PRELIMINARY PROGRAM

---Monday, October 4, 2010---

08:30
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: General (MONAM1)
Not Available

Paper Start Time: 08:30
Paper No.: 5420
Paper Title: **KEYNOTE: Material Challenges and Approaches for Clean Energy Generation through Electrochemical Technologies**
David P. Wilkinson; University of British Columbia;
Electrochemical technologies can play an important role in clean energy systems. Even though much progress has been made with electrochemical technologies a number of significant technical challenges still remain today related to materials in the areas of cost, reliability, durability, operational flexibility, and technology simplification and integration. New advanced materials (and approaches) and associated design will be required to close these technical gaps. This presentation will provide a perspective on some electrochemical technologies, their role in cleaner energy production, and research and development directions especially with respect to material challenges.

Paper Start Time: 08:55
Paper No.: 5664
Paper Title: **INVITED: Materials Challenges for Automotive Fuel Cell Applications**
Mike Sexsmith; Automotive Fuel Cell Cooperation;
In recent years Polymer Electrolyte Membrane (PEM) based hydrogen fuel cells have been used to create zero emission passenger cars in several small demonstration fleets around the world. In late 2009 Daimler unveiled its 2nd generation B-Class fuel cell vehicle (FCV) which showcases the technology required to make a technically competitive power train. In order for such technology to become economical for mass deployment the cost of the power train needs to be reduced. To reduce the costs fuel cell three factors need to be considered: the economies of mass production, the cost of the basic materials and the power produced per cell. To enable progress in each of these factors, materials research and engineering is needed. By mapping possible improvement concepts in each category and using the principles of Systems Engineering to understand the leverage each can have on the final powertrain cost a set of high value materials improvements can be generated. From this it is demonstrated that improvements in sealing materials processing, carbon composites and their processing, stainless steel corrosion coatings and joining, Flouropolymer or hydrocarbon ionomer synthesis and nanostructured catalyst layer manufacturing could enable significant Fuel cell powertrain cost reductions.

Paper Start Time: 09:20
Paper No.: 5374
Paper Title: **INVITED: New Catalytic Nanomaterials for Clean Hydrocarbon Fuels**
Wojciech Suchanek; Sawyer Technical Materials, LLC;
Hydrothermal crystallization affords excellent control of morphology, size, agglomeration, and chemical compositions of inorganic powders, which generates unique performances of catalysts and catalytic supports useful in alkylation, transesterification, hydrogenation, oxidation, etc. Specific examples of hydrothermally synthesized alpha alumina (a-Al2O3) and zinc aluminate spinel (ZnAl2O4) are provided. ZnAl2O4 nanosized powders, with BET surface areas of 1-300 m2/g, were found to be excellent heterogeneous catalysts for biodiesel production. Phase-pure, c-faceted a-Al2O3 nano-sheets with thickness of 10-30 nm, controlled chemical properties by introduction of metal dopants, and thermal stability over 1000ºC, may supplement currently used transition aluminas in a variety of catalytic applications.

Paper Start Time: 09:45
Paper No.: 5382
Paper Title: **INVITED: Manganese Dioxide Electrodes for Electrochemical Supercapacitors**
Igor Zhitomirsky; McMaster University;
New methods have been developed for the chemical synthesis,electrosynthesis and electrophoretic deposition of nanostructured manganese dioxide films for application in electrochemical supercapacitors.Nanostructured manganese dioxide films were obtained cathodically using polymer-mediated electrosynthesis from solutions of Mn2+ salts, containing polymers. Another approach was based on the cathodic reduction of KMnO4 or NaMnO4 salts. Manganese dioxide nanowires were prepared by a template free chemical method and utilized for the fabrication of manganese dioxide -carbon nanotube composites by electrophoretic deposition and by casting method. Novel dispersants and charging additives have been developed for the electrophoretic deposition of manganese dioxide-

carbon nanotube composites. Obtained electrodes showed good capacitive behavior in a voltage window of 1 V. The specific capacitance of the composite electrodes was in the range of 300-650 F/g.

10:30
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: General (MONAM2)
Not Available

Paper Start Time: 10:30
Paper No.: 5312
Paper Title: **The Magnesium-air Fuel Cell**
Bruce Downing; MagPower Ssytesm Inc.;
MagPower's approach to an alternative energy source is the development of an environmentally friendly non-toxic power source that generates electricity through a combination of magnesium, oxygen and a saltwater electrolyte with MagPowers patent (and patent pending) technologies. The magnesium-air technology has never reached the commercial stage due to several technological barriers such as hydrogen generation, precipitate control, anode material, air diffusion cathode and inexpensive manufacturing process. The main technological barrier of hydrogen inhibition (HI) led to the first issued patent. Collaborative projects between MagPower Systems and various consultative and industrial groups have resulted in new (and improved) technologies which have resulted in advancing the magnesium-air to commercialization. This paper discusses the technological and commercial pathways of the magnesium anode, and the problems and barriers that MagPower faced and overcame.

Paper Start Time: 10:55
Paper No.: 5320
Paper Title: **Hydrogen Storage in Binary and Ternary Mg-based Alloys: a Comprehensive Experimental Study**
David Mitlin; University of Alberta and NINT NRC; Peter Kalisvaart, Chemical and Materials Engineering, University of Alberta and National Research Council Canada, National Institute for Nanotechnology; Christopher Harrower, Chemical and Materials Engineering, University of Alberta and National Research Council Canada, National Institute for Nanotechnology; Beniamin Zahiri, Chemical and Materials Engineering, University of Alberta and National Research Council Canada, National Institute for Nanotechnology; Eric Poirier, National Research Council Canada, SIMS, Canadian Neutron Beam Centre, Chalk River Laboratories; Helmut Fritzsche, National Research Council Canada, SIMS, Canadian Neutron Beam Centre, Chalk River Laboratories; David Mitlin, Chemical and Materials Engineering, University of Alberta and National Research Council Canada, National Institute for Nanotechnology;
This study focused on hydrogen sorption properties of 1.5 micrometer thick Mg-based films with Al, Fe and Ti as alloying elements. The binary alloys are used to establish as baseline case for the ternary Mg-Al-Ti, Mg-Fe-Ti and Mg-Al-Fe compositions. We show that the ternary alloys in particular display remarkable sorption behavior: at 200C the films are capable of absorbing 4-6 wt.% hydrogen in seconds, and desorbing in minutes. Furthermore, this sorption behavior is stable over cycling for the Mg-Al-Ti and Mg-Fe-Ti alloys. Even after 100 absorption/desorption cycles, no degradation in capacity or kinetics is observed. For Mg-Al-Fe, the properties are clearly worse compared to the other ternary combinations. These differences are explained by considering the properties of all the different phases present during cycling in terms of their hydrogen affinity and catalytic activity. Based on these considerations, some general design principles for Mg-based hydrogen storage alloys are suggested.

Paper Start Time: 11:20
Paper No.: 5318
Paper Title: **Degradation of Silicon Nitride Glow Plugs Powered by Alternating Current in Ambient Air**
Carmen Oprea; University of British Columbia; Colin Blair, Westport Innovations Inc.; Alan Welch, Westport Innovations Inc.; Hamed Karimi Sharif, The University of British Columbia; Tom Troczynski, The University of British Columbia;
All-ceramic glow plugs (GP) based on sintered silicon nitride are best candidates for hot surface ignition systems in direct injection combustion engines fueled by natural gas and hydrogen. The complex degradation of the Si3N4 in GPs powered by direct current (DC) was studied previously by accelerated testing in ambient air and in burner rig. The principal mechanism involves re-distribution of the sintering additive ions of ytterbium under the influence of the electric field. This work presents the results of accelerated degradation in air, under alternating current (AC), for different conditions. The redistribution of the sintering additive ions in Si3N4, as studied primarily by SEM, occurred to a much lesser degree than in DC, resulting in an estimated 11 times longer life in service of the GP.

14:00
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: Materials Processing/Performance 1 (MONPM1)
Not Available

Paper Start Time: 14:00
Paper No.: 5123
Paper Title: **INVITED: Preparation and Characterization of Pd-Ru Alloy Composite Membranes**
Anwu Li; University of British Columbia; Shin-Kun Ryi, Department of Chemical and Biological Engineering, University of British Columbia; Jim Lim, Department of Chemical and Biological Engineering, University of British Columbia; John Grace, Department of Chemical and Biological Engineering, University of British Columbia;
The world nowadays faces many challenges associated with excessive utilization of fossil fuels, such as poor air quality and greenhouse gas emissions. Hydrogen appears to be an attractive alternative to the conventional fossil fuels with better energy efficiency and less environmental impact. Pd and Pd-based alloy are the most often used membranes for hydrogen separation due to their superiority over other membranes. However, the stability of the commonly-used thin Pd-based composite membranes at high temperatures still remains a big challenge. In this presentation, we will report our progress on thin Pd-Ru alloy composite membrane by electroless plating high temperature applications.

Paper Start Time: 14:25
Paper No.: 5129
Paper Title: **On the Possibility of Synthesis of Solar-grade Silicon from Rice Husk Ash**
Kingsley K. Larbi; University of Toronto; Mansoor Barati, University of Toronto; Alexander McLean, University of Toronto; Raja Roy, University of Toronto;
Impurity optimized silicon is required for the advancement of terrestrial photovoltaic power generation. In this study an approach to synthesize solar grade silicon using rice husk ash has been pursued. Metallothermic reduction of the purified rice husk ash (RHA) was investigated within the temperature range of 500-950 oC using magnesium in varied amounts. The reduction product was purified by two stage acid leaching sequence. Analysis of the final silicon product by XRD, SEM, and ICP-OES showed crystalline silicon with B and P content to be less than 3ppm and 72ppm respectively which correspond to the instrument detection limit for these impurities.

Paper Start Time: 14:50
Paper No.: 5214
Paper Title: **A Novel Purification Method for Production of Solar Grade Silicon**
Shaghayegh Esfahani; University of Toronto; Mansoor Barati, University of Toronto;
Purification of metallurgical grade silicon (MG- Si) by a combination of solvent refining and physical separation has been studied. MG-Si was alloyed with iron and solidified with different cooling rates to grow pure Si dendrites from the alloy. The Si dendrites and FeSi2 that were formed after solidification were then separated by a gravity-based method, using heavy media. Since pure Si particles have much less density than FeSi2, they formed a thick layer on the top of heavy media and the FeSi2 particles were settled at the bottom. The effect of particle size and cooling rate on the yield and separation efficiency of the Si phase was investigated. The floated Si particles were further purified by removing the physically adherent Fe-Si phase, using an acid leaching method. Analysis of the produced silicon indicates that several impurity elements can be efficiently removed using this simple and low-cost technique.

15:35
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: Materials Processing/Performance 1 (MONPM2)

Paper Start Time: 15:35
Paper No.: 5311
Paper Title: **Damage of PZT Ceramics (Pb(Zr,Ti)O3) in High Pressure Hydrogen**
Ali Shafiei; Department of Materials Engineering, University of British Columbia; Carmen Oprea, Department of Materials Engineering, University of British Columbia; Tom Troczynski, Department of Materials Engineering, University of British Columbia;
Piezoelectric actuators based on Pb(Zr,Ti)O3 (PZT) ceramics are leading candidates for hydrogen fuel injectors. It is however known that H2 can penetrate PZT and lead to progressive deterioration of its properties. In this work interactions between PZT and pure H2 have been investigated in a systematic way, at a constant H2 pressure (100 atm) and temperature (100 °C), and different exposure times (200-400, 600 and 1200 hrs). After H2 treatment, microstructural and electrical properties changes of the samples were investigated, and the results were compared to those of the as-received samples. The results show that hydrogen can cause micro-cracking and noticeable changes in the electrical properties of the PZT ceramics.

Paper Start Time: 16:00
Paper No.: 5254
Paper Title: **INVITED: The Changes of Elements Binding Energy during Crack Healing of Al2O3- MgAlON Composite**
Daoyuan Yang; Zhengzhou University; Xu Bo, School of Materials Science & Engineering, Zhengzhou University; Huiyu Yuan , School

of Materials Science & Engineering, Zhengzhou University; Fenling Qian, School of Materials Science & Engineering, Zhengzhou University; Wei Guanghui, School of Materials Science & Engineering, Zhengzhou University;
Al2O3-MgAlON composite from Al, MgO and Al2O3 was synthesized in N2 by hot-press sintering. The cracks prepared on the sample surface were healed at 1200ºC×6h. Phase composition and element chemical state of sample were studied before and after healing. The results showed that, after healing process Al and MgO disappeared, and AlN and MgAlON increased, element chemical state in Al2O3-MgAlON material changed, the changed electronic binding energy were Al 0.05ev, Mg 0.08ev, O 2.58ev, N 1.02ev respectively, and the chemical composition and crystal structure of MgAlON phase also changed, all these changes might improve the material crack healing process.

---Tuesday October 5, 2010---

08:30
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: Coatings/Modeling (TUESAM1)
Not Available

Paper Start Time: 08:30
Paper No.: 5464
Paper Title: **Solution Precursor Plasma Spray Deposition of Functional Ceramics**
Tom Coyle; University of Toronto; Ken L. Chien, University of Toronto; Mehdi Golozar, University of Toronto; Youliang Wang, IMI, National Research Council; Yanguang Shan, Shanghai University for Science and Technology;
Solution precursor plasma spray (SPPS) was introduced in the 1990s and has been investigated extensively since then. This process offers the promise of producing nanostructured coatings of a wide variety of compositions, and avoids the often difficult requirement of obtaining powder of the desired composition and particle size. The large number processing parameters involved in the SPPS process make it difficult to establish relationships between the processing parameters and the properties of the deposited coatings. Recent experimental and numerical simulation results have begun to identify how the nature of the solution precursor affects the evolution of the droplets in the plasma and the structure of the coating. SPPS by direct current arc plasma spraying (DC-SPPS) is well suited to the deposition of coatings with nanocrystalline grains, high porosity, and high surface area suitable for use as electrochemical electrodes. We have successfully deposited nanocrystalline coatings of functional ceramics such as LaMnO3, Ni-YSZ, SnO2, TiO2, and other oxide semiconducting materials of interest for SOFCs, batteries, and ultracapacitors. The nature of partially reacted solution droplets extracted from the plasma and the structure of these coatings are compared with the predictions of numeric simulations of droplet evolution within the plasma to gain insight into the evolution of the solution droplets during the process.

Paper Start Time: 08:55
Paper No.: 5570
Paper Title: **INVITED: Nanocomposite Protective Coatings for Clean Technology Applications**
Jolanta E. Klemberg-Sapieha; Ecole Polytechnique;
Recent advances in the technological sectors of aerospace, automotive, optical, architectural, energy management, environment control and others stimulate research on high performance functional coatings and surface and interface engineering processes. In many cases, the ever increasing requirements involve an ideal combination of the mechanical, tribological, corrosion, thermal and other characteristics that can only be satisfied by using specifically tailored film architectures including nanocomposite, nanolaminate, multilayer and graded layer systems. In addition, new film deposition processes are being sought that are energy efficient and environmentally friendly. In this presentation, we will outline approaches that allow one to design and fabricate high-performance protective coatings based on understanding the film growth mechanisms and the process simulation techniques. We will briefly describe our recent studies of the ion-surface interactions in low pressure plasma environment, particularly in the bias- and pulse-controlled techniques using plasma enhanced chemical vapor deposition and physical vapor deposition, while using a methodology combining in situ real-time process diagnostics and complementary microstructural and chemical analysis methods. We will particularly focus on the very promising nanostructured and nanocomposite coating systems comprising Ti-Si-N, Ti-Si-C-N, Ti-Si-C, and Cr-Si-N systems. We will specifically describe new opportunities and surface engineering pathways leading to attractive technological solutions in the areas of protective coatings against the synergistic effects of erosion, wear and corrosion in the aerospace and manufacturing applications. Examples of systems with optimized elasto-plastic and tribo-corrosion coating characteristics include compressor blades of jet engines, cutting tools, gear assemblies of aircraft, helicopter and windmills, fuel cells, and others.

Paper Start Time: 09:20
Paper No.: 5408
Paper Title: **INVITED: Axial Suspension Plasma Spray Applications and New Developments**
Alan W. Burgess; Northwest Mettech Corp;

The Axial Suspension Plasma Spray (ASPS) process is a new technology the enables unique coatings in 1-100 micron range. These coatings can be applied cost effectively and with high quality. Now moving from the lab into production, this talk discusses current and potential applications in the aerospace, fuel cell, semiconductor and medical industries.

Paper Start Time: 09:45
Paper No.: 5355
Paper Title: **INVITED: Analysis of Deformation Twins and the Partially Dehydrogenated Microstructure in Nanocrystalline Magnesium Hydride (MgH2) Powder**
Peter Kalisvaart, Chemical and Materials Engineering, University of Alberta and NINT NRC; Shu Xia Tao, Chemical Engineering and Chemistry, Eindhoven University of Technology; David Mitlin, Chemical and Materials Engineering, University of Alberta and NINT NRC; Mohsen Danaie, Chemical and Materials Engineering, University of Alberta and NINT NRC;
We combined cryo-stage transmission electron microscopy (TEM) with Density Functional Theory (DFT) to explore the microstructure of magnesium hydride (MgH2) powders. Mechanical milling results in deformation twinning of the hydride. The crystallography of the twins is established. DFT analysis shows that there is reduced activation energy for hydrogen diffusion along the twin interface. Our hypothesis is that twins contribute significantly to the observed milling-induced kinetic enhancement by acting as high diffusivity paths. Energy-Filtered TEM (EFTEM) analysis on partially desorbed MgH2 demonstrates that nucleation and growth of metallic magnesium occurs non-uniformly. Larger powder particles are a composite of isolated magnesium grains heterogeneously nucleated on the remaining hydride. Smaller particles are either fully transformed to magnesium or remain entirely a hydride. There is little evidence for any □core-shell structure. We also show that in-situ hydrogen desorption in the TEM is not representative of the elevated-temperature ex-situ sequence.

10:30
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: Coatings/Modeling (TUESAM2)
Not Available

Paper Start Time: 10:30
Paper No.: 5152
Paper Title: **Oxidation of Silicon Nitride Glow Plugs in Air**
Hamed Karimi Sharif; Materials Engineering, University of British Columbia; Carmen Oprea, Materials Engineering, University of British Columbia; Tom Troczynski, Materials Engineering, University of British Columbia; Colin C. Blair, Westport Innovations Inc.; Alan Welch, Westport Innovations Inc.;
Silicon-nitride-sintered-body glow plug (GP) is the most viable hot surface ignition system candidate for natural gas and hydrogen direct injection combustion engines. Unfortunately, the state-of-the art ceramic glow plugs fail prematurely in high-performance engines mainly due to the redistribution of sintering additives in Si3N4/Yb2O3 system under the influence of electric field as well as concentration gradient between the GP body and protective silica film. The latter causes the ytterbium ions to migrate toward the surface facilitating further penetration of oxygen into the GP. This work models silicate scale formation of experimental results of the accelerated degradation tests of the GPs in air under DC electric field. The width of depletion layer beneath the silicate scale is measured by scanning electron microscopy and used to verify the model against experimental results.

Paper Start Time: 10:55
Paper No.: 5274
Paper Title: **Modeling of Effective Parameters on Permeability of Porous Media with Application to Fuel Cell**
Amir Masoud Parvanian; Isfahan University of Technology; Masoud Panjepour, Isfahan University of Technology; Gholamreza Aryanpour, Isfahan University of Technology;
Different components of proton exchange membrane fuel cells can benefit from porous media special characteristics; such as lightness, remarkable area to volume ratio, mechanical strength, etc. Various important factors specially permeability can control and optimize the properties of porous materials. The aim of this investigation is modeling of effective parameters on permeability such as pore size, pores per inch (PPI), connectivity and thickness. The monte carlo is used to geometry generation of porous layer and then fluid flow through it has been modeled using Lattice Boltzmann Method. The results could be used for designing of porous layers applicable in PEMFC.

Paper Start Time: 11:20
Paper No.: 4926
Paper Title: **Growth of AgInSe2 Films on Glass by Laser Ablation**
Dinesh Pathak; Physics, GNDU, Amritsar; R.K. Bedi, GNDU Amritsar; Davinder . Kaur, IIT Roorkee;
Laser ablation has attracted special interest for the formation of thin films Compared with other formation technique . A distinctive

feature of laser ablation is that it allow high quality and stochiometry of films of even very complex element material. In this presentation laser ablation of AgInSe2 chalcopyrite semiconductor will be discussed in which it is difficult to maintain stochiometry by conventional method. High Quality AgInSe2 (AIS) films were grown on Glass substrates by the ultra-high-vacuum pulsed laser deposition technique from the AIS target synthesized from high-purity materials. The X-ray diffraction studies of the films show that films are textured in (112) direction. .The substrate temperature appears to influence the properties of films. Increase in substrate temperature results in more order structure .Compositional analysis has been carried out by EDAX. It is observed that compositional stochiometry is maintained to the more extent by PLD technique than other traditional methods like thermal evaporation. The optical studies of the films show that the optical band gap is about 1.20 eV

14:00
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: Materials Processing/Performance 2 (TUESPM1)
Not Available

Paper Start Time: 14:00
Paper No.: 5192
Paper Title: **Review of Methods for Removing Pollutants from Flue Gases in Clean Coal Technologies**
Mohammad Reza Shadnam; KPMG; Maryam Mahmoudi, SFU;
Coal counts for 50% of electric power production in United States. This contribution provides an assessment of research and development efforts to optimize SOx, NOx and mercury capture in flue gas. Coal characteristics and combustion conditions in a power plant have an impact on the types and concentration of flue gas pollutants. These factors can also affect the amount of pollutant removed. This contribution would also provide a comparative study of the technologies that holistically aim removal of SOx, NOx and mercury altogether in coal-fired power plants. A portion of this contribution provides background information on regulatory drivers.

Paper Start Time: 14:25
Paper No.: 5293
Paper Title: **Fuel Processing for Fuel Cell Power Systems**
Brant A. Peppley; Queen's-RMC Fuel Cell Research Centre, Queen's University; Christopher P. Thurgood, Royal Military College of Canada;
Fuel cells offer the potential for very clean energy production with significantly reduced GHG emissions. Although it is commonly believed that fuel cells require pure hydrogen there are actually a number of ways in which conventional hydrocarbon fuels and alternative liquid fuels such as alcohols or dimethyl ether can be used as the primary fuel. Innovative catalysts and adsorbents are required to reduce the overall cost of fuel cells systems and design efficient fuel processors. This presentation will discuss several new concepts for fuel processor designs and possible catalyst systems for utilizing liquid fuels with fuel cell systems.

Paper Start Time: 14:50
Paper No.: 5607
Paper Title: **Copper Coated Anode Current Collector for Solid Oxide Fuel Cells Operating on Hydrogen Sulfide Containing Syngas**
Qingxun Low; University of Alberta; Jingli Luo, University of Alberta; Xianzhu Fu, University of Alberta; Juri Melnik, University of Alberta; Alan R Sangera, University of Alberta; Karl T. Chuang, University of Alberta; Quan-Min Yang, Inco Technical Services Limited ;
Ni foam current collector has excellent electronic conductivity and mechanical property. However, nickel foam cannot be used in hydrogen sulfide containing syngas SOFCs due to sulphur poisoning and coking. Copper coated nickel foil and foam are prepared by electrochemical deposition. XRD, SEM, and EDX techniques are used to characterize the samples. After treatment in hydrogen sulfide containing syngas at high temperature, the coated samples exhibit high resistance of coke formation and sulphur corrosion compared to pure nickel. Therefore, copper coated nickel foam is a promising anode current collector for hydrogen sulfide containing syngas SOFCs.

15:35
Room: Stanley (Perspct-34th Floor)
Stream: MATERIALS FOR CLEAN ENERGY
Session: Materials Processing/Performance 2 (TUESPM2)
Not Available

Paper Start Time: 15:35
Paper No.: 5422
Paper Title: **Oxidation Behavior of Haynes HR-224**

Henry J. White; Haynes International;
Proposed operating temperature for Solid Oxide Fuel Cells (SOFC) will push the limits of stainless steels and will require fabricators to use more expensive nickel based alloys in their design. A new cost effective, weldable, fabricable, aluminum oxide forming nickel based alloy, Haynes HR-224, was developed for SOFC fuel cell systems. The oxidation behavior of HR-224 alloy will be compared to other aluminum oxide and chromium oxide forming alloys of interest to the SOFC industry.

Paper Start Time: 16:00
Paper No.: 5653
Paper Title: **Thermoelectric Properties of ß-Zn4Sb3 Synthesized by Mechanical Alloying and Vacuum Hot Pressing**
Pee-Yew Lee; National Taiwan Ocean University; Y.C. Ho, National Taiwan Ocean University; Pee-Yew Lee, National Taiwan Ocean University;
Thermoelectric power generation is a helpful method for harnessing waste thermal energy, particularly covering a middle temperature range between 500 and 800 K. Theß-Zn4Sb3 compound has become the focus of attention as a thermoelectric material applicable to thermoelectric power generation around 700 K. It has a relatively low cost and can potentially substitute for high performance lead tellurides which contain toxic lead. In this research, a method combining the mechanical alloying with the vacuum hot pressing was adopted to obtain the bulk sample ofß-Zn4Sb3. Pure zinc and antimony powders were used as the starting material for mechanical alloying. These powders were mixed in the stoichiometry ratio of 4 to 3, or more Zn-rich. The mechanical alloying was carried out by planetary ball milling under conditions of fixed revolution speed and variable milling time. The influence of the milling time on the synthesis ofß-Zn4Sb3 was investigated. The vacuum hot pressing was executed at four different temperatures for 30 min under a pressure of 1.20 GPa. The influences of the hot pressing temperature on the polycrystalline grain size and the thermoelectric properties were also studied. It is found single-phaseß-Zn4Sb3 were successfully prepared by mechanical alloying of elemental powders containing 0.6 at.% excess Zn. Thermoelectric properties as a function of temperature were investigated from room temperature to 600 K and compared with results of other studies. Transport properties at room temperature were also evaluated. Thermoelectric properties of single-phase ß-Zn4Sb3 materials produced by present method were measured and are comparable to the published data. Synthesis by mechanical alloying and vacuum hot pressing provides an optional processing route in this material.

Paper Start Time: 16:25
Paper No.: 5361
Paper Title: **Nanostructured Magnesium for Energy Storage & Conversion**
Jun Chen; Institute of New Energy Material Chemistry, Nankai University; Fangyi Cheng, Nankai University; Zhanliang Tao, Nankai University; Jing Liang, Nankai University;
The search for clean and renewable energy sources is an urgent target owing to the issues of resource limitation and environmental pollution. Magnesium (Mg), the eighth abundant element in the earths crust, is attractive because of its low cost, light weight, and environmental friendliness. Mg nanomaterials are topics of current interests and have shown a great potential in energy storage & conversion due to their unique properties compared to their bulk counterparts. Consequently, the development of Mg nanomaterials has undergone considerable attention and it would be important to forecast the more practical results of this research. In this presentation, we first demonstrate the shape-controlled preparation of Mg nanostructures by various methods such as high-energy ball milling, physical or chemical vapor deposition, and vapor transportation, etc. The structural and morphological merits of Mg nanomaterials have been especially addressed on. Next, we discuss Mg nanostructures in terms of their prospective applications in primary and rechargeable magnesium batteries and hydrogen storage for hydrogen-oxygen fuel cells. This report is expected to lead to fundamental innovations of Mg nanostructures in energy storage & conversion.

Paper Start Time: 16:50
Paper No.: 5389
Paper Title: **Hydrothermal Synthesis and Electrochemical Properties of Cobalt-Carbon Nanotubes Nanocomposite**
Yan Han, Nankai University; Yijing Wang, Nankai University; Yaping Wang, Nankai University; Lifang Jiao, Nankai University; Yongmei Wang, Nankai University; Huatang Yuan, Nankai University;
Cobalt-Carbon Nanotubes composites (Co-CNTs) were synthesized through a hydrothermal route. XRD, SEM and TEM characterizations revealed that the products contained abundance of carbon nanotubes connected by the cobalt spheres and some of them were filled with metallic nanoparticles or nanorods. A series of electrochemical measurements showed that the Co-CNTs composite possessed a good cycle performance and a high reversible electrochemical capacity above 310 mAh/g after 100 cycles, which was about 200 mAh/g higher than hydrothermally synthesized Co without CNTs. Efficient charge transfer in the composite and excellent anticorrosion property were suggested to be the possible reasons for the improvement.

Paper Start Time: 17:15
Paper No.: 5255
Paper Title: **Crack Healing Process of Al2O3- MgAlON Composite**
Daoyuan Yang; Zhengzhou University; Fen-ling Qian , School of Materials Science & Engineering, Zhengzhou University; Huiyu Yuan,

School of Materials Science & Engineering, Zhengzhou University; Bo Xu, School of Materials Science & Engineering, Zhengzhou University;

Al2O3- MgAlON composite was synthesized in N2 at 1500?×2h, using Al, MgO and Al2O3 as raw materials. After cracks were prepared on the sample surface, healing at 800-1500×6h were carried out respectively for 6h. The study result of the strength and its recovery rate of the samples, the phase composition of sample and IR spectrum of samples pre and post healing treatment indicated that: after healing treatments, the strength recovery rate of the sample was monotonously increased up to 103% with the treatments increased to 1500; there were no phase composition and IR spectrum change in the process and the characteristic IR absorption peak of MgAlON were 765cm-1?576cm-1?696cm-1?453cm-1; the crack healing of sample might be mainly caused by migration and filling of particles caused by diffusion.