2019 FUEL CELL SEMINAR TECHNICAL POSTERS – HALL A

P1: 1 TO 10-KW DIESEL/JET-FUELED SOFC GENERATORS FOR MOBILE APPLICATIONS

Subir Roychoudhury, Precision Combustion, Inc

- The study presents the performance data from the 1-kW and 10-kW solid oxide fuel cell (SOFC) prototype systems, including operation with different fuels. This will include long-term system performance, transient and steady state data, system efficiency, conditioned power output, control response, safety, water recovery, maintenance requirements, emissions, packaging constraints, and effect of multiple start/stop cycles. This presentation will also highlight the system characteristics relating to sulfur cleanup, water balance, and stack performance.

P2: SOFC AS THE KEY ATTRIBUTE TO VIRTUAL PIPELINE SYSTEM

Ling-Yuan Tseng, Electric Energy Express

- For offshore islands, remote communities, and rual areas not connected to a power grid or gas network, delivering energy is a challenge for all level of governments. Liquefied natural gas is the most economic way of transporting energy to distant customers. Once arrives at the destination, unloading the cargo and stored in big cryogenic tanks, then re-gasify into gaseous form when deliver through the pipeline. For gas pipeline un-accessible areas, transporting LNG via highway, railway or waterway to designated locations then re-gasified on-site, will be the best solution. The integration of SOFC into the LNG vaporizing process will provide the maximum flexibility and lowest cost of operation.

P3: SOLID OXIDE FUEL CELL ENERGY CONVERSION NETWORKS

Mark C. Williams, Keylogic

- A powerful electrical network analyzer, Pspice, is used to explore alternative solid oxide fuel cell configurations in Energy Conversion Networks (ECN's). The ECN's electrical network configurations are important in determining how solid oxide fuel cells can support modern grid performance and resiliency. The analysis results in this paper include the power and efficiency responses of the ECN's of interest as results from multiple solid oxide fuel cells responding within the electrical network representing a microgrid.

P4: STUDY ON FABRICATION OF ANODES FOR SOFCS WITH 3D PRINTING TECHNOLOGY

Kotaro Miyamoto, University of Kitakyushu

- The porous structure of anodes in SOFCs is the key factor to improve its performance and the manufacturing method to control its design needs to be established. Additive manufacturing, so-called 3D printing technology can be a prospective method for the fabrication of electrodes of SOFCs. In this experiment, stereolithography, which is a form of 3D printing technology using UV-light with approximately 365nm wavelength and photo-curable resin, is applied. The UV-light that goes through pinholes enables the production of multiple cylindrical objects at once.

P5: DEVELOP THE HIGH IONIC CONDUCTIVITY ELECTROLYTE IN SOLID OXIDE FUEL CELL

Zhipeng Li, Zynergy Technology Incorporation

- In this study, a comprehensive study of the defect structures in rare-earth doped ceria have been performed, through both experimental and simulation techniques. The defect cluster model is proposed accordingly, which can provide us a clear picture of the relation between the doping and ionic conductivity. It can also help us understand the microstructure evolution in rare-earth doped ceria at atomic level. Furthermore, this model can effectively predict the optimization of dopants in fluorite ceria, which shed light on the searching/developing of high ionic conductivity of rare-earth doped ceria.

P6: DEVELOPMENT AND EVALUATION OF AMMONIA-FED METAL-SUPPORTED SOLID OXIDE FUEL CELLS

Jaeseok Lee, Korea Advanced Institute of Science and Technology

- In this study, a metal-supported solid oxide fuel cell (MS-SOFC) fabricated by wet-chemical coating processes was developed and evaluated under the direct ammonia-fed operation. First of all, microstructures of the developed MS-SOFC were observed and analyzed by focused ion beam scanning electron microscope (FIB-SEM) and energy dispersive x-ray spectroscopy (EDS). Furthermore, the electrochemical performances and electrochemical impedance spectroscopy (EIS) of the MS-SOFC were evaluated by Solartron 1287 and 1260, respectively. As a result, the well-organized microstructure, stable open circuit voltage (OCV), and high electrochemical performance were confirmed.

P7: INTEGRATION OF SOLID OXIDE STEAM ELECTROLYZER SYSTEM INTO THE UCI MICROGRID TO SUPPORT HIGH RENEWABLE USE

Alireza Saeedmanesh, National Fuel Cell Research Center

P8: POWER ENHANCEMENT OF SOFC POWER GENERATION SYSTEMS USING THERMAL MANAGEMENT AND DYNAMIC ANALYSIS

Yen-Hsin Chan, Industrial Technology Research Institute

- This paper performs the dynamic analysis to evaluate the change of the temperature for each heat component during a SOFC heating process. The results show that the stack would be damaged by excessive operating temperature if the quantity of fuel gases is not controlled well. In the present case, the optimal flow rate of fuel gas is 62.5% of the full flow rate in the power generation process.

P9: POWER RESPONSE OF SOFC CELL-STACKS WITH AN INSTANTANEOUS LOAD FLUCTUATION

Koichi Asano, Central Research Institute of Electric Power Industry

- The degradation factors for SOFC durability have been analyzed by using the electrode polarization model, which has been developed by CRIEPI. As a result, an instantaneous power response with SOFC cell-stacks and the voltage decay rates of each SOFC during the load-variation tests were clarified.

P10: SILICON SUBSTITUTION INTO INORGANIC SOLID ELECTROLYTE THROUGH AB INITIO MOLECULAR DYNAMICS

Lihan Peng, National Tsing Hua University

- In this poster, we investigate the effect of aliovalent substitution in Li6PS5Br solid electrolyte via the first principles calculation techniques and ab initio molecular dynamics (AIMD) simulation of its crystal structure. We also demonstrate the diffusion mechanisms as well as interactions of lithium ion in the interstitial transport phenomenon.

P11: PERFORMANCE OF NI-GDC MINI-TUBULAR ANODE SUPPORTED SOLID OXIDE FUEL CELL AS AN INDUSTRIALLY VIABLE ENERGY SOURCE

Gonzalo Abarzua, University of Concepcion

- Solid Oxide Fuel Cells (SOFCs) are probably the most efficient elements in terms of the conversion of chemical energy into electrical energy. In this work, Ni-GDC anode-supported minitubular solid oxide fuel with GDC as electrolyte and LSFC-

GDC as cathode have been developed, analyzed and characterized.

P12: DEVELOPMENT OF OUTPUT GAS MEASUREMENT METHODS FOR STEAM ELECTROLYSIS USING SOLID OXIDE CELLS

Yohei Tanaka, National Institute of Advanced Industrial Science Technology

- Power to gas technology has attracted much attention to convert electrical energy into fuels such as hydrogen and methane for energy storage using surplus renewable and other energy. Output gas analysis from the fuel electrode is required to evaluate cell/stack performance, which consists of hydrogen, steam and sometimes nitrogen accompanied with gas leakage. We developed a new flow-rate measurement method using a thermal mass-flow meter and a micro-gas-chromatograph for such gas mixtures above 100 °C.

P13: SOFC REX WITH ADSORPTION CHILLER - THE FUTURE OF URBAN PUBLIC TRANSPORTATION?

Thomas Krauss, AVL List GmbH

- Since 2002 AVL is working on fuel cells with the focus on mobile/stationary SOFC and automotive PEM Systems. Due to AVLs collaboration with the automotive industry it has a good understanding of the requirement a SOFC Range Extenders must fulfill to meet customer demands. Therefore, AVL investigated the coupling of an SOFC REX with an onboard adsorption chiller for heating and cooling of the vehicle.

P14: PORTABLE JP8-FUELED SOLID ACID FUEL CELL SYSTEM

Calum Chisholm, SAFCell

- This project addresses the Army's need for high-energy density, lightweight power sources for dismounted soldiers. Over two years of Phase II efforts, we have successfully integrated our proprietary solid acid fuel cell (SAFC) stack with a auto-thermal JP-8 reformer and other balance-of-plant components required to produce a 50 Wnet person-portable, rugged, and efficient power supply, capable of running for 500 hours with a system energy density of 1000 Whr/kg. The system runs on military grade, desulfurized JP-8 fuel.

P15: ESTIMATION OF CURRENT DISTRIBUTION INSIDE MEA IN SINGLE CELL TYPE PEFC BY PARTICLE FILTER USING CIRCUMFERENCE MAGNETIC FIELD

Tomoyuki Taguchi, Oita University

- In this paper, the distribution of the static magnetic field around the PEFC is measured, and the presumed technology of the distribution of the power generation current inside the MEA by an inverse problem analysis is proposed.

The static magnetic field around the fuel cell is measured by MI (Magneto-Impedance) sensor of three axes. The MI sensor is a sensor for measuring the magnetic field by the magneto-impedance effect. This MI sensor is arranged at 36 places of the single cell type around the fuel cell. In the inverse problem analysis, the particle filter is used for the estimating of the distribution of the power generation current inside the MEA.

P16: FUNDAMENTAL CHARACTERIZATION OF CATALYST LAYER IONOMER INTERACTIONS IN PEM FUEL CELLS

Derek Richard, Los Alamos National Laboratory

P17: POLYMER BLEND ELECTROLYTE MEMBRANE CONTAINING HYDROXYL GROUP FOR PROTON EXCHANGE MEMBRANE FUEL CELL & WATER ELECTROLYSIS APPLICATIONS

So Young Lee, Korea Institute of Science & Technology

P18: SUPPORT DURABILITY ENHANCEMENT OF PT/C CATHODE CATALYST OF POLYMER ELECTROLYTE MEMBRANE FUEL CELL

Taekeun Kim, Chungnam National University

- HSAC (High surface area carbon) is widely used as a support of Pt/C catalyst due to its excellent electrical conductivity, pore structure suitable for supporting Pt nanoparticles, high surface area for uniform Pt particle dispersion and low cost. However, previous studies have shown that high surface area carbons are less resistant to thermal and electrochemical oxidation due to their amorphous carbon structure and dangling bonds. Graphitic carbon materials have been used as support materials of the Pt/C catalyst in order to improve durability.

P19: INVERSE PROBLEM ANALYSIS OF DISTRIBUTION OF POWER GENERATION CURRENT INSIDE PEFC USING MAGNETIC FIELD AROUND FUEL CELL

Takeshi Neki, Oita University

- In this paper, the evaluation method of the distribution of the power generation current inside MEA using the distribution of static magnetic field around PEFC is proposed. By this proposed method, the distribution of power generation current inside MEA is presumed without disturbing the power generation state or changing the internal structure of the fuel cell.

P20: TEMPERATURE IMPACT ON THE INTERNAL RESISTANCE OF A PEFC CONSIDERING THE ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

Mayken Espinoza, Centro de Energias Renovables y Alternativas

- In this study, the internal resistance of a PEFC is evaluated by using Electrochemical Impedance Spectroscopy (EIS) at moderate low current density, i.e., 0.5 A/cm2, in the range of 40 – 80°C. The evaluation is carried out considering frequencies between 10kHz and 0.1Hz. Results show that the ohmic resistance and charge transport at low frequencies increase when the operating temperature is low, while the double layer capacitance increase at high temperatures.

P21: FUNCTIONALIZED PHOSPHONATES PROTIC IONIC LIQUIDS WITH VERY HIGH PROTONIC CONDUCTIVITY FOR PROTON EXCHANGE MEMBRANE FUEL CELLS (PEMFCS)

Badr Jismy, Université de Tours Sciences et Techniques

P22: LIQUID HYDROGEN SAFETY RESEARCH

Thomas Jordan, Leiter Wassterstoffgruppe IKET

P23: BIPHENYL-BASED LIQUID ORGANIC HYDROGEN CARRIER FOR HYDROGEN STORAGE

Suk Woo Nam, Korea Institute of Science and Technology

- Here, we present a new eutectic mixture of biphenyl (35wt%) and diphenylmethane (65wt%) as a novel liquid-organic hydrogen carrier (LOHC), and their H2 storage/release properties are characterized. In addition, small-sized hydrogenation and dehydrogenation systems for different stationary fuel cell applications are further discussed.

P24: DESIGN OF A COST-EFFECTIVE AND HIGHLY EFFICIENT PRESSURIZED MODULAR HYDROGEN DISTRIBUTED PRODUCTION PLATFORM FOR VOLUNTARY MARKET DIFFUSION

Wang Lai Yoon, Korea Institute of Energy Research

- Design, fabrication and performance validation of a genuine hydrogen production platform (reforming module + VPSA module) with 100 Nm3/h H2 capacities as a test stand is carried out. The baseline design consists of ambient desulfurization, steam methane reforming (SMR), low temperature water gas shift (LTS) and vacuum pressure swing absorption (VPSA) for hydrogen purification and auxiliary components (steam generator, superheater, heat exchanger, burner, pump, compressor and control logics).

P25: FIRST PRINCIPLES ANALYSIS ON METHANOL PRODUCTION USING ARTIFICIAL PHOTOSYNTHESIS SYSTEMS

Hong-Yi Ji, National Tsing Hua University

- This research aims to use the first principles calculation technique to study the effect of inorganic/organic photoanode and the metal organic frameworks (MOFs) cathode on an artificial photosynthesis system.

P26: PARAMETER TUNING OF FUEL CELL SYSTEM USING AN IMPROVED WHALE OPTIMIZATION ALGORITHM

En-Jui Liu, National Tsing Hua University

P27: MULTISCALE SIMULATION AND PERFORMANCE PREDICTION OF FUEL CELLS AND BATTERIES

I-An Chiang, National Tsing Hua University

- The objective of this research is to generate a simulation package which employs a multiscale model to simulate the transport phenomena and to predict the electrochemical performance of various fuel cells and batteries. An electrochemically similar lithium ion battery (LiB) containing a separator membrane with carbon anode and various molecule structured cathodes is demonstrated to show how the choice of cathode materials can influence the final performance of general lithium ion batteries.

P28: DEVELOPMENT OF BIMETALLIC NANOSPONGE ELECTRODES WITH ENHANCED PERFORMANCE FOR AMBIENT ELECTROCHEMICAL REDUCTION OF NITROGEN TO AMMONIA

Dr. Feng-Yuan Zhang, UT Space Institute, University of Tennessee, Knoxville

- Electrochemical reduction of nitrogen to ammonia under ambient conditions could be a promising alternative to the Haber-Bosch process. The high-performance electrocatalysts and associated electrodes for the nitrogen reduction reaction (N2RR) have been strongly desired. In this study, we explored bimetallic Ru-Cu nanosponge (NSP) catalysts fabricated with rapid and facile methods and demonstrated N2RRs at room temperature and atmospheric pressure. The NSP Ru-Cu catalysts with excellent morphology regulation and synergistic effect exhibit outstanding N2RR performance and reach a high ammonia yield rate and Faradic efficiency. This study provides a scalable strategy to the development of bimetallic catalysts with nanoporous structures for electrochemical ammonia generation.

P29: A STUDY ON FACTORS AFFECTING THE LDV DRIVING BEHAVIOR

Weilun Yu, National Tsing Hua University

- In the present research, we use the latest equipment, namely, the Horiba OBS-ONE series, and refer to the European regulations (RDE-LDV) to conduct a pre-study. We conducted 10 tests in two different areas and 2 cases with different drivers. The results show that the Horiba OBS-ONE performed with great stability in all tests and that the major factors that determine CO2 emissions are throttle opening ratio, engine speed, and vehicle speed. Stunt driving will produce more than 30% of the carbon emissions produced by normal driving.

P30: DIRECT LIQUID FUEL CELLS AND LI.F.E.(TM) ENGINES

Emory De Castro, Advent Technologies, Inc.

- Liquid Fueled Electrochemical Engines (Li.F.E. ™ Engines) play a critical role in the transportation market by solving the two overriding issues for electric mobility: long charge times and limited range. By using energy-dense fuels as a hydrogen source, and coupling a fuel cell that can readily use low grade hydrogen derived from these fuels, a potent hybrid vehicle consisting of batteries recharged by a fuel cell running on low grade hydrogen derived from on-board reforming of methanol can significantly impact GHG emissions today.

P31: APPLICATION OF METAL DIRECT DEPOSITION METHOD TO ELECTROCATALYST FOR ORR

Masaru Yoshitake, Tokyo University of Science

- The development of electrocatalyst for ORR has been regarded one of the most important terms for the realization of PEFC systems. Pt has been considered the best element for ORR in acidic condition in the point of activity, stability and power density. But it is essential to develop a new catalyst with much higher activity and durability. We proposed a new catalyst concept which uses dry process (PVD method) to deposit Pt onto carbon substrate, which can afford higher activity based on the formation of bonding between Pt and carbon structure based on the basic study using liquid phase experiments. The mechanism and characteristics have been investigated by using theoretical computing analysis, electrochemical methods and surface physical methods. Pt element particles with high energy discharged from the Pt target can form strong bonding with carbon atoms especially in the case of a vacancy formation in graphene structure, which we named a V-site. This V-site model is examined to afford higher activity and stability for Pt/C system.

P32: FUEL CELL POWER MODULE FOR ELECTRIC FORKLIFT WITH INTEGRATED METAL HYDRIDE HYDROGEN STORAGE SYSTEM

Ivan Tolj, University of Split, FESB

- In this work, we present a prototype fuel cell power module for 3-tonne electric forklift developed by HySA Systems and integrated by Hot Platinum (Pty) Ltd, South Africa.

P33: BAKER AWARD FIRST PLACE WINNER - HIGHLY ACTIVE FE-N-C CATALYSTS FOR PEMFC FROM CARBIDE-DERIVED CARBONS

Sander Ratso, University of Tartu

- This is the first study of Fe-N-C catalysts based on carbide-derived carbon (CDC) in proton exchange membrane fuel cells (PEMFC). CDC can be designed to result different pore size distributions (PSD), in the microporous and/or mesoporous domains, which is interesting to optimize the number and/or accessibility of active sites in Fe-N-C catalysts. We propose catalysts from two different CDCs, one of which has activity comparable to 5 wt.% Pt/C in PEMFC conditions

P34: BAKER AWARD SECOND PLACE WINNER - OXYGEN VACANCY ENGINEERING ON PYROCHLORE OXIDES CATALYSTS FOR ELECTROCHEMICAL ENERGY STORAGE AND CONVERSION SYSTEMS

Qi Feng, Southern University of Science and Technology

- The oxygen electrocatalysts that synchronously satisfy the active and stable demands of proton exchange membrane water electrolysis (PEMWE) and zinc-air battery (ZAB) have not been reported yet, although this kind of electrocatalyst is quite imperative for accelerating the development of energy storage and conversion systems. We for the first time demonstrate that oxygen electrocatalysts can be synchronously applied and stably operated in both PEMWE and ZAB devices. The oxygen vacancy (OV) engineering on pyrochlore oxides is turned out to vastly promote the electrocatalytic performance.