characterized by: X-ray diffraction (XRD), surface area (BET), scanning electron microscopy (SEM) and a thermogravimetric analysis (TGA). The evaluation of the catalyst was carried out using a bench-scale fixed bed reactor system for the reforming of ethanol and reaction product compositions followed by gas chromatography. Preliminary results indicate that catalyst selectivity was highly dependent on reaction temperature, steam to ethanol ratio and space velocity for the production of a high content hydrogen gas product accompanied with low carbon deposition on the catalyst surface.

00090

Hydrogen Storage in Nanocomposite Materials of Polyaniline, Carbon Nanotubes and Titanium

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ABSTRACT

One of the remaining challenges to achieve the implementation of hydrogen technology is hydrogen storage, since due to its molecule size and low energy density per volume special systems or alloys are required. One alternative is the storage in solids, for example metal hydrides. In this project, we are studying the storage of hydrogen in composites of electroconductive polymer and nanoporous materials, specifically polyaniline, titanium and/or carbon nanotubes. Such nanostructured materials have large surface area, are microporosity and may reversibly store hydrogen in its molecular state through weak bonds of the molecules onto the surface. In the first part of this project polyaniline synthesis is performed. Polyaniline is a nanoporous polymeric material, and due to its high specific surface area and microporosity, allows for hydrogen storage by physisorption, provoking an optimal interaction of the adsorbate with the adsorbent walls and interaction of Van der Waals forces. Subsequently it is intended to further increase the pore structure of the nanocomposite, adding carbon nanotubes to the material to provide more bounding sites and consequently increasing the hydrogen storage capacity. Titanium compounds may be used to further modify the materials. For the characterization of the nanocomposites and their modifications, electrochemical techniques such as cyclic voltammetry will be used and morphological characterization will be performed by scanning electron microscopy and atomic force microscopy. To determine the hydrogen storage, thermogravimetry will be used in different temperatures and pressures, in order to quantify the amount of hydrogen absorbed by the material and its ability to desorb it. Only the initial results of the characterizations are presented.

00091

Development of a Low Power Backup System for Technology Demonstration

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ABSTRACT

This work presents the development of a low power backup system through the integration of a prototype based on hydrogen in-house PEMFC technology. The prototype consists of a homemade 20 cells stack of 25 cm² of geometrical active area, a power conditioning circuit with open loop control for the stack's cooling system and its air supply. The work also includes performance characterization of the stack alone, including polarization curves and stability during operation for balance of plant determination. The polarization curve showed an open circuit voltage of 17.8 V and a limit current of 11.6 A at 6.54 V. The power curve shows an output 90.5W as maximum power delivered. Additionally, fuel cell current and voltage output were monitored during operation when the system was connected to a load (Acer laptop model One D255e). Such data are discussed in relation to the systems performance.

00092

Scooters electric motor characterization and the sizing of a PEMFC power plant required for its operation

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ABSTRACT

The development of power plant prototypes based on PEMFC's for a particular application has important technical and economical impacts on the practical implementation of this technology. In this study, the characterization of an electric motor of an E-Z rider model Scooter was performed aiming at determining the load and therefore, the power demand required under specific operating conditions: no-load, with load and during sudden full stop breaking due to overload conditions. The characterization was performed under two operating modes, i.e. low and high speed modes. Results show that the minimum power required for the low speed, no load operation is 48 W, while maximum power reaches 84 W for operation at high speed with load. Also, maximum power during sudden breaking was limited to 84 W as the Scooter's control system allows for a maximum consumption of 7A at 12V. The second part of the work presents the methodology used for dimensioning a fuel cell stack that will provide the power for the motor to fulfill load requirements. Simple calculations are based on polarization curves of a 90.5 W fuel cell stack. Accordingly, a 50cm² area and 20 cell stack can provide 84W of power plus a 20% extra power for auxiliaries required in the power system. To maintain higher efficiencies in the conversion of hydrogen while meeting power requirements, it was established that 0.615V per cell at an operating current density of 0.16A/cm² fuel cell stack is adequate for the application.

00093

**Development And Application Of Pt Black- Pt/IrO₂ As
Bifunctional Catalyst For URFC's**

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ABSTRACT

A Unitized Regenerative Fuel Cell or URFC is an electrochemical device that functions both as a fuel cell as well as an electrolyzer. In electrolyzer mode, it uses electricity to generate hydrogen and oxygen through the electrolysis of water. In fuel cell mode, the system generates electrical energy by the direct, electrochemical conversion of the chemical energy of the fuel (hydrogen). One of the main issues for URFC development is the preparation of stable electrocatalysts and support materials, since conventional carbon black, used as catalyst support in PEM fuel cells, is not suitable for the URFC, due to corrosion at high voltage in electrolyzer mode. In this study we intend to improve URFC efficiency by the application of bifunctional supported electrocatalysts. For the oxygen electrode, Pt black and iridium oxides are used, combining the properties of both catalysts and increasing the performance of the oxygen reactions. For the hydrogen electrode, platinum black only is used. IrO₂ synthesis was performed by the chemical reduction of an iridium salt (H₂IrCl₆) with sodium hydroxide (NaOH). Platinum black was synthesized by chemical reaction of chloroplatinic acid (H₂PtCl₆) with sodium nitrate (NaNO₃). Pt was supported onto synthesized IrO₂ by reduction of H₂PtCl₆ with sodium borohydride (NaBH₄). Finally a mixture was prepared of Pt black:Pt/IrO₂ at a ratio of 1:1. Cyclic voltammetry is being used to characterize the prepared materials, while SEM and EDX allow to determine morphology and elemental composition. Materials will be applied in a URFC of our own design to study performance.

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00E11

Design, Manufacture And Evaluation Of A 250W PEM Fuel Cell Stack

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ABSTRACT

The interest of this work is to build and develop an Eco friendly device from the renewable energy sources. In order to achieve our goal, we construct a hydrogen-oxygen fuelled 250W PEM fuel cell stack. The stack were designed and constructed on high density carbon with the aid of Auto CAD software and CNC router. Later on the stack was evaluated following a potentiostatic polarization perturbation with a fuel cell tests station. The operation conditions of a fuel cell stack was maintained by feeding the fuel (H₂) and oxidant (air) at room temperature and a pressure of 0.1 atm (1.5psi). Operating temperature was varied from 20 °C to 70 °C with gases at 100%RH. Experimental results reveal that a constant production of 250 W was achieved. Also in this work the auxiliary systems for the operation of the fuel cell stack is presented.

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00E12

Feasibility Study To Use Hydrogen As Alternate Source Of Energy In Mexico.

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ABSTRACT

Mexican hydrogen industry currently produces 500,000 tons of hydrogen per year. Hydrogen is primarily used as a feedstock, intermediate chemical, or specialty chemical in: chemical production, petroleum refining, metal treating, electronic applications, and food and soap/detergent industries. The principal method of hydrogen production is steam methane reforming (SMR). Other methods include: gasification of fossil fuels, partial oxidation and water electrolysis. Some of the produced hydrogen could be used like alternative energy source. United States, Spain and Germany already use it like fuel, this hydrogen is mainly produced by SMR, however there are also projects focus to produce hydrogen from electrolysis method coupling renewable energies sources (solar energy, wind power, wave energy, etc). In Mexico, SMR is also the main process to obtain hydrogen, 98%, nevertheless Mexichem Plant and Quimikao Plant (where hydrogen is a by-product of Sodium Hypochlorite Process and feedstock to fats hydrogenations respectively) are planning use the hydrogen as fuel, they have a projects where the hydrogen is a potential energetic to reduce energy spending of grid from CFE through fuel cells use, decreasing the energy from the second consumer of electricity in Jalisco. Exist production potential of hydrogen in the country; the SMH is working to incorporate into Mexican Legislation the hydrogen as alternative source of energy in

00E13

**Microwave Assisted Polyol Synthesis of Nano-sized Pt and PtCr-based Electrocatalysts on Oxygen Reduction
Reaction for PEM Fuel Cells**

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ABSTRACT

The goal of this study is to enhance the electrocatalytic activity of the PtCr-based cathode catalysts synthesized via microwave assisted polyol process. The electrochemical techniques considered were cyclic voltammetry and steady state polarization, which were made using the standard rotating ring/disk electrode (RRDE). In order to evaluate the contribution of the formation of hydrogen peroxide during the reduction process, rotating ring disc measurements were carried out with a glass carbon disc electrode loaded with 6µg ink, and a ring platinum electrode polarized at 1.2V vs RHE[1,3].

The behaviour of the ring response clearly denotes the formation of H₂O₂ between 0.50 < E < 0.80V during the ORR. In the low potential region the O₂ reduction currents on the disc electrode are accompanied quantitatively by the H₂O₂ oxidation currents on the ring electrode, reaching maximum peroxide production at 0.25V. The fraction of H₂O₂ calculate related to the each catalyst[4,5].

Electrocatalyst synthesized were characterized by using X-ray diffraction (XRD) and high resolution transmission electron microscopy (HR-TEM). The average metal diameters were about 2.02 nm for Pt and 2.14 nm for PtCr (3:1).

00E14

Life Cycle Assessment of Solar Selective Surfaces Produced by Continuous Electrochemical Process from Cradle to Grave

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ABSTRACT

The need to strengthen the “green market” has been successively confirmed in another official document named “the green paper on Integrated Product Policy - IPP”. For IPP to be effective, life-cycle assessment (LCA) represents an important support tool. LCA, also known as life-cycle analysis, eco-balance, and cradle-to-grave analysis is a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).

In this study, energy and the environmental performances of the solar selective surface prototype plant in SELEKTİF TEKNOLOJİ Co. Inc. Ltd. is analysed. The new production process is continuous electrochemical process and differs from the conventional batch systems in the respect. To obtain reliable results, data is collected and managed following international ISO 14040 and 14044 standard procedures.

The aim is to trace the SELEKTİF's eco-profile that synthesises the main energy and environmental impacts related to the whole product's life cycle. Compiling an inventory of relevant energy and material inputs, environmental releases and evaluating the potential impacts associated with identified inputs and releases, the results are interpreted to make a more informed decision in mass production plant.

00E15

Towards the understanding and controlling of the photo-deposition of metal nanoparticles on oxides

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ABSTRACT

The photo-deposition technique has proven to be a very efficient way to support selectively Pt nanoparticles on TiO_2 using UV light [1], allowing thus the increase of the electrocatalytic activity of Pt towards the oxygen reduction reaction [2]. This is done via a metal support interaction (MSI) produced by Pt-Ti nanoalloying [3]. However, its mechanism is not well understood and the photo-deposition technique is not yet accurately controlled. Herein, we report an *in-situ* study of the photo-deposition process of Pt nanoparticles onto TiO_2 using aqueous solution containing $[\text{PtCl}_6]^{-2}$ ions, TiO_2 generated via sol-gel, and small organics illuminated for 3h with UV-Vis radiation. A xenon lamp was used as source of photons. By measuring the absorbance in the Vis-region that passed through the solution, we were able to monitor, in real time, the photo-deposition process. The reduction of the $[\text{PtCl}_6]^{-2}$ in H_2O does not take place under UV-Vis irradiation. The presence of TiO_2 , in the solution, induces the photo-deposition at a very slow rate. The size of Pt particles and their distribution on TiO_2 , were studied by TEM. With the presence of hole-scavengers, such as, methanol, ethanol, isopropanol, or acetone, the nucleation of $[\text{PtCl}_6]^{-2}$ starts abruptly at a certain time of the process. This is determined by C-chain length. Indeed, the e^-/h^+ pairs generated at the TiO_2 under UV illumination, increases as the C-chain is longer. It shows that two mechanisms of platinum deposition compete and contribute to the entire process.

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00E16

Effect of the Selection of Material on the Electric Power Generation and Costs PEMFC Experimental Designs.

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ABSTRACT

PEMFC technology is considered in several studies as a development applicable to portable and transport services, however its application in stationary has been widely questioned as a viable proposition. In this paper a comparative study of costs FEL type 1 by applying an integrated approach to determine the cost of technology, the total investment cost + / - 50% to 20 year life for three structural designs PEMFC H₂-Air and the present values and annual future. The prototypes for the design basis are experimental and are scaled to a steady domestic service. Operating costs are estimated considering the consumption of hydrogen from a material balance and is also developing an estimate of the cost of producing electricity for these cases finally compared to the cost of energy is usually considered in studies of cost. The results show the effect of the costs of materials selected for PEMFC assembly on investment costs and operating costs, the effect is also observed on the cost of production when applied pressure below 10 psi in the cathode compartment without but at pressures greater than the cost of production is influenced in combination between the efficiency of assembly and the cost of materials. Production costs do not preclude the application obtained from the PEMFC technology in stationary services.

00E17

**Theoretical studies of Sulfonated Poly (ether-imide): A Promising Material for Proton Exchange Membranes
in fuel cells**

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ABSTRACT

Polymers based on Poly (ether-imide) (PEI) with $(-\text{SO}_3\text{H})_n$ ($n=1-6$) groups were built to carried out theoretical studies by methods of Density Functional Theory (DFT), molecular mechanics and dynamics. The results of geometry optimization in conjunction with ones Raman and Infrared spectroscopy indicated that these polymers have excellent thermal stability. Besides in this study, structural properties, thermal properties, ion exchange capacity, water uptake, and molecular interactions were calculated for comparison with other polymers. The comparative study demonstrates that the Poly (ether-imide) with $-\text{SO}_3\text{H}$ groups exhibit good overall properties for proton exchange membranes in fuel cells.

**9th International Symposium on New Materials and Nano-Materials for
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00E18

Evaluation of nano-sized Pd@Pt core-shell electrocatalysts as ORR cathodes for fuel cell applications

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ABSTRACT

The catalytic activity of Pd@Pt core-shell nanostructures for the oxygen reduction reaction (ORR) in acid medium was evaluated in this work. The core materials were prepared using three stirring methods: magnetic, mechanical and sonochemical (MS, UT and USS, respectively). Then, the Pt shell was deposited by the UT method. The XRD characterization showed the formation of crystalline nanostructures in all cases, even though the materials were synthesized by the rapid sequential reduction of the core and the shell precursors (60 s for each step). Average particle sizes of 6-8 nm were calculated from XRD analysis. The Pd@Pt cathodes demonstrated higher specific and mass activities than Pt-alone nanoparticles for the ORR. A comparison of the effect of the stirring method on the electrochemical behavior of the Pd@Pt nanomaterials showed that similar performances were obtained during the ORR, suggesting that MS, UT and USS are highly efficient techniques for the preparation of core-shell cathodes.

00E19

Fast synthesis of M@Pt (M=Ru, Pd, Fe₃O₄) core-shell nanostructures and their evaluation as anodes for the oxidation of ethanol

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ABSTRACT

We report the fast synthesis and electrochemical evaluation of M@Pt core-shell nanostructures (where M=Ru, Pd, Fe₃O₄) for the ethanol oxidation reaction (EOR). Separately, the chemical precursor of each core material was synthesized in NaBH₄ in a reduction time of 60 s. The Pt shell was deposited afterwards on the cores also in 60 s using the same reducing agent. Pt-alone nanoparticles were synthesized in one minute as well for comparison purposes. The XRD results indicate that crystalline materials can be obtained with this rapid process. The average particle sizes of the core-shell nanostructures, determined with the Scherrer equation, were in the 6-8 nm range for the nanomaterials. The electrochemical evaluation revealed a higher catalytic activity of the Ru@Pt material for the EOR, compared to Pd@Pt, Fe₃O₄@Pt and Pt-alone. Durability tests performed on the Ru@Pt anode indicated a high stability of this anode in acid medium.

00E20

Synthesis of unsupported Pt-based electrocatalysts and evaluation of their catalytic activity for the ethylene glycol oxidation reaction

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ABSTRACT

Pt, Pt-Ru, Pt-CeO₂ and (Pt-Ru)CeO₂ electrocatalysts were synthesized and evaluated as anodes for the ethylene glycol oxidation reaction (EGOR). The nanomaterials were prepared by slowly dropping the precursors in a NaBH₄ solution, in a reduction process of 10 min. The results from the electrochemical characterization of the anodes, carried out in 0.5 M H₂SO₄, showed that the Pt-Ru material possess a higher catalytic activity for the EGOR, compared to Pt-alone, Pt-CeO₂ and (Pt-Ru)-CeO₂. The nano-sized Pt-Ru anode demonstrated a high stability in accelerated potential cycling tests, with very low surface losses in the hydrogen adsorption/desorption region after 500 cycles.

00E21

Integration of solar-hydrogen technologies for sustainable housing

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ABSTRACT

The continuous and accelerated growth of population has brought an increase in the energy demand for the production of goods and services. This has caused at the same time high cost environmental as well as economic troubles such as global warming and increase in electricity costs. These issues generated international actions to mitigate the consequences due to fossil fuels overexploitation; Mexico participates in these actions so it is promoting projects fostering environment care, such as the proposal described in this work, aimed to develop sustainable systems through the integration of technologies related to renewable energy sources.

In Mexico, greenhouse gas emissions are mainly due to the transport sector and electrical industry. Regarding the last sector, electrical power consumption per household is around 33%. Electrical service users are classified according to power consumption as established by the Electric Federal Commission, CFE. Lamps and fridges are the most used energy consuming households reaching around 50% of total consumption. These devices are commonly used in most houses during the day. TV and DVD's are other appliances used in most Mexican houses, representing a 25% of power consumption.

In this work a sustainable house was designed to be powered by a solar-hydrogen system. The whole project was divided in three stages; the first stage consists in setting up a photovoltaic system; in the second one, the integration of an electrolysis and hydrogen storage system to the solar system will be carried out. The third stage corresponds to the integration of a fuel cell system. In this work, we report the installation of a 1 kW PV system consisting of: two 540 W Si solar panels, controller, inverter and a set of batteries to supply power to basic services, such as lamps, fridge, TV, DVD and a laptop. We analyze the performance of the PV system regarding the power supply and consumption to the house.

00E22

Hydrogen adsorption in isorecticular MOF

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ABSTRACT

Hydrogen fuel is considered a promising alternative energy source due to its clean combustion and high gravimetric energy density. However, hydrogen has an important disadvantage: its storage. Attempting to solve this problem, many materials, such as metal hydrides and carbon-based materials have been synthesized. MOFs materials have attracted much attention because of their relatively simple and economic synthesis, large storage capacity (1.32 wt% hydrogen was reported at 1 bar and 77 K), and high thermal stability up to 400 °C.

MOFs are a recently identified class of porous polymeric materials, which structure depends on the metal center and on the organic linker. MOF-5 was the first studied MOF for H₂ adsorption, presenting 4.5 wt% (at 78 K and 20 bar) adsorption capacity. The cubic structure of MOF-5 is characterized by having a Fm-3m crystalline group, a 25.85 Å a₀ parameter and a free pore access of 11.2 Å. Other MOFs with the same structure as MOF-5, but larger pore size (isorecticular structures) have been synthesized, by varying the organic linker. These isorecticular structures present even higher hydrogen adsorption.

In this work, results of the hydrogen adsorption by four isorecticular MOF, synthesized with different organic linkers, are presented. The MOFs studied correspond to MOF-5 (Zn₄O[(OOC)₂C₆H₄]₃), IRMOF-3 (Zn₄O[(OOC)₂C₆H₃NH₂]₃), IRMOF-9 (Zn₄O[(OOC)₂(C₆H₄)₂]₃) and a novel structure, built from zinc metal centers and a trifenildicarboxylate type linker, functionalized with amine groups. The solids obtained were characterized by XRD, IR, TGA and N₂ adsorption techniques. H₂ adsorption was carried out at 77 K and 1 atm.

00E23

Synthesis of Ag/Pt-Pd Core/Shell Nanoparticles and Their Electrocatalytic Properties towards the Oxygen Reduction Reaction.

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ABSTRACT

A two-step procedure was used for the preparation of Ag/Pt-Pd core/shell nanoparticles. First, Ag particles were formed and then the Pt-Pd shells, this last step was carried out by deposition of Pt and Pd on the colloidal Ag using sonication. During the characterization of Ag colloidal a plasmon band around 400 nm was observed that it is characteristic of Ag particle size in the range of 10-15nm. The measurements with dynamic light scattering (DLS) indicated that the average particle size was of 15nm which confirms the previous UV-Vis observation. XRD and UV-Vis spectroscopy were used to characterize the core-shell structures. The electrocatalytic properties for the oxygen reduction reaction (ORR) were studied in 0.5M H₂SO₄ solution using the cyclic voltammetry (CV) and thin-film rotating disk electrode (TF-RDE) techniques. The cyclic voltammograms for the Ag/Pt-Pd core-shell nanoparticles were compared with those of a Pt-Pd alloy without silver, both of them were very similar. The CV characteristic peaks of silver were not observed even that this is a *highly sensitive technique* for detecting small amounts of electroactive metals as silver. This last suggest that the silver nanoparticles were completely covered with the Pd-Pt alloy forming core-shell structures that it is consistent with the XRD and UV-Vis results. The results of TF-RDE show that the Ag/Pt-Pd electrocatalyst exhibits a higher catalytic activity than pure Pt for the ORR. The obtained results indicate that a high performance in PEMFC's of the novel Ag/Pt-Pd core-shell electrocatalyst could be expected, so the Pt requirement could be considerably diminished and therefore the cost in comparison with pure platinum catalysts.

00E24

Effects on Nafion® 117 membrane using different types of strong acids in various concentrations.

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ABSTRACT

This study proposes a pre-treatment to Nafion® 117 membrane with different acids in various concentrations. The objective is to increase the membrane hydration, which is determined by the amount of water molecules it incorporates. It is well known that the membrane hydration directly affects its conductivity. Even though many studies were published regarding this issue, none of them explains the procedure in detail, justifying the election of a particular acid in a determined concentration; in addition, Perchloric acid is also studied.

Our work was developed using five strong acids treatments -Nitric, Sulphuric, Perchloric, Phosphoric and Hydrochloric acid- in six different concentrations -0.025 M, 0.05 M, 0.25 M, 0.5 M, 0.75 M and 1 M.

Analyzing the results after an exhaustive study, the membrane shows a similar behaviour when it is treated with different strong acids, incorporating between 16 to 21 molecules of water depending on the concentration of the acid that was chosen. The effect of the different concentrations is remarkable, which leads to the conclusion that the best treatment is to use solutions 0.025 M and 0.05 M (twenty times more diluted than the other concentrations tested in the experience).

Another effect to be taken into account when the Membrane Electrode Assembly (MEA) is joined in a following step, is the fact that after membrane hydration its size increases by 10 percent (average).

00E25

C-TiO₂ and C-ZrO₂ composite supports for Pt electrocatalyst to evaluate in ethanol anodic oxidation

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ABSTRACT

The commercial application of Direct Ethanol Fuel Cells (DEFC) devices has been limited because of the poor Pt tolerance to the intermediate species formed in the complex mechanism of the ethanol oxidation reaction. Bimetallic and multimetallic active phases have been extensively studied in the last decades, however, the catalyst activity is still insufficient. As alternative, the support modification could upset the interaction between both the intermediate species and Pt sites. In this work C-TiO₂ and C-ZrO₂ supports were synthesized using 5, 23, 50 and 100 wt % of TiO₂ or ZrO₂. The prepared materials were characterized by N₂ adsorption-desorption, XRD, SEM, DRS-UV-VIS, Cyclic Voltammetry and Electrochemical Impedance Spectroscopy. With the exception of TiO₂ support, all samples presented macroporous with a bi-modal pore distribution ranging from 1500 to 2000 Å; TiO₂ support shows a mesoporous behavior and C-TiO₂ (5%) support showed the largest area, 277 m²/g, close to that of vulcan carbon XC72R (322 m²/g). Electrochemical analysis showed that Pt/C-ZrO₂(5%) and Pt/C-TiO₂(5%) were the synthesized materials with higher active areas.

00E26

Design of bipolar plates for a PEM electrolysis cell

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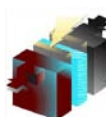
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ABSTRACT

Hydrogen demand will increase in the near future due to the development of different energy conversion technologies like fuel cells or new internal combustion engines. Water PEM electrolyzers are devices capable of produce hydrogen with a high purity and one of its important components are the water distributor plates, which are called end plates and bipolar plates in a multiple cells configuration stack. Its primary functions are: distribute the water evenly over of the electrodes surface, connecting the cells electrically in series, to separate water from adjacent cells and provide a support structure to the stack. Bipolar plates performance is affected by architecture of the flow channel fields, because it could exists stagnant zones generating pressure and speed losses. Produced hydrogen bubbles can be trapped in the channels and this would reduce the contact reactive area and therefore, a loss in PEM-WE efficiency. This work focus in the flow channels fields design for a PEMWE-bipolar plate. Several prototypes are simulated in ANSYS FLUENT 12.0 solving through of the finite element method the pressure drops, loss of speed, and the evacuation of the gases generated from the electrochemical reactions.



00E27

**Desarrollo Y Aplicación De Membranas Híbridas Por El Proceso Sol – Gel Para El Enriquecimiento De
Metano En Un Biodigestor Anaerobio**

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ABSTRACT

Dentro de los aspectos clave para toda sociedad, se encuentran las fuentes de energía. Actualmente la investigación se enfoca en la producción y uso de los llamados biocombustibles, como el biogás.

Este biogás se produce a partir de diversos residuos orgánicos, hecho que genera una alternativa al uso de los diferentes desechos orgánicos, con una consecuencia positiva al medio ambiente. La producción de biogás se realiza normalmente en biodigestores anaerobios a partir de la descomposición de la materia orgánica por medio de bacterias. Sin embargo en la producción de biogás (compuesto principalmente de metano), se producen otros gases no deseables como nitrógeno, CO₂ y compuestos sulfurados; por lo que para enriquecerlo es importante reducir el contenido de estos gases. En nuestro grupo de investigación se trabaja en el desarrollo de membranas, que permitan incrementar el contenido de metano e hidrógeno en el biogás y disminuir la concentración de los otros gases.

En el presente trabajo, se muestran los resultados obtenidos en membranas híbridas sílice-polímero, producidas por sol-gel, de porosidad variada dependiendo del tipo de solvente usado, con tratamiento térmico de consolidación a bajas temperaturas (100°C). Posteriormente se diseñó y construyó un dispositivo que permitió poner a prueba las membranas; para ello se utilizaron gases puros a presiones bajas simulando las condiciones de los gases obtenidos en un biodigestor. Los resultados de las pruebas mostraron que el orden de difusión es: H₂, CH₄, N₂ y CO₂. Encontrándose que para la membrana con 35% de sílice, el CO₂ saturó los poros teniendo de esta manera un incremento en la eficiencia durante la separación de los gases. A partir de los resultados, se está diseñando un dispositivo para integrar las membranas a un biodigestor piloto para realizar las pruebas *in situ* y obtener de esta manera el enriquecimiento del biogás que pueda ser utilizado para generación de calor y energía por otros dispositivos.



00E28

Study of the Ni/WO_x-Hydrotalcite catalysts to produce hydrogen by ethanol steam reforming

(Analysis of the catalyst structure)

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ABSTRACT

The effect of WO_x over Ni-hydrotalcite catalysts to produce H₂ by ethanol steam reforming was studied. The catalysts were characterized by N₂ physisorption (BET area), X-ray diffraction, Infrared and UV-vis spectroscopies. The W concentration ranged from 0.5 to 3 wt%. As W concentration increased, the intensity of XRD reflections of the Ni catalysts decreased. The porous structure of the materials consisted of parallel layers with a monomodal mesoporous distribution. The surface groups detected by IR were: -OH, Al-OH, Mg-OH, W=O and CO₃²⁻. UV-vis results suggested that Ni²⁺ ions were substituted by W ions. The catalytic evaluations were made in a fixed bed reactor using a water/ethanol mol ratio of 4 at 450°C. Catalysts with low loadings of W (0.5 and 1%) showed the highest H₂ production and stability. W promoted the conversion of ethanol towards hydrogen in the case of the Ni-hydrotalcite catalysts. The reaction products were; H₂, CO₂, CH₃CHO, CH₄ and C₂H₄. The catalysts did not produce CO. The addition of 0.5 wt % W increased the selectivity to H₂ and the conversion, with the selectivity being the highest for the catalyst with 1 wt%. Experimental and calculated equilibrium mole fractions of H₂ were close for the Ni-hydrotalcite catalysts studied. The catalyst with the lowest W concentration was more stable than the catalyst without W. Catalysts with W concentrations higher than 0.5 wt% W did not show a promotion effect during long time-on-stream tests. These catalysts, having basic sites on their surface have showed good conversion and H₂ selectivity using other type of metals instead of Ni.



00E29

Decentralized Energy Planning Using Multicriteria Methods

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ABSTRACT

Traditionally, the planning of rural electrification in the developing countries has taken into account technical and economic criteria. So far, the environmental and social aspects have been considered very little. Consequently, a coherent and appropriate power supply planning is required to facilitate the access to electricity. To do this, Multi-criteria Decision Making (MCDM) approaches, emerge as well suited options for such purposes. This work applies Analytical Hierarchy Process (AHP) and a comprehensive VIKOR method for evaluate the best compromise solution that satisfies the electricity requirements from a rural-remote population located in the Venezuelan Andean region (35 houses, one school and a medical dispensary). The work considers three configurations for electricity supply, spread over 19 alternatives; the first nine alternatives are associated with Scattered Decentralized Energy Supply (SDES); other nine relates to Compact Decentralized Energy Supply (CDES); and the latter alternative (in the comparative form) considers the network extension or Centralized Energy Supply (CES). The criteria and sub-criteria weighting has been assigned through expert group assessment. The results indicate that SDES represents the best configuration for electricity supply, consisting on the combination of an integrated hybrid system with solar photovoltaic (SPV), small hydropower (SHP) and sustainable hydrogen fuel cell.

00E30

Synthesis and Characterization of Magnetic Barium Ferrite-Silica Nanocomposites

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ABSTRACT

Hexagonal bariumferrite ($\text{BaFe}_{12}\text{O}_{19}$, BaM) has been studied intensively for many years due to their importance as permanent magnets, high density magnetic recording media and microwave devices. The magnetic and electromagnetic absorption properties of BaM can be improved by the partial substitution of nonmagnetic materials like SiO_2 , Al_2O_3 , ZrO_2 etc to make composites. In this work, we prepared BaM- SiO_2 nanocomposites by using mechanical alloying in a planetary mill followed by heat treatment near to phase transition. Relationship of BaM and SiO_2 used were 40:60, 50:50, 60:40 and 70:30 % by volume. The raw materials consisted of BaM and SiO_2 powders of analytical grade with a particle size of $\sim 5 \mu\text{m}$ BaM and $1 \mu\text{m}$ SiO_2 . The magnetic properties and microstructure were characterized for different milling times and heat-treatments. Vibrating Sample Magnetometer (VSM), X-Ray Diffraction (XRD) and Scanning Electron Microscope (SEM) were used as the main characterization techniques to study as-milled and heat-treated powders. The results indicate that 15 h of milling were enough to avoid the generation of hematite phase and to get a good dispersion of barium ferrite particles in the ceramic matrix. For milling periods beyond 15 h, the XRD patterns showed the presence of hematite phase caused by the decomposition of BaM. The purpose of the annealing process was to refine the nanocomposite structure to obtain monodomains on the BaM grains in order to modify the magnetic properties. The BaM- SiO_2 nanocomposites heat treated at 900°C showed that the magnetization (M_s) and coercivity (H_c) were enhanced with respect to lower BaM volume fractions. The agglomerate size observed through scanning electron microscopic analysis was around 150 nm with a good BaM dispersion into the SiO_2 matrix. The highest saturation magnetization of 42 emu/g is obtained for the composition 60BaFe₁₂O₁₉-40SiO₂ heat treated at 900°C .

00E31

Electrical Transport Studies of the Solid Electrolyte system $x\text{AgI}-(95-x)[2\text{Ag}_2\text{O}-\text{B}_2\text{O}_3]-5\text{TeO}_2$, where $45 \leq x \leq 65$

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ABSTRACT

Superionic conducting glassy electrolyte materials with high ionic conductivity are of technological interest due to their potential applications in solid state batteries, capacitors, sensors, memory devices etc. An interesting class of superionic conductors is AgI doped silver borate glasses, which can accommodate AgI in a disordered phase without any evidence of crystallization. In this work, quaternary silverborotellurite glasses of the composition $x\text{AgI}-(95-x)[2\text{Ag}_2\text{O}-\text{B}_2\text{O}_3]-5\text{TeO}_2$, where $45 \leq x \leq 65$ in steps of 5 were synthesized by melt quenching technique. The synthesized samples were characterized by X-ray diffraction and Differential Scanning Calorimetry, to confirm the amorphous nature and glass transition. Ac conductivity measurements were carried out in the frequency range 1Hz to 32MHz by using Solartron 1260 impedance analyzer in the temperature range 303-373K. The present work explains the effect of AgI addition on the silver borotellurite glass and the obtained dc conductivity is found to increase with the addition of AgI and maximum conductivity is obtained for $x=65$ mole%. The frequency dependence of conductivity is found to obey Jonscher's Universal law. Impedance and modulus analyses indicated the temperature distribution of relaxation time and non-Debye behavior. The cooperative motion due to strong coupling between the mobile Ag^+ ions are assumed to give rise to non-Debye type of relaxation.

00E32

Structural and magnetic studies of undoped and strontium doped lanthanum manganite system

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ABSTRACT

Lanthanum strontium manganite perovskites are the most studied cathode materials for solid oxide fuel cells. Lanthanum manganite and strontium doped lanthanum manganite belong to the perovskite oxide family. The larger rare earth ion (e.g., La) occupies the 12 coordinated A-sites and the transition metal ions (e.g., Mn) occupy the octahedral B sites. Both the electrical conductivity and catalytic activity of lanthanum manganite are enhanced considerably when lanthanum is substituted partially with strontium. In this work, the effect of Sr doping on the composition, $\text{La}_{1-x}\text{Sr}_x\text{MnO}_3$ ($x=0, 0.1, 0.3, 0.5$) has been studied. The perovskite oxides have been synthesized by the conventional ceramic route. Stoichiometric amounts of the starting materials were milled for 2 hrs after being thoroughly mixed in methanol. The obtained materials were calcined at 1000°C in air for 12 hrs and then they were ground, and calcined in air at 1200°C for 12 hrs and ground again to obtain fine powders. The synthesized powders were characterized by X-ray diffraction, transmission electron microscopy, scanning electron microscopy, physical adsorption of N_2 . The magnetic studies were done by an alternating gradient magnetometer. The XRD patterns of all the samples clearly shows the formation of crystalline perovskite structure, however the LSM samples with $x=0$ and 0.1 shows a small amount of La_2O_3 . The magnetic measurements of the samples were realized at room temperature and all samples displayed superparamagnetic properties with coercive fields near to zero. This behavior is originated from the surface spin disorder enhancement caused by decreasing particle size.



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00E33

Bimetallic materials based in Ag for cathode/anode electrode in a glucose microfluidic fuel cell.

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ABSTRACT

The present work shows the results for bimetallic materials PtAg/C and AuAg/C as cathode and anode electrode respectively in a microfluidic fuel cell with glucose as fuel in basic media. The electrodes were prepared for chemical reduction according to a modification of the Burst method and were characterized by XRD and electrochemical techniques. The fuel cell was able to harvest 600 mW cm^{-2} . The PtAg/C exhibits a better performance respect the commercial Pt/C at high concentrations of glucose. Meanwhile AuAg/C also contributed to stability of the fuel cell during long times of operation.

00E34

New BLi clusters capable of storing molecular hydrogen

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ABSTRACT

The search for new materials capable of storing molecular hydrogen on its surface has been the work of many researchers over the past decade. Fossil fuel is running out and need to find new alternative energy sources that are efficient and also environmentally friendly. Hydrogen is a clean fuel, but the problem has been to find materials that can store and transport because of their physical and chemical characteristics.

In this work, we have investigated the chemical properties of the BxLix clusters (where x = 2-6) and their ability to coordinate molecular hydrogen. We first searched the global minimum of the many possible combinations for each type of structure. This was not easy because the grater of number of atoms arise many combinations.

All structures were calculated with the PBE/def2-TZVP method. The results suggest a combination of structures in two and three dimensions, which have demonstrated the ability to coordinate hydrogen molecules around the lithium atoms. Lithium atoms are deficient in electronic density and this property is compensated by sigma bonds from hydrogen molecules. Details of the bond dissociation energies and other properties calculated for all structures will be presented the day of the congress

00E35

Electrochemical Synthesis of Au and Pd Electrodes for Glucose Oxidation

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ABSTRACT

Glucose oxidation reaction represents great interest due to the application in different important areas, such as the development of biosensors and biological fuel cells. Moreover, glucose is cheap, abundant in Nature and environmentally friendly. Energy density value is approximately 4430 Whkg^{-1} , which is slightly lower than methanol (6100 Whkg^{-1}). Glucose is energy source in all living organisms, which make possible the incorporation of glucose-based devices for *in vivo* applications.

Au already has shown an excellent catalytic activity toward the glucose oxidation without poisoning effects. Pd is another alternative metal that could show good electrocatalytic features, taking into account that kinetics of glucose oxidation in metallic electrodes is highly sensitive to the electrode material and surface crystallographic orientation. In this work, the performance of Au and Pd electrocatalysts for glucose oxidation is showed. Furthermore, a mixed deposit of Au/Pd was prepared in order to compare with the individual deposits. The materials were prepared by electro-deposition on a sheet of glassy carbon by cyclic voltammetry technique. The electro-deposits were physicochemically characterized by XRD, SEM and AFM techniques. The average particle size was around 60 and 89 nm for Au and Pd respectively.

00E36

Design and development of a Direct Ethanol Fuel Cell (DEFC) stack

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ABSTRACT

The global increasing energy demand and its environmental consequences make necessary to find new alternatives of electrical power supplies or fuels. Ethanol from lignocellulosic raws has been considered as a sustainable fuel because its local production, the use of residual biomass, can be transported, handling using the actual infrastructure and possesses a lower toxicity. The chemical energy of this low molecular weight alcohol can be transformed directly and efficiently through electrochemical reactions in a Direct Ethanol Fuel Cells (DEFC). It is not required a previous reformed process and by its high flexibility, DEFC can be used in transport and portability applications. This work presents the DEFC stack design using computational fluid dynamics and structural strength analysis. The prototype was built with catalysts loads of 1 mgPt cm⁻² in both anode and cathode, an active area of 64 cm². Cell was operated at 333 K with 1 mL min⁻¹ of 1M CH₃C₂OH at the anode and, 140 mL min⁻¹ of wet air at the cathode. Computational fluid dynamics analyses established that lower pressure drop achieved in the designed flow fields was 1.43 Pa. Stress analyses of the end plates data help to determine the compressive force for stack and have a better efforts distribution on the screws. The cell current density achieved was 9.5 mA cm⁻² with an OCP of 650 mV. The maximum stack power attained was 8 W with 56 % efficiency



00E37

2nd Harmonic Voltammetry Electrochemical Technique For Palladium Synthesis Of Dendritic Structures.

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ABSTRACT

Dendritic micro/nanostructures of palladium are obtained for first time by the electrochemical technique of 2nd harmonic voltammetry (2ndHV). Dendritic architectures are important since the point of view of their high electroactive area. The frequency of the 2HV technique was modified 1Hz (s1), 10Hz (s2) and 100 Hz(s3) in order to obtain different dendritic architectures. Morphology and electrocatalytic properties were investigated by scanning electron microscopy (SEM), X-ray diffraction (XRD) and electrochemical measurements. SEM images showed dendritic architecture with size higher than 2 micrometers. However, crystal sizes were around 20 to 50 nm. XRD pattern showed a fcc structure corresponding to metallic palladium, where (111) plane was preferential for all dendritic structures. Electrochemical measurements in acid media (0.5M H₂SO₄) exhibited the characteristic palladium profile, which was employed to estimate the electroactive area (68, 65 and 60 cm², for s1, s2, and s3, respectively). Three concentrations of formic acid (0.1, 0.5 and 1M) were employed to evaluate the catalytic properties of Pd dendritic structures. Maximum current density was obtained for 0.5M formic acid in all cases, following the order: system s1>s2>s3. The decreased of the current density in 1M formic acid compared to 0.5M concentration could be attributed to the blocking effect of active sites due to the formation of bubbles in the surface.

00E38

Hydrogen Storage in Metal Organic Framework

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ABSTRACT

The decreasing fossil fuel supply and climate change caused by carbon dioxide emission have spurred an initiative to develop alternative fuels. Hydrogen is one of the most promising candidates for the replacement of current carbon-based energy sources. Hydrogen has an energy density much greater than gasoline and emits no carbon dioxide after burning.

Free hydrogen does not occur naturally in quantity, and it should be generated from some other energy source by steam reformation of natural gas or other methods. Hydrogen is therefore an energy carrier, not a primary energy source. For the advancement of hydrogen and fuel cell power technologies in transportation, stationary, and portable application, the research on hydrogen production, delivery, storage, and fuel cell technologies should be fully developed.

In particular, hydrogen storage is considered to be a key enabling technology. This adsorption has been studied in materials as zeolite, carbon nanotubes, hydrides metallic and currently in metal organic framework (MOF). In this context, in the present work, the recently results around the world, about the hydrogen adsorption in different MOF are showed. We discussed the different strategies (as elongation of ligands, catenation, mixed ligands, open metal sites, impregnation, doping and fictionalization) employed for increased the storage in this materials.

00E39

Hydrogen Releasing Examination During The Reaction Of Aluminum At Al₅Fe₂ Intermetallic Powders With Water

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ABSTRACT

In this work, we reported the evaluation of hydrogen generation using a mechanical activation of Al₅Fe₂ intermetallic prealloyed powders. The intermetallic alloy was initially produced employed a conventional casting method starting from high purity elements. Subsequently, this alloy was subjected to high-energy ball-milling at different times (1, 5 and 10 h). The milling experiments were carried out using stainless steel vials and balls. Deionized water was directly added to intermetallic powders mechanical activated. The structural characterizations were conducted using X-ray diffraction and scanning electron microscopy. The results indicate that the bayerite phase is obtained as subproduct in the reaction among Al and H₂O to produce hydrogen. As the milling time increased, the hydrogen releasing was increased and the hydrogen generation rate is increased too.

00E40

**Evaluation of a ZrO₂ composite membrane operating at High Temperature (100 °C) for
Direct Methanol Fuel Cells.**

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ABSTRACT

In the present work, shown the performance of a methanol fuel cell at high temperatures (100 °C) using two different membranes, a Zirconium Dioxide composite membrane versus a commercial membrane (Nafion – 112). The inorganic material was synthesized by the sol-gel method. Then the inorganic filler was mixed with a Nafion (5%) solution and dried in order to obtain the composite membrane. The composite membrane was characterized by SEM and FTIR, confirming the inclusion of the inorganic oxide into the Nafion matrix. Ion exchange capacity and water uptake were obtained from the membranes observing that the composite membrane has a similar behavior than the Nafion membrane. On the fuel cell tests, the zirconium membrane has better performance than the commercial membrane. This behavior is related with the methanol crossover. Methanol diffused to the cathode and reacts with the oxygen from the cathode and produces carbon monoxide (CO), which is easily to adsorb on the Pt active sites than the O₂, and a decrease in the active sites for the oxygen reduction reaction is presented. This phenomenon is suppressed by the inclusion of ZrO₂ fillers and a better performance in the fuel cell is observed.

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00E41

Development of a Dynamic Hydrogen electrode coupled to a hydrogen proton exchange fuel cell.

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ABSTRACT

The present work shows the results of a Dynamic Hydrogen Electrode (DHE) coupled on a hydrogen proton Exchange fuel cell operated at high temperature conditions and low relative humidity ($T = 120\text{ }^{\circ}\text{C}$ y $\text{HR} = 23\%$), also using different composite membranes (SBA – 16 and ZrO_2) compared with a commercial Nafion – 115 membrane. The reference electrode was made using the methodology previously reported by Ivez y Janz, obtaining a platinum black deposit on the platinum wire surface. The stability of this reference electrode was obtained according to Khun, with a voltage difference of $-25.9 \pm 1.5\text{ mV}$. The electrode was introduced in the PEMFC and the DHE presents good stability. The parameters obtained with the incorporation of DHE were the anode and cathode reactions and their corresponding kinetic information related with the oxygen reduction reaction. By the analysis of these parameters we observed that the kinetics increase with the increasing of the temperature.

00E42

Synthesis of Pd/C and Pd/Pani for formic acid oxidation

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ABSTRACT

Palladium nanoparticles have been prepared by two methods: chemical (ex-situ, Pd/C) by two phase protocol and electrochemical (in-situ, Pd/Pani) by electroreduction of palladium ions on a polyaniline film and compared as anode catalysts for formic acid oxidation reaction. Structural and electrocatalytic properties of synthesized materials were investigated by X-ray diffraction, cyclic voltammetry and chronoamperometry techniques.

00E43

Synthesis And Photoelectrochemical Characterization Of WO₃ Nanomaterials

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ABSTRACT

In order to succeed in establishing an economy based on hydrogen, 3 challenges need to be met: efficient, low-cost production, safe storage and efficient use. The current commercial methods for H₂ production, water electrolysis, gasification and gas reforming, usually require a large consumption of energy from non-renewable sources. New technologies for H₂ production are needed, where oxygen and hydrogen are produced by water dissociation using solar energy as renewable source. For this purpose, photoelectrochemistry using nanostructured metal oxide electrodes is a promising method. In general, it appears necessary to use tandem cells with two photo-active systems in order to achieve water splitting.

In this work, we present a study of the synthesis of WO₃ nanoparticles from the thermal dehydration of tungstic acid (H₂WO₄•2H₂O). The starting material was deposited in film form, by employing the screen-printing and electrodeposition methods. The WO₃ films obtained are used as photo-anodes for oxygen production, and we evaluate the efficiency of oxygen production as a function of the film morphology. In order to obtain water splitting, the WO₃ half-cell is combined with a dye-sensitized solar cell, which has the task to provide the electrons for hydrogen evolution.

00E44

Theoretic-experimental study of Pd-based electrocatalyst for fuel cells

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ABSTRACT

The electrochemical oxygen reduction reaction (ORR) was analyzed by both theoretical and experimental methods, the objective of this Project is to elucidate the factors controlling the observed activity and be able to design electrocatalysts ad hoc with high activity and stability. Three electrocatalyst were studied: Pd, PdNi and PdSe. For the theoretical study was used DFT as implemented in the deMon 2K software, oxygen adsorption was calculated in a four atoms cluster and then reduction steps were calculated. In this study we found that there are remarkable differences in the adsorption process for example: The oxygen adsorption energy is higher in PdNi followed by Pd and very low in PdSe, the preferred type of oxygen adsorption is bridge on Pd and PdNi however in PdSe the preferred adsorption is 1-hapticity on a single Pd or Se atom. The experimental study demonstrate high activity towards the ORR when PdNi is used as catalyst, lesser for Pd and very low activity for PdSe, it was also demonstrate high hydrogen peroxide production on PdSe and low production on Pd and PdNi.

The theoretical and experimental results match very well correlating the Oxygen adsorption with the electrochemical activity and the species formed during the simulation with the ORR mechanism. A detailed analysis will be discussed in the extended version and during the presentation in the meeting.

00E45

**Tungsten Effect Over Co-hydrotalcite Catalysts to Produce Hydrogen
from Bio-ethanol (Analysis of the catalyst structure)**

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ABSTRACT

A great stabilization effect of tungsten over the Co-hydrotalcite catalysts to produce H₂ from ethanol in steam reforming was found. The catalysts were characterized by N₂ physisorption (BET area), X-ray diffraction, Infrared, Raman and UV-vis spectroscopies.

Catalytic evaluations were performed in a fixed bed reactor using a water/ethanol mol ratio of 4, at 450°C, and the W concentration studied was from 0.5 to 3 wt%. As W concentration increases, the intensity of crystalline reflections of the Co-hydrotalcite catalysts decreases. There were found porous with the shape of parallel layers with a monomodal mesoporous distribution. Superficial chemical groups as: -OH, H₂O, Al-OH, Mg-OH, W-O-W and CO₃²⁻ were found by infrared spectroscopy. Catalyst with low amounts of W (1%) showed both, the highest H₂ production and the best catalytic stability. The smallest pore volume of this catalyst could be related with long residence times of ethanol in the pores. Tungsten promoted the conversion for the Co-hydrotalcite catalysts. The reaction products were: H₂, CO₂, CH₃CHO, CH₄ and C₂H₄ and the catalysts did not produce CO. These enhanced catalytic properties for the catalyst with 1wt%W were related with an excellent stabilization produced by the W⁶⁺ ions bonded with the Co-hydrotalcite structure

00E46

Pt Nanoparticles Supported on Carbon Nanotubes for Direct Ethanol Fuel Cells (DEFC) Application

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ABSTRACT

Direct ethanol fuel cells (DEFC) based on a polymer electrolyte membrane (PEM) are attractive alternative devices for transport and portable applications because of their high thermodynamic efficiency and the easiness of production, distribution and handling of this low molecular weight alcohol. In acidic conditions, platinum presents the highest activity for ethanol oxidation reaction and for this reason it has been used extensively as anodic catalyst in the last decade. However, the DEFC commercial applications still have some challenges to be overcome, such as the intermediate species tolerance. In this work, platinum nanoparticles with particle size distribution ranging between 3 to 6 nm were synthesized at room temperature by chemical reduction of platinum chloride using NaBH₄ as reduction reagent and Poly(N-vinylpyrrolidone) as stabilizer of the obtained particles. The colloidal nanoparticles were deposited onto Multiwall Carbon Nanotubes (MWCNT) synthesized by the chemical vapor deposition method. Pt/MWCNT at 20 wt.% was evaluated as anode electrocatalyst in a 9 cm² DEFC using PtRu/C as cathode material. Both electrodes had a metal loading of 1 mg Pt/ cm². Polarization curves on Pt/MWCNT shows highest electroactivity compared with DEFC using Pt/C (commercial) as anode electrocatalyst.

00E47

High Performance Electroactivity in Pt/MWCNT and Pt/NiMWCNT Electrocatalysts

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ABSTRACT

The outstanding properties that multi-walled carbon nanotubes (MWCNT) possess, such as electron conduction, chemical and thermal stability, corrosion tolerance, nanostructured morphology, among others, allow them to have advantages over other carbonaceous materials commonly used as supports for electrocatalysts. Additionally, the MWCNT present the ability to allow metallic nanoparticles to be homogeneously dispersed over the external walls, making possible to decrease the metal loadings. This work presents the synthesis, characterization and electrochemical evaluation of electrocatalysts for PEM fuel cells base on Pt and Pt-Ni nanoparticles over MWCNT. The MWCNT were synthesized by spray pyrolysis of toluene, using two organometallic compounds as catalytic agents, ferrocene and nickelocene. The Pt nanoparticles were deposited using the ultrasound assisted aqueous deposition method, followed by either thermal or chemical reduction. The materials were characterized by scanning and transmission electron microscopy, as well as X-ray diffraction. In addition, Raman spectroscopy was used to analyze the quality of the MWCNT. The MWCNT exhibit lengths of 200 μm (using ferrocene) and 30 μm (using nickelocene), as well as diameters around 50 to 70 nm. Pt nanoparticles showed sizes between 5-10 nm. The electrochemical active area towards the hydrogen oxidation reaction was evaluated by cyclic voltammetry (CV) in a classical three cell electrodes. The electrolyte used was 0.5M H₂SO₄, a Pt foil was the counter electrode, and Ag/AgCl and glassy carbon as reference and working electrode respectively. In addition to corroborate the electrochemical active area, CO stripping tests were performed. From both, the CV and CO stripping analyses, it was found that the synthesized electrocatalysts exhibited electrochemical activity higher than an analyzed commercial material (Pt/Vulcan from Etek). The obtained areas are in the range of 140-230 m²gr⁻¹, the detailed results will be discussed.

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00E48

Characterization of a fuel cell unitized regenerative stack based on IrO₂-Pt/ATO as dual material.

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ABSTRACT

The Unitized Regenerative Fuel Cell (URFC) is a system that works like a secondary battery. These function as a Proton Exchange Membrane fuel cell (PEMFC) and water electrolysis PEM (WEPEM). The oxygen reduction reactions (ORR) in a PEMFC cathode and oxygen evolution reaction (OER) at the anode of a WEPEM are limitations to these reactions in the system. In this work, is characterized electrochemically an URFC stack (4 cells and 100cm² of geometric area) and investigated at different temperature (30-80 °C) in PEMFC mode and WEPEM mode. Electrocatalytic material was used nanosized Pt-IrO₂ catalysts and ATO support in dual oxygen electrode. The material was deposited by hot spray technique, the Pt/IrO₂ (50:50 wt.%) catalyst loading was 0.5 mg cm⁻² and Pt/C (30% wt, Pt) as dual hydrogen electrode. These MEA's were compared with commercial MEA's based on Pt/C with a similar loading to proposed. The electrochemical parameters were determined using the techniques of linear voltammetry, electrochemical impedance spectroscopy, chronoamperometry and chronopotentiometry. It was determined the amount of hydrogen production at 80 °C and 6.4 V during the time; it was obtained the maximum power in both modes.

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Electrochemical Systems
XII International Congress of the Mexican Hydrogen Society
Merida, Mexico, 2012**

00E49

Synthesis of Au-based materials with electrocatalytic properties for the glucosa electro-oxidation reaction.

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ABSTRACT

Nanoparticles (NP) are particularly important in the catalysis area. Moreover, bimetallic nanoparticles supported over multi walled carbon nanotubes (MWCNT) have received especial attention due to their better catalytic properties in micro fluidic fuel cells compared with mono metallic catalysts. In the present work, Au-based catalytic materials are prepared to generate electronic effects and bi-functional mechanisms for the glucose electro oxidation. Au/MWCNT, AuAg/MWCNT and AuCo/MWCNT with a 30:70 weight ratio were synthesized by the reverse micro emulsion method. It was used a Water/Surfactant molar ratio of 3.7 for the systems: (Water/Triton X-100/Heptane) (Water/Triton X-100/Sodium Dodecylbencensulfonic acid/Heptane), and (Water/Triton X-100/hexanol/Heptane). The MWCNTs were synthesized using the spray pyrolysis method, and functionalized with ammine groups. The physicochemical characterization of the prepared catalysts were done by X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM) and Thermo Gravimetric Analysis (TGA). The electrochemical characterization was investigated by Cyclic Voltammetry (CV) and Lineal Voltammetry (LV). Au NPs of 5 nm were obtained. In addition, a comparative analysis for the proposed systems in the present investigation was developed in order to observe the effect of the crystallographic effect on the glucose electro oxidation reaction.

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00E50

Design and implementation of a hybrid power system (wind-solar-fuel cell) of 4kW

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ABSTRACT

The main objective of this paper is to present the design and implementation of a hybrid power system (wind-solar-fuel cell) of 4kW. The hybrid unit contains three electricity generating plants interconnected photovoltaic plant, wind turbine, fuel cell (hydrogen) and storage system (batteries). For converting solar energy to electricity used two types of solar panels, a first panel with single crystalline silicon technology and the second with a CIGS (copper, indium, gallium and selenium), which provide 40% power to system. For the production of electricity based on the wind used a horizontal axis wind turbine, which contributes a 35% power to the system. The photovoltaic and wind systems are based on highly transient energy sources; due to this reason we implemented a hydrogen fuel cell PEM (proton exchange membrane) as a third source of energy, which provide a 25% power in periods of high demand. These sources are connected in parallel and synchronized to the storage system, then go to a power conversion module. For best performance or use of energy, created a program based on LabView graphical monitoring, wireless sensor that together with meteorological and solar radiation, the software will provide real time information on energy available on site, allowing the program decisions in the short and long term on the selection of one or all of the power source and the remote control, data capture and storage

00E51

Biological production of CO₂-free hydrogen by anaerobic microbial mixed microflora in an upflow anaerobic sludge blanket (UASB) reactor coupled with a gas purification device.

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ABSTRACT

To satisfy the world's growing appetite for energy and keep our planet healthy, at least 10 TW (or terawatt) of carbon-free power has to be produced by mid-century. The process described in the present work is a CO₂-free biohydrogen production in an upflow anaerobic sludge blanket (UASB) reactor using 400 mL of pretreated mixed anaerobic cultures. The reactor was used for developed biofilms in 44 spheres covered with ixtle (natural material), and was tested at a hydraulic retention time (HRT) of 3 h using 4 L of mineral medium with glucose concentration of 20 g L⁻¹, at pH 5.0 and 18°C. The hydrogen produced was sent to a gas purification device in which H₂ is passed through a 2M NaOH solution, this is to obtain CO₂-free biohydrogen. The cumulative hydrogen production in the purification system was 3.07 mol at 304 h of fermentation and was not detected CO₂ or methane, so reducing sugar concentration was decreased to 99.65%.

00E52

**Photocatalytic water splitting for hydrogen production from N-TiO₂-X/Pt prepared by Nitrogen gas plasma
(AC) method**

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ABSTRACT

We reported in previous papers a novel method for metal impregnation, using argon or nitrogen gas plasma using a AC glow discharge plasma treatment for production nanostructured TiO₂/Metal (Metal=Au and Cu) [1, 2]. In this work, it is shown that doping of titania Degussa P25 in the presence of Pt using N₂ gas plasma (AC) can induce the deposition Pt nanoparticles over the titania particles surface. This material, known as N-TiO₂-X/Pt is characterized by X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), and UV-Vis diffuse reflectance spectroscopy. In this work the photocatalytic activity of the developed material as well as the hydrogen generation from water/methanol mixtures is studied. It is observed that the Pt impregnation over TiO₂ nanoparticles using N₂ gas plasma (AC) improves the light-induced hydrogen production, due to the water splitting process, as compared with non-doped nanostructured titania. This can be attributed to the N-doping of the lattice structure of titania, and a possible enhancement in the TiO₂-Pt synergy induced by the plasma treatment.

Keywords: Degussa P25, TiO₂ nanoparticles, UV/Vis irradiation, TiO₂/Pt, N₂ plasma, TiO₂/Pt, hydrogen production.

00E53

**Hydrogen Generation in a Microbial Electrolysis Cell (MEC) using two configurations:
Catalyzed by Platinum and Biocathode.**

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ABSTRACT

Microbial Electrolysis Cells (CEM) are biological devices that offer a new way to produce hydrogen electrolyzing any type of organic matter by the action of electrochemically active microorganisms and an external potential (between 0.22 and 1 V). The CEM require a catalyst to form hydrogen, being platinum the most widely used in these devices. However, platinum is expensive and performance may decrease (poisoning) when it is exposed to compounds such as CO, CO₂ and sulfides. In the present study two types of catalysts were used: platinum (CEM Pt) and a biocathode using a technique that was allowed to reverse electrochemical reaction of hydrogenase enzyme present in the electrochemically active microorganisms, so it was possible to convert a bioanode to biocathode hydrogen generator (CEM b). CEM Pt (0.5 mg/cm², 10% Pt / C) generated H₂ 0.032 m³ / m³ of liquid reactor volume / day at a potential of 0.9 V and CEM b generated H₂ 0.010 m³ / m³ liquid volume reactor / day at a potential of 1 V.

00E54

Progress on the PdP alloy deposition onto a gas diffusion layer for a PEMFC application

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ABSTRACT

The catalytic properties and design of the gas diffusion electrodes (GDE) are the key to control the reaction kinetics, mass transport and to avoid the poisoning of the catalyst surface during the fuel cell operation. It has been our goal the development of novel architectures of gas diffusion electrodes and novel composition catalysts. With this purpose we have developed a novel method of depositing the catalyst directly onto the gas diffusion layer (carbon paper) [1] and a novel catalyst composition, a PdP alloy [2]. The catalyst deposition process relies on an electroless process. Since the carbon paper is not catalytic for the electroless deposition, it has to be previously submitted to a sensibilization/activation step for depositing the catalytic nucleus. However, this procedure gives non-uniform deposits on scaling-up the GDE preparation. In order to avoid this constraint a novel methodology of depositing the catalytic nucleus has been developed by electrodeposition. The effect of this procedure on the morphology of the PdP deposit and on its catalytic activity towards the oxygen reduction was analyzed. Concomitantly, a method to control accurately the amount of Pd deposited on the electroless deposition process was established.

00E55

ORR kinetics on carbon paper-supported PdP cathodes: electrochemical impedance spectroscopy and rotating disk electrode study

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ABSTRACT

The search for novel cheap electrocatalysts with high activity and stability to be used as cathodes in polymer electrolyte membrane fuel cells (PEMFCs) has been an intense active area of research for a number of years. Pd-based cathode catalysts have attracted more attention since Savadogo et al. [1] observed for the first time the enhanced ORR activities on sputtered Pd-Co, Pd-Ni and Pd-Cr bulk in acid media. Recent reports showed that Pd-based metal catalysts exhibit ORR activities comparable to or even higher than that of Pt/C in fuel cell testing [2-4]. Modifying Pd through the addition of a non-metal element can be a good strategy in view of enhancing stability and tolerance to organics (methanol and ethanol). In the last few years, our group has synthesized and characterized carbon paper-supported Pd [5] and Pd-nonmetal (P and B) alloys as cathodes for fuel cells. PdP catalysts with 10 and 15 P at. % have a high catalytic activity for ORR in both acid and alkaline media (higher than that of Pd/C).

This work presents an electrochemical impedance spectroscopy (EIS) and rotating disk electrode (RDE) study of PdP catalysts with 10 and 15 P at. % and different Pd loads, in acid media. A detailed physical characterization of PdP was performed by X-ray diffraction (XRD), scanning and transmission electron microscopy (SEM and TEM, respectively), energy dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS). The XRD data indicated that both PdP catalysts are amorphous although PdP10 is less disordered than PdP15. These results were confirmed by TEM.

00E56

Hydrogen Production by Solar Energy in Tropical Conditions

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ABSTRACT

During the past few decades, energy consumption has been associated with the well-being and progress in the society; however, the indiscriminate use of conventional energy sources, such as petroleum, has brought, among other problems, environmental contamination. An alternative to diminish this issue is the implementation of renewable energy sources and hydrogen technologies, which would provide environmental friendly energy systems. The current work presents the implementation and evaluation of a system to generate high purity hydrogen by electrolysis using photovoltaic (PV) energy in tropical conditions. The research work scope is to show the results obtained during the interconnection between the solar panel system and the solid polymer electrolyte (SPE) electrolyzer. PV power system consists in 4 photovoltaic panels (800 W), 4 batteries (225 AH), controller (1.8 kW) and CD-CA converter (3.5 kW). Commercial SPE electrolyzer (Peak Scientific) was characterized considering energy consumption during the different operation scenarios (i.e. H₂ flow rate and pressure) and hydrogen quantification. A comparison between the available solar energy resources in the site, electricity production through the photovoltaic system and the hydrogen production will be discussed.

00E57

Electrocatalytic activity of Pt-Re /C catalysts for methanol electrooxidation

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ABSTRACT

The following research has the objective to develop electrocatalysts for DMFC. It is a metal very little explored as electrocatalyst like the rhenium. Some particles of rhenium were synthesized starting from $\text{Re}_2(\text{CO})_{10}$. It was studied the N, N-Dimethylformamide at different times and temperatures, to find out if there would be any change in the molecular composition of the N, N-Dimethylformamide during the changes of the stages liquid-gas-liquid that was evaluated at the presence of a visible change when it was heated up and confirming with a spectroscopic analysis after being boiled the reagent at different times.

Selecting the temperature at 30 degrees with moderated agitation to dissolve the carbonyl. The solution and particles of synthesized Rhenium were characterized by spectroscopy FTIR. Also the particles of Rhenium in Vulcan XC-350 were endured. The particles were characterized by sweeping spectroscopy observing its distribution in lengths of 50 micrometers and the formation of oxide of Rhenium was determined by EDX. The particles were studied in the agglomerate (composite) nafion/Vulcan XC 350/Re by cyclic voltammetry using as media the sulfuric acid 0.5 M with and without methanol. The results show that there is few electrocatalytic activity.

In another hand due to the lack of information that exists of electrocatalytic of Re, some agglomerated (composites) of nafion with metallic dust from this metal were prepared.

The behavior of Re and few electrocatalytic activity was observed. Therefore it is being studied the electrodeposition of Re on Pt because is stated that the adatoms of Re increase the activity of Pt. The electrodeposition of $\text{Re}_2(\text{CO})_{10}$ dissolved in N, N-Dimethylformamide has not been reported.

Our approach to greatly change the electrocatalytic activity of Pt is to modify its surface by underpotential deposition (upd) of foreign adatoms of Re.

00E58

High Altitude Platforms (HAP's) powered by PEMFC's: a technological advantages review and analysis of their implementation in Quintana Roo, Mexico

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ABSTRACT

Due to the increase in world population, energy demand is growing, similarly, the "bandwidth demand". In other words, the exchange of data through "Network Connections" is increasingly requested and vital for socioeconomic growth of communities, in both urban and suburban areas. As an alternative to increasing the effectiveness of future communication, there are proposed the use of High Altitude Platforms (HAP's) as liberators of bandwidth and enhancers of wireless communication. These "Platforms" are based on UAV's (Unmanned Aerial Systems), and their main function is to make communication links and provide central services to data transmission. In this paper we first present the general features and some applications of HAP's, doing more emphasis in their "energy architecture". Then, we discuss their hypothetical application in the state of Quintana Roo. Remotely controlled, these platforms can be operated up to six months continuously without external energy recharges. This is possible due to the use of an energy closed loop system based on Proton Exchange Membrane Fuel Cells (PEMFC's), Proton Exchange Membrane Electrolyzers and Photovoltaic Modules. Specifically, in the state of Quintana Roo, Mexico, HAP's could solve various "gaps" of current information exchange. Likewise, HAP's can be used during and after any contingency, for example: hurricanes and wildfires; and to security, for example: on borders and illegal trafficking.

00E59

Production And Purification Of Hydrogen Coupled To A Photovoltaic System

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ABSTRACT

We present in this work the technological development of a photovoltaic system coupled to an alkaline electrolyzer. These activities comprise mainly the production (in situ) and purification of hydrogen by electrolysis using two different types of electrolyte (NaOH and KOH) of known concentration.

Nylamid material and stainless steel electrodes were used for the construction of electrolyzer. H₂ was recirculated through deionized water in order to remove adsorbates then filter by a silica gel to dehumidify.

The PV-Electrolyzer efficiency of the system is as well presented and discussed.

00E60

**Preparation and Characterization of Pt-Pd and Pt-CeOx Electrocatalysts for the Oxygen Reduction
Reaction in Absence and Presence of Metanol in Alkaline Medium**

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ABSTRACT

In this work, we report the synthesis and the structural, morphological and electrochemical characterization of novel Pt-Pd and Pt-CeOx electrocatalysts as candidate cathodes for DAFCs (Direct Alcohol Fuel Cells). The materials have been prepared by two methods a) chemical reduction of $\text{H}_2\text{PtCl}_6 \cdot 6\text{H}_2\text{O}$, $(\text{NH}_4)_2\text{PdCl}_6$ or $\text{Ce}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ precursors with sodium borohydride and b) pyrolysis of the same precursors at temperatures between 360 and 600 °C, under an (H_2/N_2 5:95) atmosphere for 5 h. This was done to evaluate the effect of the medium of synthesis on the structure and electrocatalytic properties of the materials for the oxygen reduction reaction (ORR) in absence and presence of metanol in 0.1 M KOH. The materials were structurally characterized by XRD and were subjected to chemical analysis by EDS. From these analyses we estimated the particle size, the structural phases and the atomic composition of the materials. The electrochemical characterization consisted of rotating disk electrode (RDE) measurement at room temperature in 0.1 M KOH, using cyclic and linear sweep voltammetry (CV and LSV) techniques. The kinetic parameters such as the Tafel slope and exchange current density were calculated from the LSV polarization curves.

00E61

Thermodynamic Analysis of the Absorption Enhanced Autothermal Reforming of Ethanol

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ABSTRACT

Thermodynamic analysis of the absorption enhanced autothermal reforming of ethanol using CaO, CaO*MgO, Na₂ZrO₃, Li₂ZrO₃ and Li₄SiO₄ as CO₂ absorbents was performed to determine favorable operating conditions to produce a high hydrogen ratio (HR, mols H₂-produced/EtOH-feed) and hydrogen concentration in gas product. Ethanol/water and ethanol/oxygen feed ratios were varied in order to find autothermal reaction conditions ($\Delta H \approx 0$). Equilibrium product compositions were studied at temperature (300-850°C), steam to ethanol molar feed ratio (S/EtOH), oxygen to EtOH ratio (O₂/EtOH) and type of CO₂ absorbent at 1 atm. S/EtOH was varied from stoichiometric; 3:1 to 9:1, and O₂/EtOH from 0 to 1.25. Results indicate no carbon formation at \geq S/EtOH stoichiometric. Conventional ethanol reforming at T = 600°C and S/EtOH = 6.5 resulted in a HR of 4.7 and a highly endothermic system. The introduction of O₂ (ATR) in the feed (O₂/EtOH = 0.88) produced a reduction in HR of 22% at autothermal conditions with no carbon formation, while the use of a CO₂ absorbent (CaO) combined with conventional reforming resulted in an increase in H₂ purity and HPR of about 21% with a still endothermic system. Whereas, the absorption enhanced autothermal reforming of ethanol using CaO, O₂/EtOH = 0.33, S/EtOH = 6.5 and 600°C, produced an autothermal system with only a reduction of 9.8% in HR with respect to the CO₂ absorption reforming without O₂ as a feed. At absorption enhanced autothermal reforming conditions studied; CaO and CaO*MgO showed similar HR results, while Na₂ZrO₃ and Li₂ZrO₃ resulted only in slightly lower values than CaO, while Li₄SiO₄ showed significantly lower values than CaO. Finally, Na₂ZrO₃ should be considered as high potential absorbent in the system due to its superior thermal stability and kinetics to be used in the proposed reaction scheme.

Keywords: Absorption-Enhanced-Autothermal-Reforming, CO₂-absorbent, Thermodynamic Analysis

00E62

PREPARATION OF CoTETA/MWCNT ORR ELECTROCATALYST

ABSTRACT

This paper systematically studies the CoTETA / MWCNT catalysts :(1) Heat treatment on the CoTETA / MWCNT catalyst structure and performance impact. XRD showed that, CoTETA / MWCNT catalyst heat treatment the critical temperature 500 ° C. RDE test showed that the heat treatment temperature on CoTETA / MWCNT catalyst for oxygen reduction peak potential, peak current and current - greater impact on the polarization curves, the starting potential in the vicinity of 0.70V, 800 ° C heat treatment the best catalytic performance.

(2) Cobalt content on CoTETA / MWCNT catalyst structure and performance impact.

XRD showed that with the increase of Co content, CoTETA / MWCNT catalysts in α -Co more obvious characteristic diffraction peaks. RDE tests show that the different Co content obtained CoTETA / MWCNT catalysts for oxygen reduction peak potentials were between 620-710mV. CVs test results show that the 30wt% Co CoTETA / MWCNT catalyst for oxygen reduction potential of oxygen reduction peak potential value the most, the best performance of this catalyst. (3) Nitrogen by ICP analysis testing and further confirm the preparation of CoTETA / MWCNT catalyst for the best amount of cobalt 30wt% Co. (4) SEM graph of after 600 ° C, 800 ° C, 1000 ° C heat treatment at different temperatures CoTETA / MWCNT catalyst oxygen reduction shows that electricity, heat treatment temperature on the structure of carbon nanotubes larger carriers, meaning that as the calcination temperature increases, the catalyst of carbon Structure of nanotubes was greatly changed, that is more and more become thin carbon nanotubes.

(5) By RRDE test to calculate the oxygen reduction reaction in the conversion process of the number of electrons $n = 1.77$ or so and the resulting percentage% H₂O₂ hydrogen peroxide is about 1.3%.

00E63

Absorption/Desorption Hydrogen Process In A Material Type Hidrotalcite

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ABSTRACT

In this study a new material type hidrotalcite obtained as a by-product from a mixed oxide (MgOAl) and water in hydrogen generation is presented. The material (MgOAl) was prepared according to the reported elsewhere. For this type of material a relation between the two metal components should exist. The rank of relations $\text{M}^{3+}/(\text{M}^{2+} + \text{M}^{3+})$, generally is accepted to obtain this type of compounds as an unique phase, and the value is between 0,2 and 0,33. Although the formation has been described of hidrotalcites so much of smaller relation (0,15) as of greater relation (0,44). The materials were first characterized by scanning electron microscopy (SEM) and X-ray diffraction (XRD). The hydrogenation tests were carried out in a micro-reactor with varying pressure, temperature and reaction time. The material was analyzed with a thermogravimetric system (TGA) before and after the hydrogenation process. To confirm the presence of hydrogen in the material type hidrotalcite, gas chromatographic technique was also utilized. The results of X-ray diffraction analyses demonstrated that the unique crystalline phase identified was a hidrotalcite, and according to the Mg, Al concentration in the material the value of the $\text{Al}^{3+}/(\text{Mg}^{2+} + \text{Al}^{3+})$ ratio was 0.22 and correspond to the theoretical rank value, and by SEM its morphology correspond to laminated forms. The identification of hydrogen both by TGA and gas chromatography techniques were resulted positive. The first tests in absorption/desorption hydrogen process in this material are promising for a practical applications.

00E64

Platinum loading variation in MEAs to compare PEM Fuel Cell performance

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ABSTRACT

Today there is a tendency to reduce the content of platinum in the preparation of Membrane Electrode-Assemblies (MEAs) in order to reduce the cost of the fuel cell technology. Nevertheless, a general agreement has not been reached regarding the optimum content of platinum to obtain a good performance and an acceptable durability of this technology. Recent studies indicate that the optimum reduction of platinum is in the range of 0.5 to 0.2 mg/cm². In this work, three MEAs of 25cm² active area were fabricated by spraying technique to apply the catalyst layers on the membrane. The platinum content of a Reference MEA was 1.0mg/cm² on both anode and cathode. A second MEA was prepared with a platinum content of 1.0/0.5 mg/cm², and a third one with 0.5/0.7 cm², in anode/cathode respectively. The characterization for these MEAs from Electrochemical Surface Area, Polarization Curves, and Electrochemical Impedance Spectroscopy tests are presented and discussed under the scope of MEA performance in a single fuel cell hardware.

00E65

Revisiting alkaline electrolysis: Challenges and opportunities for the production of hydrogen

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ABSTRACT

Alkaline electrolysis is considered a mature technology as it has developed extensively over the past several decades shown by the numerous commercial products available from different companies. With the arrival of solid proton conductive electrolytes for acid electrolysis, which has offered some advantages over alkaline electrolyzers, alkaline electrolysis seemed out-of-the-scene for a while. Nevertheless, high costs of both technologies have prompted to review remaining challenges but also opportunities for alkaline electrolysis, in particular regarding central components such as porous electrodes and all the factors affecting their performance and substitutes for old asbestos separators. This work reviews such factors making emphasis on those aspects related to new approaches for the search of non-noble metal electrocatalysts.

00E66

Preparation and study on CoTETA/MWCNT catalyst as ORR electrocatalyst

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ABSTRACT

Multilayer carbon nanotube (MWCNT) supported on CoTETA was prepared to improve its catalytic activity for oxygen reduction reaction in PEMFC. The effect of preparation process on its performance was researched. These catalysts were characterized by scanning electron microscopy (SEM), x-ray diffraction (XRD) and Inductive Coupled Plasma Emission Spectrometer (ICP).

The CVs of the CoTETA/C catalysts in oxygen-saturated 0.5M H₂SO₄ solution prepared from different heat treatment temperature was carried out by scan rate 5mV/s at 25°C. The results of above CVs said that the heat treatment temperature has greater impact on the performance of CoTETA / MWCNT catalyst such as oxygen reduction peak potential, peak current and current. It is known that the catalyst treated at 800 °C has the best catalytic performance. XRD showed that CoTETA / MWCNT catalyst has the peaks of Co(111), Co(220) and Co(200) with CNT.

The effect of cobalt content on CoTETA / MWCNT catalyst was studied too. XRD showed that with the increasing of Co content, CoTETA / MWCNT catalysts showed more obvious characteristic diffraction peaks of α -Co. RDE tests showed that the oxygen reduction peak potentials of the different Co content catalysts were around 620-710mV. CVs test results showed that the CoTETA / MWCNT catalyst with 30wt% Co illuminated the best performance. Nitrogen content of above catalysts was obtained by ICP analysis testing and further confirmed that the CoTETA / MWCNT catalyst with 30wt% Co had the highest nitrogen content, which might result in good performance. SEM image of all CoTETA / MWCNT catalyst shows the heat treatment temperature had important effect on the structure of catalysts. When the calcination temperature increased, the catalyst of carbon Structure of nanotubes was greatly changed, and more and more MWCNT became thin carbon nanotubes. Finally, the electron conversion number of ORR were calculated By RRDE test, and the electron conversion number were around 1.77. Production yield of H₂O₂ was about 1.3%.

00E67

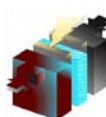
Effect of carbon porosity on the electrochemical properties of carbon/polyaniline supercapacitor electrodes

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ABSTRACT

Electrochemical supercapacitors have attracted great attention in power source applications, due to their high power density, high charge/discharge rate, good reversibility and long life. Activated carbons are the most frequently used electrode material, due to their high accessibility, non-toxicity, high chemical stability, good electrical conductivity, high surface area and low cost, but in practice the capacitance values are limited by the material microstructure. Several methods have been reported to increase the capacitance, such as the incorporation of functional groups at the surface, the development of nanostructured carbons and the synthesis of hybrid composites of carbon with conducting polymers or metal oxides. In this work we report on the synthesis and electrochemical characterization of carbon/polyaniline composites, synthesized by in-situ chemical oxidative polymerization in acid media of aniline monomer on the surface of two commercial activated carbons having different textural properties, and the effect of the carbon porosity on the electrochemical properties of the electrodes. Results obtained indicate that the BET specific surface of the composites decreases sharply due to the collapse of the porous structure (mainly the micropores) of the carbon by the polyaniline chains. Regarding capacitance values, Csp increases on increasing polyaniline loading in the composite, however high polymer concentration lead to a decrease on capacitance when high current were applied, probably due to diffusion restrictions of the electrolyte to the carbon surface.



00E68

**Enhancement of oxygen reduction activity on carbon-supported Co-phthalocyanine
modified with pyridine as nitrogen precursor in alkaline electrolyte**

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ABSTRACT

In this paper, we report a novel CoPc-Py/C catalyst for the oxygen reduction reaction (ORR) in alkaline electrolyte using cobalt phthalocyanine (CoPc) and pyridine (Py) as the metal and nitrogen precursors, followed by a heat-treatment at temperatures of 600-900°C. The catalytic activities of both heated and unheated catalysts were screened by means of cyclic voltammetry (CV) and linear sweep voltammetry (LSV) employing a rotating disk electrode (RDE) technique to quantitatively obtain the oxygen reduction reaction (ORR) kinetic constants and the reaction mechanisms. In particular, the effect of pyridine as the nitrogen-rich ligand for precursor complex formation on the electrocatalytic activity of carbon-supported CoPc were studied. The results show that the presence of pyridine plays an important role in improving the catalytic activity of CoPc/C toward ORR. The best performing catalyst is for 20%CoPc-20%Py/C after heat-treatment at 700°C. In 0.1mol/L KOH, 20%CoPc-20%Py/C catalyst (in O₂) gives the on-set potential of 0.24V with a half-wave potential of 0.01V (vs. SHE). Compared with pure 40%Py/C and pure 40%CoPc/C catalyst, the half-wave potential on 20%CoPc-20%Py/C catalyst for oxygen reduction positively shifted by 220mV and 33mV, respectively. In order to understand this heat-treatment temperature effect, TG, XRD, TEM as well as XPS were used to study the thermal stability, crystal structure, physical characterization and surface structure changes. All results from these tests indicated that high temperature treatment can greatly affect the ORR activity of CoPc-Py/C catalysts. In particular, XRD and XPS analysis indicates that the structure of CoPc-Py/C was decomposed after heat treatment at 700°C, forming the Co-N_x-C active sites, which is responsible for the ORR. From Koutechy-Levich analysis, the overall electron transfer number in the catalyzed ORR on 20%CoPc-20%Py/C was found to be 3.08, which is much higher than 1.64 on pure Py/C and 2.05 on pure CoPc/C catalyst under the same measuring conditions.

00E69

**Studies of electrochemical properties and active sites of carbon-supported nickel phthalocyanine (NiPc/C)
catalysts for oxygen reduction reaction**

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ABSTRACT

Carbon-supported nickel phthalocyanine (NiPc/C) catalysts were synthesized at several heat treated temperatures such as 600, 700, 800 and 900°C under N₂ atmosphere. The electrocatalytic activity and electron transfer mechanism of NiPc/C catalysts were demonstrated in oxygen-saturated alkaline electrolyte by cyclic voltammetry (CV), linear sweep voltammetry (LSV) as well as rotating disk electrode (RDE) technologies, respectively. The results show that the heat-treatment temperature has a remarkable impact on the ORR activity of NiPc/C. In particular, an onset potential of 0.08 V and a half-wave potential of -0.15 V are achieved in 0.1 M KOH after the catalyst was heat-treated at 800°C. Besides the ORR kinetic rate is increased, the ORR electron transfer increased from 2.2 to 2.8 with increasing heat-treated temperature from 600 to 800°C. To study the ORR active sites, X-ray diffraction (XRD), transmission electron microscopy (TEM) and X-ray photoelectron spectroscopy (XPS) were used to identify the catalyst structure and composition. XRD results clearly confirmed that the structure of NiPc/C was partly decomposed after heat-treatment at 600°C to form the Ni-N_x-C active sites, which is responsible for the ORR activity. XPS analysis showed that after the sample was heat treated at 800°C pyridinic-N and graphitic-N can be observed, which may be assigned to sites catalytically active towards ORR and lead to activity enhancement.



00E70

**Carbon-supported copper phthalocyanine (CuPc/C) as novel cathode catalyst for polymer electrolyte
membrane fuel cells --- Effect of Nafion ionomer as for alkaline electrolyte**

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ABSTRACT

Carbon-supported copper phthalocyanine (CuPc/C) nanoclusters, as a novel suitable cathode catalyst in polymer electrolyte membrane fuel cells have been synthesized via a combined solvent-impregnation and milling procedure along with the high temperature treatment. For optimizing the electrocatalytic activity of the catalyst obtained, the electrode with a variety of Nafion ionomer contents from 2.5×10^1 to $1.6 \times 10^2 \text{ g cm}^{-2}$ in the catalyst layer was screened by cyclic voltammetry (CV) and linear sweep voltammetry (LSV) employing a rotating disk electrode (RDE) techniques to investigate the effect of Nafion ionomer as for alkaline electrolyte. For comparative purposes, electrode with various contents of available anion-ionomer was also investigated. The results reveal that the content of Nafion ionomer can affect the ORR activity of the CuPc/C catalyst and an optimal content of Nafion ionomer is around $3.5 \times 10^1 \text{ g cm}^{-2}$, which corresponds well with the electrode prepared using available anion-ionomer. Under which, the electrode prepared using Nafion ionomer can produce a comparable performance to that of using available anion-ionomer, giving the on-set potential at 0.1 V with a half-wave potential of -0.05 V. Furthermore, Koutechy-Levich analysis shows that the value of electron transfer number is in a range of 3.4 to 3.7 when electrode with a variety of Nafion ionomer contents changing from 2.5×10^1 to $1.6 \times 10^2 \text{ g cm}^{-2}$. In addition, fuel cell test was also investigated in this paper. The membrane electrode assembly fabricated with CuPc/C cathode catalyst loading of 3.6 mg cm^{-2} and a Nafion membrane immersed in 3M KOH for 48 hours reached the initial power density of 3.8 mW cm^{-2} .

00E71

**High catalytic performance of Pt/C for the ethanol electrooxidation using sonochemically-treated XC-72R
carbon support**

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ABSTRACT

In this work, the polyol method was used to disperse Pt on sonochemically-treated Vulcan XC-72R carbon (labeled Pt/C-treated). The support was sonicated in concentrated HNO₃ and then in a concentrated H₂SO₄-HNO₃ mixture. The treated carbon showed a more hydrophilic surface with the presence of functional oxygen groups, related to the surface of non-treated Vulcan, leading to a homogeneous metal nanoparticles deposition. The Pt/C-treated showed an enhanced mass activity toward the ethanol oxidation reaction compared to the non-treated Pt/C, also synthesized in our lab following the same ethylene glycol route. This sonochemical treatment for Vulcan XC-72R may lead to a cheap alternative route to develop high performance and less expensive Pt based catalyst for DEFCs.

00E72

Synthesis and evaluation of Pt-Sn/C and Pt/C nanomaterials for the ethanol oxidation reaction

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ABSTRACT

Carbon-supported Pt and Pt-Sn nanoparticles have been synthesized by the polyol method. The electrocatalysts were tested as anode materials for the ethanol oxidation reaction (EOR) by cyclic voltammetry and chronoamperometry techniques. Structural properties of the synthesized materials were investigated by X-ray diffraction. The Pt-Sn/C anode showed an enhanced catalytic activity for the EOR, in part because of its significantly higher electrochemically active surface area, compared to that of Pt/C.

00E73

Synthesis and Characterization of Pt-Au/C for Ethanol Tolerant ORR Electrocatalyst

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ABSTRACT

The synthesis and characterization of alcohol tolerant Pt-Au/C (20 wt. %) nanoparticles with different surface composition (Pt: Au 1:1, 1:2, 1:3 in mole ratio) as an electrocatalysts for oxygen reduction reaction (ORR) in 0.5M H₂SO₄ with and without 0.5M ethanol (EtOH) is presented. The Pt-Au nanoparticles were synthesized by a chemical reduction of (NH₄)₂PtCl₆ and AuCl₃ as precursor salts at a room temperature of about 28 °C. The nanoparticles were dispersed and supported on Vulcan carbon XC-72R. Information about the structure and particle size is obtained by means of EDAX-SEM and X-ray diffraction (XRD) techniques. The Pt-Au/C was electrochemically characterized for ORR by cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and rotating disc electrode (RDE) techniques. In the absence of EtOH, Pt-Au/C (1:2) shows the best activity towards ORR related to Pt-Au/C 1:1 and 1:3. In the presence of the liquid fuel, the Pt-Au/C (1:3) cathode shows an activity comparable to that in the absence of ethanol (i.e., high tolerance) although its activity is lower than those of the other two Pt-Au/C towards the ORR. No current peak associated to the oxidation of ethanol is observed at Pt-Au/C (1:3) and the shift in onset potential of the ORR is negligible at this cathode catalyst. These results give us an insight about Pt-Au/C electrocatalysts can be used as a promising ethanol tolerant cathode electrocatalyst in DEFCs.

00E74

Method for Water Electrolysis in Acid Medium

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ABSTRACT

Titanium oxy nitride has been fabricated for the first time from anhydrous Sol-gel Method and used as anode for water electrolysis in acid medium. It is shown that the properties of this material are highly dependent on the calcination temperature. The conductivity increases from insulator (titanium dioxide type) to metallic (titanium nitride type) when the calcination temperature rose from 500oC to 1000oC. When the catalyst material is calcinated at 700oC, the rutile structure of titanium dioxide is obtained and agrees well with those obtained with the TGA-DSC results. These results also show that the structure of the osbornite of titanium nitride appears at 1000oC. The BET surface area also increases with the calcination temperature. The morphology of the calcinated samples gradually breaks into smaller conchoidal fracture particles when the sample preparation temperature increases. Electrochemical voltage-current polarization curves of the oxygen evolution reaction in sulphuric acid on these anodes electrodes confirm that the materials calcinated at 800oC or even at higher temperatures exhibit a low Tafel slope and a high electrochemistry surface area which are both known as good values for the oxygen evolution in acid medium. The results of this study suggest that our titanium oxy nitride prepared by an anhydrous sol-gel method followed by calcination is an interesting anode catalyst for water electrolysis. Its performance for this reaction is compared to those of some noble metal oxides.



00E75

The Oxygen Reduction Reaction on Pt/TiOxNy Based Electrocatalyst for PEM Fuel Cell Applications

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ABSTRACT

Titanium oxy-nitride was developed for the first time as Pt electrocatalyst support for the ORR in PEM fuel applications. The conditions of the support preparation and the Pt/TiOxNy based electrodes' elaboration by chemical reduction method were determined. It was found that the particle size of titanium oxy-nitride is about 50 nm to 100 nm; platinum particles with the size of 8 nm are dispersed well on the titanium oxy-nitride. The interaction between the Pt electrocatalyst and the support was observed. Comparison of the polarization curves of the carbon and the TiOxNy supports showed clearly that TiOxNy is more stable than the Vulcan XC-72R. On the other hand, from cyclic voltammetry curves, no oxidation peak of the TiOxNy support was observed after several cycles, whereas peak carbon corrosion was obtained under the same conditions as for Vulcan XC-72R. It was found that the 40 wt% Pt/TiOxNy based electrocatalyst is active for the ORR in acid medium, but the activity is less than that of Pt/C. The normalized electrochemical surface area degradation of Pt/TiOxNy was significantly less than that of Pt/C. The kinetics of the ORR on Pt/TiOxNy proceeds through a four-electron transfer process. Meanwhile, greater electrochemical surface area and improved durability are discovered by cyclic voltammetry. The single-cell hydrogen/oxygen PEM fuel cell based on Pt/TiOxNy as the cathode electrocatalyst exhibits the same range of performance as that based on Pt/C. These results make this support a potentially interesting candidate for PEM fuel cell applications.

00E76

Correlation between the Physico-chemical Properties and the Oxygen Reduction Reaction electro catalytic activity in acid medium of Pd-Co Alloys synthesized by Ultrasonic Spray Method

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ABSTRACT

Pd-Co alloys electro catalysts were synthesized for the Oxygen Reduction Reaction (ORR) for Polymer Electrolyte Membrane Fuel Cells by a new ultrasonic spray method. This allows for the first time the preparation of reproducible small particle size with dominant dimensions between 2.5 and 6.5 nm for all samples of the Pd-Co electro catalysts. This method is also based on less time consuming and steps than the classical methods. The physico-chemical properties of Pd-Co electro catalysts from different compositions were characterized. Samples of Pd/C, Pd₅Co₁/C, Pd₃Co₁/C, Pd₂Co₁/C, and Pd₁Co₁/C were synthesized and Pt/C for comparison. The samples of Pd-Co alloys prepared here are substitution solid solutions where some atoms of Pd are replaced by Co atoms. Based on experimental bending energies, the main composition of the samples is found to be metallic Pd and Co. The physico-chemical composition and properties of the alloys were correlated to the ORR electro catalytic activity in an acid medium. A volcano plot was observed between the variation of the mass activity and the Pd content or Pd-Pd distance of the Pd-Co alloys. The optimum value of the mass activity was obtained for Pd₃Co.

00E77

Electrochemical investigation of Pd-Co thin films binary alloy for the oxygen reduction reaction in acid medium

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ABSTRACT

The oxygen reduction reaction (ORR) on Pd–Co electro-catalyst has been studied in acidic media. The palladium alloys were prepared by coating glassy (GC) carbon substrates using a R-F magnetron sputtering equipment with a palladium and cobalt wafers as targets. The dual sputtering we used and allowed us to obtain a thin film of 40-60 nm thick. The ORR kinetics was studied on these catalysts in 0.05 M H₂SO₄. An increase in the hydrogen adsorption charge, the oxide formation and the oxide reduction or desorption was observed with the Co content in the alloy for the alloys containing 20 to 84% of Co. It was further shown that the ORR on the Pd–Co alloys proceeds through four transferred electrons mechanism and a Tafel slope of 60 mV/dec. The electro catalytic performance of the ORR on the various electrodes studied here is: in the order Pd₁₆Co₈₄ < Pd₄₂Co₅₈ < Pd < Pd₅₀Co₅₀ < Pd₇₅Co₂₅ < Pd₆₅Co₃₅ < Pt. This result clearly shows that alloying Pd with a specific composition of Co enhances significantly the electro-catalytic properties of the ORR on Pd-Co alloys in comparison to Pd alone. The enhancement of the electro catalytic activity is attributed to an optimal d band property that makes easier the OOH dissociative adsorption which is considered as chemical rate-determining step (RDS) for the ORR.

