9th Annual International Conference

Lithium Battery Power 2013

November 12-13, 2013
San Diego, CA USA

Conference Agenda

Tuesday, November 12, 2013

12:30 *Registration*

1:55 **Organizer's Welcome and Opening Remarks**

2:00 **Roadmap for Next-Generation Batteries**

Cosmin Laslau, PhD, Analyst, Lux Research Inc.

Next-generation battery technologies such as lithium-air, lithium-sulfur, and solid-state threaten to disrupt the growing $20 billion Li-ion market. However, advancing Li-ion itself will present a moving target, as high-voltage cathodes and improved anodes move the performance needle. Lux Research looked at transportation, consumer electronics, and military applications to assess cost, performance, and outlook, and built a roadmap to show which next-generation energy storage technologies have the best chance of adoption, in which applications, and when.

2:30 **Global Lithium-Ion Battery Market – Charging or Discharging**

Vishal Sapru, Research Manager, Energy & Power Systems, Frost & Sullivan, Inc.

The presentation will focus on market opportunities for lithium-ion batteries, with an end-user focus on consumer, industrial, automotive, and renewable energy / grid storage applications. The presentation will highlight the impact of the hybrid and electric vehicle slowdown on the lithium-ion battery market, and its potential impact on the renewable/grid storage battery business. The presentation will focus on key challenges, drivers and restraints, potential market size, and trends, among others.

3:00 **The Lithium Ion Battery Market From a Supply and Demand Perspective**

Sam Jaffe, Senior Research Analyst, Navigant Research

Navigant Research will launch an advanced battery tracker in the third quarter of 2013. The tracker will follow Li-Ion shipments from factory gate to end use application. It will cover the automotive, stationary, consumer electronics and other markets. This presentation will reveal initial results of the tracker, including market sizing and forecasting for each major sub-market.

3:30 *Networking Refreshment Break, Exhibit/Poster Viewing*

4:00 **High Performance Lithium Cathode Nanopowders Prepared by a Novel Methodology**

Teresita C. Frianeza-Kullberg, PhD, Co-CEO, CTO, Perfect Lithium Corp., Canada

A novel universal methodology suitable for large scale industrial production of nanopowders was invented by Perfect Lithium Corp. While the methodology can be applied to produce nanopowders in other applications such as nano-medicine, structural ceramics and others, the initial focus was the development of a scalable production process for making lithium cathode nanopowders. As an example, high energy layered lithium-rich lithium nickel manganese cobalt oxide nanopowders were produced by this proprietary synthetic process. Production costs are reduced significantly because of the elimination of numerous process steps such as, for example, filtration, washing, milling and classifying, as well as repeated calcinations used in traditional preparation routes. Contaminations, metallic or ceramic, are eliminated. Environmentally, the Perfect Lithium methodology is benign since there is no need for treatment of neither wastewaters nor exhaust from firing. Furthermore, the results from battery cycling tests showed increased performance over commercially available lithium materials. The nanostructures formed early in the preparative step are retained over 1000 cycles at a high C-rate which indicate structural stability of the cathode nanopowder. Therefore, these nanopowders produced by the Perfect Lithium methodology have a value-added advantage in cycle life, charge and cost over commercial materials. Physical characterization results such as surface area, X-ray powder diffraction, porosity, scanning electron microscopy, and tap density will be presented. Battery cycling tests will be given for more than 1000 cycles at high C rate. Five patents have been filed on the process, application, products, and apparatus; additional patents are underway. Achievement of 50% reduction in $/kWh is realizable from nanopowders produced by this methodology derived from process cost reductions plus the value-added performance.

4:30 **Development and Optimization of a Process for Producing the Battery Grade LiOH: Optimization of Water and Energy Consumption**

Wilson Alavia, PhD, Researcher, Center for Advanced Research in Lithium and Industrial Minerals-Celimin, Universidad de Antofagasta, Chile*

To satisfy the current and future energy demand in Chile, the government is investing in ERNC and energy storage technologies, and specifically in lithium battery technologies. The components of our lithium batteries are fabricated from LiOH, which is produced from Li_2CO_3. In this presentation we will discuss development and optimization of a process for fabrication of LiOH battery grade from Li_2CO_3 using the metallurgic process simulator Metsim. We have determined the optimal conditions to produce the battery grade LiOH and to reduce water and energy consumption. **In collaboration with: A.Gonzales, S.Ushak, M.Grageda*

5:00 **Coupling Lithium Ion Battery Thermo-Electrochemical Models with Orbital-Thermal Analysis Software for Space Applications**

William Walker, Researcher, NASA Johnson Space Center

Lithium-ion batteries (LIBs) are replacing some of the Nickel

Metal Hydride (NiMH) batteries on the International Space Station. Knowing that LIB efficiency and survivability are highly influenced by the effects of temperature, this study focused on coupling orbital-thermal analysis software, Thermal Desktop (TD) v5.5, with LIB thermo-electrochemical models representing the local heat generated during charge/discharge cycles. Before attempting complex orbital analyses, a simple sink temperature model needed development to determine the compatibility of the two techniques. LIB energy balance equations solved for local heating (Bernardi's equation) were used as the internal volumetric heat generation rate for native geometries in TD. The sink temperature, various environmental parameters, and thermophysical properties were based on those used in a previous study for the end of 1, 2, & 3 Coulomb (C) discharge cycles of a 185 Amp-Hour (Ah) capacity LIB. The TD model successfully replicated the temperature vs. depth of discharge (DoD) profiles and temperature ranges for all discharge and convection variations with minimal deviation. In this study, we successfully developed the capability of programming the logic of the variables and their relationship to DoD into TD. This coupled version of orbital thermal analysis software and thermo-electrochemical models provides a new generation of techniques for analyzing thermal performance of batteries in orbital-space environments.

5:30 **Power Conversion System Architectures for Grid Tied Energy Storage**

Kyle B. Clark, Engineering Manager, Advanced Systems, Dynapower Corporation

The Power Conversion System (PCS) for Grid Tied Energy Storage applications is an integral component to system performance. The PCS provides the function of controlling the power flow and conversion of AC to DC and DC to AC electrical power between the storage medium and the grid. Currently there are various fundamental conversion topologies employed including, single-stage and multi-stage converters, standard three-legged IGBT based inverters, line commutated inverters and multi-level inverters. Each of these will be reviewed and the efficiency, cost drivers and merits examined. Specific application topics will include: single phase systems, three phase systems, low voltage and medium voltage interconnection, islanding methods, battery string voltage, output power quality assurance, protection mechanisms, isolated and non-isolated systems, IEEE1 1547 and UL1741 requirements and PCS controls. This presentation provides an overview of various PCS topologies and control structures employed in energy storage applications with associated advantages and disadvantages. The audience is expected to understand the basic purpose of the PCS; a prior detailed technical knowledge is not necessary. In closing the presentation will discuss recent trends in the development of grid tied energy storage PCS technology.

6:00 *Networking Cocktail Reception*

Wednesday, November 13, 2013

8:00 *Exhibit/Poster Viewing, Coffee and Pastries*

9:00 **Outlook for Li-Ion Batteries in Transportation**

Ralph Brodd, PhD, President, Broddarp of Nevada

The talk will summarize the recent NRC publication "Transitions to Alternative Vehicles and Fuels." The time line for introduction and the main factors controlling the transitions electrified transportation will be discussed. The study included a comparison of fuel cell, battery powered and hybrid vehicles as well as alternative fuels, such as ethanol, etc.

9:30 **Intelligent Battery Design Toolbox**

Bor Yann Liaw, Hawaii Natural Energy Institute, University of Hawaii at Manoa

We have recently developed a mechanistic model as a battery design toolbox that can emulate "what if" scenarios to predict battery performance and life under various duty cycle requirements. Based on half-cell data, we can compose metrics for cell performance by matching electrode loading and loading ratio to construct different configurations for performance and life prediction. This unique capability will allow the user through simple design panel to estimate various "what if" criteria to design the cell with the performance and life in mind. The presentation will explain the approach and utility offered by this model and toolbox.

10:00 **Charging Li-Ion Batteries with Wireless Power**

William von Novak, Principal Engineer, QUALCOMM

Wireless charging for portable devices is becoming more popular, with several competing technologies currently on the market. Each has its drawbacks and benefits, and each presents different challenges for charging of lithium ion batteries. Integration of the battery with common PMIC's (power management IC's) and portable device chipsets presents design challenges to the power system designer, including issues during dead battery startup and charge termination. This talk will provide an overview of the various types of wireless charging, along with their relative benefits and drawbacks, and will present some specific test results for charging on a loosely coupled system. It will also present some general guidelines for designing wireless power systems to be compatible with lithium ion battery systems.

10:30 *Networking Refreshment Break, Exhibit/Poster Viewing*

11:00 **Presentation title to be confirmed**

Rachid Yazami, PhD, Professor, School of Materials Science and Engineering, Nanyang Technological University, Singapore

Abstract not available at time of printing. Visit www.KnowledgeFoundation.com for the latest Program updates

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11:30 **Microfiber/Nanofiber Battery Separators**

Brian Morin, President and COO, and Justin Pardi, Dreamweaver International

Current stretched porous film battery separators for lithium ion batteries are thin, strong, and provide a good barrier between electrodes, at the cost of having very high internal resistance and low ionic flow. In this work, linear nanofibers and microfibers are combined in wet laid nonwoven processes to give separators that are strong and thin, but have higher porosity (60%) and much higher ionic flow. Batteries made with these separators are able to give similar performance at much higher electrode coat weights, reducing the surface area of both current collectors and separator and also the volume of electrolyte needed. Total mass reduction can be as high as 20% (1.3 kg/kWh), with raw material cost savings of over 25% ($55/kWh). Volume savings are 0.5 liters/kWh. Batteries made with similar construction show much higher charge and discharge rate capability. Temperature stability is also improved, from a current stability temperature of about 110˚C up to 175˚C. Applications include all power source applications that require high energy density, high power, high temperature stability, including cell phones, laptop and tablet computers, power tools, and electric and hybrid vehicles.

12:00 **Lithium-Ion Battery Formation Process Development through Novel Thermal Measurement**

Jeff Xu, PhD, Principal Scientist, Powertrain Controls, Engine & Vehicle R&D Department Southwest Research Institute

An important step often overlooked or rarely investigated in lithium-ion battery manufacturing is the formation process. The formation process is the first full charging cycle of a lithium ion battery, which activates the cells before the lithium-ion cells can be used. The presentation will focus using novel thermal measurement tool to monitor heat profile during the first charging/discharging cycle of new cells. The novel formation protocol can thus be developed to determine the impact of the Lithium-ion battery formation process on battery performance such as capacity, cycle life, and safety.

12:30 *Lunch*

2:00 **Discovery of High Power and High Energy Conversion Electrode for Lithium-Ion Batteries**

Steven Kaye, PhD, Chief Scientific Officer, Wildcat Discovery Technologies

Wildcat Discovery Technologies has developed a high throughput synthesis and screening platform for battery materials. Wildcat's system produces materials in bulk form, enabling evaluation of its properties in a standard cell configuration. This allows simultaneous optimization of all aspects of the cell, including the active materials, binders, separator, electrolyte and additives. Wildcat is using this high throughput system to develop new electrode and electrolyte materials for a variety of battery types (primary, secondary, aqueous, non-aqueous). In this talk, I will discuss our latest discovery, a copper fluoride-based conversion electrode with excellent rate capability (95% capacity at 1C, 20 µm electrode), energy density (3,000 Wh/L), voltage hysteresis (0.3 V), and stable cycling.

2:30 **Laser-Induced 3D Structures in Laser-Printed LiFePO4 Cathodes for Highly Flexible Production of Li-Ion Batteries**

Johannes Proell, Researcher, Laser Material Processing Group, Institute for Applied Materials (IAM-AWP), Karlsruhe Institute of Technology (KIT), Germany

Since $LiFePO_4$ is a promising cathode material due to its high safety issues and specific capacity, it suffers from poor Li-ion diffusion. In order to overcome these drawbacks, $LiFePO_4$ has been laser-printed onto aluminum foil. This process enables highly porous structure and intrinsic active surface area. Further improvement of the cycling behavior is achieved by 3D surface structures formed by a laser structuring process. The combination of both techniques allows for novel cathode architectures with flexible design and improved lifetime.

3:00 **Development of $LiFePO_4$ Cathode Materials with High Quality and Consistent Performance**

George Ting-Kuo Fey, PhD, Bettery Energy Technology Inc., Taiwan R.O.C.

The work team of Battery Energy Technology (BET) Inc. combined a number of modification techniques in the fabrication processes for high quality lithium iron phosphate. The sources of raw materials and the synthesis procedure were carefully controlled for the mass production of $LiFePO_4$ with good reproducibility. In this work, the effects of purity and stoichiometric compositions of iron raw materials on the electrochemical performance are presented. We will show our latest work in the consistency of performance of 1.5 tons of $LiFePO_4$ cathode materials by measuring the capability process of key characteristics (C_{pk}).

3:30 **Requirements for the Transportation of Lithium Batteries**

Rich Bysczek, Global Technical Lead for Electric Vehicle and Energy Storage, Intertek

New United Nations (UN) regulations regarding the transportation of lithium batteries recently went into effect and were adopted by other global regulatory bodies. To avoid product launch delays and begin earning revenue faster, manufacturers must be aware of these requirements and how they affect their business. During this presentation we will discuss the updated national and international standards required for transporting lithium batteries.

4:00 **Site Visit to Wildcat Discovery Technologies, Inc.** (Limited Spaces Available)