NCCAVS
THIN FILM USER GROUP
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FREE ADMISSION—No need to register, just show up!!

Topic: Energy Storage

Meeting Date: September 10, 2013

Start Time: 12:30 – 5:00pm

Location: SEMI Global Headquarters
Seminar rooms 1 & 2
3081 Zanker Road
San Jose, CA 95134
****Park in SEMI GLOBAL Parking Lots ONLY****

Meeting and Lunch Sponsored By:
Kurt J. Lesker Company

Co-Chairs:

Sing-Pin Tay,
NCCAVS Chapter Chair, sing-pin_tay@avs.org

Michael Oye,
Advanced Studies Laboratories (ASL) and Dept. of EE,
University of California Santa Cruz, moye@ucsc.edu

AGENDA

12:30 PM - 1:00 PM: Free Lunch (Sponsored by Kurt J. Lesker Company)

1:00 - 1:15 PM: **Welcome and Introduction**

1:15 - 1:45 PM: A front row seat to electrochemical systems in action: in-situ measurements of Li-ion diffusion, Jeff Urban, *Molecular Foundry at Berkeley Labs*

Abstract: Lithium ion transport is the fundamental process behind the function of lithium ion batteries, yet there is little agreement on even the "simple" value of the diffusion coefficient of lithium ions. To help resolve this issue, we have developed the use of confocal Raman microscopy to perform in-situ measurements of lithium ion concentration profiles in liquid electrolytes with sub-micron spatial resolution and temporal resolution as fast as 100 ms. In our first experiment, we measure the temporal evolution of concentration gradients of lithium hexafluorophosphate (LiPF6) in dimethyl carbonate (DMC) in a one-dimensional diffusion chamber. We are working to extend this technique to the measurement of in-situ concentration gradients established by the polarization of a symmetric Li/LiPF6/Li electrochemical cell. In the future, we will apply confocal Raman microscopy to the measurement of concentration profiles in the vicinity of realistic electrode geometries during charging and discharging.

Bio: Jeff Urban is the Facility Director of the Inorganic Nanostructures facility in the Molecular Foundry at Berkeley Labs. He got his PhD in physical chemistry at Harvard in 2004 studying size-dependent phase transitions in ferroelectrics and superconductors. He then did a joint postdoc with Chris Murray and Mercouri Kanatzidis on nanocrystal based thermoelectrics and solar cells. He now works on the materials and measurements related to heat, charge, and mass transport in multi-component, composite materials.

1:45 - 2:15 PM: Is there a Moore's Law for Batteries?, James Kaschmitter, *Polystor Energy Corporation*

Abstract: Gordon Moore's 1965 prediction has proven to be uncannily accurate, in part because the law is now used in the semiconductor industry to guide long-term planning and to set targets for research and development. It has become a self-fulfilling prophecy. Some hope that a similar predictability might exist for batteries, helping guide our energy future. This paper examines the performance history of batteries to see if any similar trends might exist.

Bio: James L. Kaschmitter is CEO and co-founder of PolyStor Energy Corporation, Livermore, CA providing R&D and consulting services to the energy storage industry. Jim formerly was Chairman and CEO of UltraCell Corporation. He founded UltraCell in 2002 to commercialize reformed methanol micro fuel cells for portable power applications. As part of Brentronics since 2011, UltraCell currently supplies micro fuel cells to the U.S. military and other customers. In 1997, Jim founded PowerStor Corporation, to commercialize a carbon aerogel supercapacitor, which he co-invented at Lawrence Livermore National Laboratory (LLNL). The company was sold in 2000 to Cooper Bussmann, which manufactures and sells the devices in high volume for commercial electronics applications. In 1993, Jim was co-founder and CEO of PolyStor Corporation, a developer and manufacturer of lithium-ion and lithium-ion polymer batteries. PolyStor's manufacturing operations were sold to Moltech in 2002. Prior to this, Jim was at LLNL for more than nine years, where he held a variety of management and engineering level positions, including power systems responsibility for the Strategic Defense Office's Brilliant Pebbles project.

2:15 - 2:45 PM: Energy Storage in Thin Sputtered Films, J.R. Gaines, *Kurt J. Lesker Company*

Abstract: After nearly 20 years of development, thin film, all solid-state, rechargeable batteries are available to the market in large scale. In addition to their extraordinarily small form factor, these micro-batteries demonstrate several great properties including near perfect charge/discharge performance over thousands of cycles, high energy and power densities, and extremely low self-discharge rates. This presentation will discuss specific characteristics of these revolutionary batteries, comparisons with competing batteries, the manufacturing process, key players in the industry, and the impact of the micro-battery on future product designs. Barriers to wide-spread commercialization will also be discussed as well as the role of the Kurt J. Lesker Company in this emerging industry.

Bio: J.R. Gaines, Jr. is the Technical Director of the Materials Group at the Kurt J. Lesker Company (KJLC). He has spent his career in the development and commercialization of advanced materials including temperature sensors, high temperature superconductors and ceramics for thin applications such as thin film batteries and electro-chromic windows. Prior to joining KJLC J.R. worked for Lake Shore Cryotronics manufacturing temperature sensors, Superconductive Components, Inc. where he developed a line of products based on ceramic high temperature superconductors which includes powders, sputtering targets and levitation components, Oak Ridge Micro-Energy where he helped commercialize thin film batteries, and the Sputtering Target Manufacturing Company where he developed a unique sputter target manufacturing approach which was then acquired by the Kurt J. Lesker Company. In addition to supporting a wide range of thin film materials for research applications such as non-volatile memory, FeRAM, transparent conductive oxides and thin film capacitors, his work is currently focused on the optimization of properties for sputtering targets used to make thin film batteries and electro-chromic windows.

2:45 - 3:05 PM: Break

3:05 - 3:35 PM: Photovoltaics to Electric Vehicles: The Role of Energy Storage, Robert Cormia, *Foothill College*

Abstract: With the plummeting costs of solar PV modules experienced in 2012-2013, and predicted for 2014-2015, solar panels at a cost of $1 (wholesale), to $2 (retail), will enable large-scale integration of photovoltaic energy, much of it inside the distribution grid. California's Title 24 building codes for Zero Net Energy (ZNE) residential and commercial buildings likewise will leverage PV deployment in parking lots and building rooftops, creating problems for electrical distribution systems not designed for these power flows. One application in particular, solar charging for Electric Vehicles (EVs), is of particular interest for both residential and commercial settings. A key problem is how to use solar generated electricity that is produced in excess of what is needed, and additionally is not time coincident with load. This presentation

will discuss two applications, energy storage for buildings and campuses, and solar EV charging, and the requirements for cost, specific energy, power density, and durability. The emphasis of the presentation is to show the value proposition of energy storage for the distribution grid, enabling the ZNE building concept, and supplying EV owners with zero emission solutions for transportation fuel.

Bio: Robert Cormia is a full-time faculty member at Foothill College, where he teaches XML, bioinformatics, informatics, and nanotechnology. Bob's background includes a long career in technology and business development while working at Surface Science Laboratories, specializing in materials analysis and new market development. After entering the Internet in 1994 as an educator and Web developer, Bob developed the eCommerce curriculum at Foothill College. Bob joined Foothill College full-time in fall 2001, where he developed courses in Internet projects, XML for biologists, bioinformatics, and the nanotechnology program. He completed the UCSC extension Certificate in Bioinformatics in 2003, and helped to develop Foothill College's certificate in bioinformatics (2003) and nanotechnology (2005). Bob now pursues research in Semantic Web Technologies, global warming, and energy policy. He is a team member of Sustainable Silicon Valley (SSV), and the Utilities and Sustainability Task Force (USTF) for San Mateo County. As part of Foothill College, Bob is also an active collaborator in the Advanced Studies Laboratories, which is a partnership between UCSC and NASA Ames Research Center to foster collaboration between Academia, Government, and Industry.

3:35 - 4:05 PM: Expectations of Next Generation Batteries, Naoki Matsumara, *Intel Corp.*

Abstract: Talk will cover the expectations for next generation batteries from usage standpoint (energy density, power requirement, shape, cost, environmental requirement, etc...).

Bio: Naoki Matsumura is a senior component/product engineer at *Intel* Corporation. Naoki is responsible for technical assessment of new battery technologies and battery sourcing for *Intel* products/reference designs.

4:05 - 4:35 PM: Analytical Methods for Characterizing Battery Materials, Sanjay Patel, *Evans Analytical Group (EAG)*

Abstract: Batteries used in cars and mobile devices require good performance at low cost and meet safety requirements. While the industry works to improve batteries used in these vehicles and devices, there are many challenges with analyzing the complex electrode materials that are inside every battery. Electrochemical processes that occur during battery charge/discharge cycles need to be understood in order identify unwanted side reactions that cause degradation in battery performance. In this presentation, we show how selecting the appropriate analytical technique results in improvements in R&D and better control of material quality during manufacture. We will present data on a study where we analyzed a range of electrode materials prior to battery manufacture and show how impurity levels affect battery performance.

Bio: Sanjay Patel received his PhD from Imperial College London, where he was engaged with analytical methods for characterizing surfaces of materials. He held several positions in the semiconductor industry before joining Evans Analytical Group (EAG) as Director of Analytical Services at the company's Arizona facility. EAG has been providing materials characterization services for over 30 years with laboratories across the US, Far East and Europe. With the rapid growth of the battery industry, Sanjay has been leading EAG's lithium ion battery characterization initiative.

4:45 PM: Adjourn*
*SEMI requests that we vacate the building by 5:00PM.

All presentations will be requested to be posted on the TFUG Proceedings webpages.

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