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19TH ANNUAL
**advanced
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battery
conference**

JUNE 24-27, 2019 • HOTEL DEL CORONADO • SAN DIEGO, CA

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June 24

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June 24-25

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June 26-27

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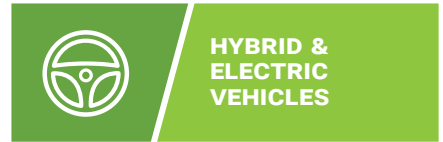
June 24



June 24-25



June 26-27



PLENARY SESSION Wednesday, June 26



9:05 Vehicle Electrification: Opportunities and Challenges

Norman Lu, Senior Program Manager Powertrain, Powertrain Planning & Research, Toyota Motor North America

The past 10 years of the electrification movement focused on overcoming initial purchase challenges of price, electric range, and public charging infrastructure. In the next 10 years, numerous additional challenges from the full life cycle of electrified vehicles will become ever more significant towards their mass-market acceptance. Battery makers, OEMs, charging service providers, and electric utilities can work together to turn these challenges into opportunities to deliver a holistic customer experience through clean and smart collaboration between the energy and transportation industries.



9:25 Energy, Propulsion, and Sustainability – The New Watchwords in Automotive Powertrain

Ted Miller, Senior Manager of Energy Storage Strategy and Research, Ford Motor Company

As vehicle electrification becomes an increasingly important and influential part of the automotive landscape, automotive OEMs are undergoing a transition of powertrain research and engineering focus. While the internal combustion engine has arguably resulted in the greatest advancement in mobility during the past century, regulatory and societal desire for improved efficiency and reduced environmental impact has resulted in the present era of electrification. Improvements are still anticipated to increase internal combustion engine efficiency and further reduce emissions. However, the most dramatic gains will result from increased vehicle electrification. As such, traditional powertrain research is transitioning to comprehensive propulsion system optimization, with a keen focus on energy and sustainability.



9:45 California Emission Regulations and EV Market Expansion

Michael McCarthy, CTO ECARS, California Air Resources Board



11:00 xEV Market Expansion

Menahem Anderman, PhD, President, Total Battery Consulting, Inc.

This presentation will assess the expansion of the xEV market. It will show that while xEV market expansion is now unstoppable, the pace of growth for each of the xEV architectures is tied to i) regional-government regulations, ii) battery and vehicle technology and cost development, and iii) consumer eagerness. We will attempt to provide some likely scenarios and estimate the resulting battery and xEV markets.



11:20 xEV Expansion in China: Vehicle, Battery, and Materials Impact

Mark Lu, PhD, Certified Senior Industrial Analyst, Industrial Economics & Knowledge Center (IEK), Industrial Technology Research Institute (ITRI)



11:40 Latest Market Status and Forecast for Li-Ion Batteries

Hideo Takeshita, President and CEO, B3 Corporation

Almost 30 years have passed since the first LIB entered the market. After replacing NiMH/NiCd and starting MP for xEV/ESS, LIB moves into the 4th decade. B3 will provide this LIB industry's real market information including supply/demand status and future forecast. Brief comments on the future of solid-state batteries will be also made.



12:00 pm The LiB-Industry: Status and Outlook

Wolfgang Bernhart, PhD, Senior Partner/Automotive, Roland Berger GmbH

The presentation will discuss: i) the outlook on demand and supply, ii) the current costs across the value chain – outlook 2025ff, iii) the cost reduction measures across the value chain, iv) the impact of recycling, v) the potential impact of fuel cell technology on cell demand 2025ff, and vi) the implications for the industry.



MONDAY, JUNE 24

7:00 am Partnering Forum Registration & Morning Coffee

STRATEGIC INVESTING FOR OPPORTUNITIES IN RENEWABLE ENERGY

8:15 Chairperson's Opening Remarks

J. Norman Allen, CTO, NanoFlex Power Corporation

8:20 Achieving Breakthrough Success in the Battery Value Chain

David Jacoby, President, Boston Strategies International

Scaling a battery venture often depends on strong strategic and financial partnerships. How can you tap into value chains that maximize the value of your product or solution and successfully negotiate strategic partnerships in that channel? Explore case studies of extended value chain strategies and the associated financial events – VC, private equity, M&A, etc. – that have accelerated certain companies' paths to success in the battery supply chain. Learn the channel strategies that can make your company attractive to partners, and the criteria that investors use to evaluate your company and your growth strategy.

8:35 Succeeding in Grid-Connected Energy Storage: Bulk Storage, Distributed Storage, and Behind-the-Meter

Haresh Kamath, Senior Program Manager, Distributed Energy Resources (DER), Electric Power Research Institute (EPRI)

Energy storage for the grid has the potential to be a game changer – but like many revolutionary technologies, it faces technical, economic, regulatory and social challenges before it can achieve its full potential. Over its nearly 50 year history, EPRI has worked with hundreds of developers, manufacturers, and utilities to accelerate the introduction of technologies with the potential to enhance the clean, safe, reliable and affordable delivery of electric power. Our efforts in energy storage are oriented towards helping developers ensure their products focus on real and monetizable applications of energy storage. Discuss the directions for stationary energy storage and what is likely to be profitable first.

8:50 Approaches to Vehicle Energy Storage and Barriers to Commercialization

*Aron Newman, Contractor, Advanced Research Projects Agency - Energy (ARPA-E), U.S. Department of Energy**

The Advanced Research Projects Agency-Energy (ARPA-E) advances high-potential, high-impact energy technologies that are too early for private-sector investment. Many of the projects making up ARPA-E's IONICS and REFUEL programs are developing technologies for next-generation vehicle energy storage based on lithium metal batteries and carbon neutral liquid fuel (CNLF), respectively. This presentation will also discuss barriers to commercialization that includes challenges with technology development, funding, and consumer acceptance. Additional Authors: Grigori Soloveichik, Madhav Acharya, and Mark Pouy.

9:05 Q&A

10:00 Networking Coffee Break & One on One Partnering Meetings

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INNOVATION SHOWCASE FOR RENEWABLE ENERGY COMMERCIALIZATION

11:00 Charging as Fast as Refueling a Gas Car

Robert A. Rango, CEO, Enevate Corporation

Extreme fast charging batteries with high energy density can help break down barriers to higher EV adoption. Enevate develops and licenses a silicon-dominant anode cell technologies that enables 10X faster charging without compromising the EV range or energy densities, operates at low temperatures, and has increased safety. Such extreme fast charging batteries also enables lower cost EVs that fit in daily driving use.

11:15 Creating a More Efficient, Safer, Greener, and Easily Manufactured Solid-State Battery

Freidoon Rastegar, PhD, CEO, Solid State Battery, Inc.

Solid State Battery Incorporated in October 2017 in Los Angeles. The company has successfully developed a patent-pending solid-state electrolyte for lithium-ion batteries. New material lends itself to large area Battery configuration by replacing liquid electrolyte with developed Nanocomposite polymer.

11:30 The Role of Newer Higher Specific Energy Photovoltaics in Reducing Solar Packaging Weight in Vehicles, Solar Portable Battery Charging, and Energy Harvesting Microscale IoT Sensors

J. Norman Allen, CTO, NanoFlex Power Corporation

NanoFlex is developing advanced thin film GaAs solar and Organic Photovoltaics. NanoFlex has a large contract with the US Army to develop its thin film GaAs solar for soldier use. This technology can also have application on vehicles and IoT applications.

11:45 Q&A

12:30 pm One on One Partnering Meetings – Lunch on Your Own

INNOVATION SHOWCASE FOR RENEWABLE ENERGY COMMERCIALIZATION

2:10 Chairperson's Remarks

David Deak, PhD, President, Marbex LLC, formerly of Lithium Americas Corp, and Tesla, Inc.

2:15 Ionic Materials: Opportunities in Solid State

Erik Terjesen, Senior Director, Licensing and Strategy, Ionic Materials

Ionic's polymer electrolyte represents a major breakthrough in battery technology. By enabling the creation of batteries that are safer, cheaper, and higher performance than the current state-of-the-art, Ionic's polymer electrolyte shatters the traditional battery design paradigm, under which safety, cost, and performance must generally be traded off against one another. We are excited to bring this technology to market with core partners in the battery industry.

2:35 Modular Energy Storage Systems in Grid and Alternative Energy Applications

Jerry Hoffman, President, Hoffman Capital and Development

This presentation will cover why energy storage makes sense in these systems, the technology

changes making these systems meaningful and the roadblocks to implementing these systems. In addition, the economics and the projected time plan for implementation will be discussed.

2:55 Q&A

3:15 Refreshment Break

RENEWABLE ENERGY STORAGE MARKET OUTLOOK AND COMMERCIALIZATION OPPORTUNITIES

3:35 Future Investment Outlook Non-Passenger Electrified-Vehicle Market Expansion and Broad Penetration of High Power Charging Infrastructure Development

Joshua Posamentier, Co-Founder and Managing Partner, Congruent Ventures

In this presentation, areas of future investment interest around non-passenger electrified-vehicle market expansion and broad penetration of high power charging infrastructure development will be discussed. What battery and balance-of-system technology needs do other EV segments drive in terms of performance and capability requirements? New solutions are needed that expand the capabilities of mobile energy storage while maintaining or improving durability, cost, and safety.

3:55 The Hidden Benefits of New Technological Advances in Energy Storage

Fernando Gómez-Baquero, PhD, CEO, BESSTECH, LLC

Emerging technologies are sometimes seen as too complex or outside of manufacturing norm. But changing manufacturing in some capacity is absolutely necessary to enable accelerated performance increases. In this talk I give examples of "hidden" benefits of emerging energy storage technologies, that seem difficult to adopt but once adopted could increase the effective utilization of the current slurry lines, reduce the costs of chemical processing, and even double plant output. Looking at these benefits, technological advances might seem less daunting and more like real opportunities that are readily scalable.

4:15 PANEL DISCUSSION: Partnering & Investing on the Convergence of Mobility, Artificial Intelligence, Energy Storage & Renewable Energies

Moderator: Joshua Posamentier, Co-Founder and Managing Partner, Congruent Ventures

Panelists: David Jacoby, President, Boston Strategies International

Fernando Gómez-Baquero, PhD, CEO, BESSTECH LLC
Jarvis Tou, Executive Vice President, Enevate
David Deak, PhD, President, Marbex LLC, formerly of Lithium Americas Corp, and Tesla, Inc.

By 2030 it is predicted that 95 percent of US passenger miles will be served by on-demand autonomous EVs owned by fleets in a business model dubbed "transport-as-a-service" (TaaS), whose market size is expected to exceed \$120 billion by 2025. Discover what VCs look for in funding companies and new business strategies in a TaaS based economy and how to ready your company to participate in the upcoming mobility disruption.

5:20 Close of Partnering Forum



8:00 - 10:00 AM

TUT1: The Rechargeable Battery Market: Value Chain and Main Trends 2018-2028

Instructor: Christophe Pillot, PhD, Battery Survey Manager, Avicenne Energy, France

This tutorial will present the 10-year automotive market forecasts from Avicenne and other analysts (Micro|Hybrid|P-HEV|EV). Other coverage will include Car makers' strategies, Advanced Energy Storage (Advanced lead acid|Supercap|NiMH|LIB). Additionally, LIB design for P-HEV & EV markets (Cylindrical, prismatic, pouch|Wounded, stacked, Z fold cells) and LIB cell, module & pack cost structure 2018-2028 will be discussed.

TUT2: Solid-State Batteries

Instructor: Steven J. Visco, PhD, CEO & CTO, PolyPlus Battery Company

This tutorial will provide an overview of Solid State Technology. PolyPlus is developing rechargeable lithium metal batteries based on the use of continuous ultra-thin conductive glass as a separator. These high conductivity glasses are single-ion conductors (~10-3 S/cm), have a high shear modulus, and are enabling for high cycle life lithium metal batteries.

TUT3: Improving the Energy Density of Batteries with Silicon-Based Anodes

Instructor: Dee Strand, PhD, CSO, Wildcat Discovery Technologies

This tutorial gives an overview on the benefits and challenges of using silicon-based anodes to improve the energy density of lithium-ion batteries. Topics will include the key challenges in use of silicon-based anodes as well as progress in implementation of silicon and what can we expect in the future, and the latest improvements in other battery components required to maximize the benefit of silicon-based anodes.

TUT4: Battery Safety and Abuse Tolerance Validation

Instructor: Shmuel De-Leon, CEO, Shmuel De-Leon Energy, Ltd.

Batteries have become daily use components for many applications. New growing segments like EV and Grid storage batteries extend the traditional ordinary battery applications. In the race for energy density, we shouldn't forget the safety – as an example, the Samsung Galaxy Note 7 battery safety case. Unfortunately, we face daily safety events with injuries and severe damage. The tutorial focuses on portable, stationary and automotive battery safety along the battery cycle life (acceptance, testing, assembly, use, transportation and disposal). The training incorporates Shmuel De-Leon's and other experiences on battery safety representing over 26 years of work in the field. The motivation behind the training is to provide attendees with the knowledge needed to safely handle the batteries in their organizations and to support reduction in safety events.

*Separate registration required

10:30 AM - 12:30 PM

TUT5: Managing and Understanding the Risks of Li-Ion Battery Safety

Instructor: Brian Barnett, PhD, President, Battery Perspectives LLC

A wide variety of stresses and abuses of Li-ion cells can result in safety events involving significant, even violent energy release and thermal runaway. This tutorial provides a framework for a better understanding of how these events occur, how lithium-ion batteries respond to various stresses/abuses, how various stresses can lead to thermal runaway and why these stresses produce challenges to assessment of safety characteristics of Li-ion cells. For major types of stress/abuse, a flow chart identifying key process steps and characteristics of cell response helps provide important insights regarding similarities and differences of various types of safety-related failures. A systematic understanding of similarities and differences of most types of stresses helps provide perspective regarding management of Li-ion battery safety as well as appropriate safety testing.

TUT6: Materials for Next Generation Batteries

Instructor: George Crabtree, PhD, Director, Joint Center for Energy Storage Research (JCESR), Argonne National Laboratory & Distinguished Professor of Physics, Electrical and Mechanical Engineering, University of Illinois at Chicago

This tutorial will cover the materials and performance challenges for next generation batteries for electric vehicles and the electricity grid. The needs and use cases for storage in these two applications will be analyzed, and the possibilities of advanced lithium-ion, lithium-sulfur and multivalent batteries for vehicles will be presented. Lithium and magnesium anodes, wide electrochemical window electrolytes and high voltage cathodes will receive special attention. New discovery approaches based on materials simulation and statistical learning will be discussed.

TUT7: Battery Pack Engineering for xEVs

Instructor: Kevin Konecky, Energy Storage Systems Consultant, Total Battery Consulting

This tutorial will give an overview of battery systems design. An overall product development process will be discussed for a typical system. Design aspects of each individual subsystem will be explored with cost impacts of different design choices. Testing, validation and designing for safety will be other key areas of discussion.

TUT8: xEV Lithium-Ion Recycling Methods

Instructors: Steven E. Sloop, President, OnTo Technology LLC

Michael Slater, PhD, Senior Scientist, Farasis Energy, Inc.

Additional Instructors to be Announced

Lithium-ion batteries provide power for a range of electric vehicles (EVs). By 2025, the industry is expected to grow to \$98 billion worldwide with a related recycling industrial market as high as \$14 billion. Large scale adoption of EV with lithium-ion is tied to low cost material drivers such as \$10/kg cathode; can recycling achieve such a goal? A supportive recycling industry will be expected to (1) operate with end-of-life batteries as an asset (2) produce cost-competitive electrodes or electrode precursor materials, and (3) safely address large scale throughputs. This recycling methods tutorial and panel includes pyrometallurgy, hydrometallurgy, and mechanical/direct technical approaches. The panelists will discuss them in light of cost goals and market realities.

“It’s really the whole ecosystem of the battery world. We find it extremely valuable.”

- Ted Miller, Ford Motor Company



BATTERY CHEMISTRIES FOR AUTOMOTIVE APPLICATIONS

Recent Advancements in Battery Chemistries

MONDAY, JUNE 24**12:30 pm Symposia Registration**

RECHARGEABLE LITHIUM CHEMISTRIES

1:30 Chairperson's Opening Remarks

Martin Winter, PhD, Chair, Applied Material Science for Energy Conversion and Storage, MEET Battery, Research Center, Institute of Physical Chemistry, University of Muenster

1:35 Joint Center for Energy Storage Research (JCESR): Overview and Focus

Venkat Srinivasan, PhD, Deputy Director, Research & Development, JCESR

The Joint Center for Energy Storage Research, otherwise known as the Battery Hub, is a US Department of Energy Innovation Hub focused on developing the science behind next-generation batteries that can help usher in a more resilient electric grid and electrify transportation. While batteries today are becoming more cost effective for many applications, their widespread penetration requires further cost reduction and performance improvements. Revolutionary new materials are needed that can outperform the ones available today; however, many scientific challenges prevent these materials from being used in the real world. In this talk we will describe the science gaps JCESR is addressing, the goals, and the approach that is being taken, along with a few key highlights.

1:55 Silicon Anode – A Deep Dive

Anthony Burrell, Chief Technologist, Energy Storage, National Renewable Laboratory

2:15 Understanding and Addressing the Li Problems for High Energy Li Batteries

Jun Liu, PhD, Battelle Fellow and Professor, Director Battery500 Consortium, Pacific Northwest National Laboratory/University of Washington

Li metal is a key electrode material for developing high energy batteries with a specific energy much higher than 300 Wh kg⁻¹. Despite intensive efforts, significant challenges remain in direct utilization of Li metal anode in realistic high energy cells. This talk will summarize our current understanding of the scientific and technological challenges, discuss recent progress and propose potential directions based on a high-energy cell design, fabrication and testing. The fundamental relationship between the Li anode and other cell components, especially electrolytes, is explored at the cell level in order to inspire more new ideas to effectively address the grand challenges in high energy Li cells.

2:35 Talk Title to be Announced

Peter Lamp, PhD, Head, Director, Research Battery Technology, BMW Group

2:55 Discussion with Data, Validates Paraclete's SM-Silicon/3590™ as the Highest Capacity, Cycle Stable Silicon on the Market

Jeff Norris, MBA, CEO, Paraclete Energy, Inc.

Performance and electrochemistry data validating Paraclete's SM-Silicon/3590TM, product architecture and the roadmap for its Fast Charge product will be covered. SM-Silicon/3590TM is a drop-in precursor that has an ICL similar to graphite. SM/3590TM is priced at up to 5x less than composites available today at up to only 450 mAh/g.

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3:15 Refreshment Break**3:35 From Liquid to Solid: High Conductivity Electrolytes for Lithium Batteries**

Andreas Hintennach, PhD, Professor, Research HV Battery Systems, Daimler AG
Novel and sustainable electroactive materials can help to decrease the ecological impact of novel battery concepts soon. While on the one hand, high energy density is required, the aspects of safety, lifetime get more important and often mean a challenge. All these requirements are met by very different approaches with different characteristics: all-solid-state cells, high-energy materials, lithium-sulfur and even different systems, e.g. Na- or Mg-Ion.

3:55 400Wh/Kg Is Here, a Practical Approach to Solid-State Lithium Metal Cells

Qichao Hu, PhD, Founder & CEO, SolidEnergy Systems, LLC

In semiconductor, there's a Moore's Law, where the number of transistors doubles every 18 months; in battery, a similar law applies, where the energy density doubles every 30 years. Li-Metal cells can double the energy density of conventional Li-ion. SolidEnergy has been developing a unique electrolyte system that enables Li-Metal to perform safely and reliably at more than 400Wh/kg. It has also built and demonstrated Li-Metal at pilot scale and validated by customers in drones and electric vehicles.

4:15 Paradigm-Breaking Non-Flammable Lithium-Ion Batteries for Next-Generation Transportation Needs

Arthur von Wald Cresce, PhD, Materials Science and Engineering, University of Maryland, Material Scientist, Electrochemistry, US Army Research Laboratory

The development of aqueous lithium-ion electrolytes has opened up new avenues for the application of inherently safe lithium-ion batteries, especially in the field of vehicles and transportation. The challenge is to make aqueous battery packs that are energy-dense and that can be manufactured using rapid curing techniques and additive manufacturing. This talk will summarize current efforts as well as recent breakthroughs in aqueous lithium-ion battery development.

4:35 Talk Title to be Announced

Marina Yakovleva, PhD, Manager, Global Marketing, Livent

4:55 Q&A**5:20 Close of Day****TUESDAY, JUNE 25****8:30 am Morning Coffee**

LITHIUM METAL/ELECTROLYTE

9:00 Chairperson's Remarks

Martin Winter, PhD, Chair, Applied Material Science for Energy Conversion and Storage, MEET Battery, Research Center, Institute of Physical Chemistry, University of Muenster

9:05 Strategies for Long Life and Safe Lithium Metal Batteries

Ping Liu, PhD, Associate Professor, Nanoengineering, UC San Diego

Rechargeable lithium metal batteries can reduce the cost of energy storage for both transportation and grid applications. In order to combat issues of infinite volume change, dendrite growth, and parasitic reactions with electrolytes, we are developing multifunctional 3D host structures with built-in electrolyte additives and new electrolyte chemistries to achieve high efficiency. In addition, we will discuss the safety implications of lithium metal anodes and strategies to mitigate internal shorting.

9:25 Advanced Lithium-Ion Technologies for Mobility Applications and Beyond

Patrick Bernard, PhD, Director, Research, Saft

Saft is developing a new range of Li-ion products reflecting the current market needs (increase of energy density while keeping long life, enhanced charging and cycling capabilities, cost reduction while maintaining or improving the safety), LTO prismatic cell for heavy cycling applications, phosphate based technology for safety critical applications, and NMC/Gr-Si based cells for high energy applications. Beyond Li-ion, Saft is developing Solid-State technology with some global key companies.

9:45 Solid-State Batteries – The Next Disruptive Vehicle Technology

Brian Sisk, PhD, Vice President, Cell Product Development, A123 Systems
Lithium-ion batteries have seen significant improvements in energy density in recent years, raising expectations for electric vehicle adoption. However, energy density approaches a threshold at which the pace of improvement is limited by safety requirements. Solid-state batteries solve this problem by eliminating flammable liquid electrolyte, safely allowing high-energy batteries. The coming solid-state battery revolution presents significant opportunities to automakers in terms of safety and potential cost savings – but will also require drastic system-level changes. In this presentation, I will demonstrate the great promise of solid-state batteries, identify opportunities for vehicle cost savings, and focus on system integration challenges.

10:05 Grand Opening Coffee Break in the Exhibit Hall with Poster Viewing



11:00 Solvay's Recent Developments on Electrolyte Ingredients for High Voltage Li-Ion Batteries

Dominick Cangiano, PhD, Technical Business Development Manager, SOLVAY



A leading target of the Li-ion battery industry is to achieve high energy density at affordable cost without compromising on safety. Solvay has increased its efforts to propose innovative electrolyte ingredients to battery makers, enabling high voltage solutions. New results with fluorinated additives and Energain® on silicon graphite / lithium anodes will be presented.

11:20 Compositional and Processing Studies of Garnet-Type Lithium-Ion Conductor

Dee Strand, PhD, CSO, Wildcat Discovery Technologies

Solid-state batteries show promise of improved energy density and safety relative to batteries containing conventional organic liquid electrolytes. Ceramic solid electrolytes, such as Li7La3Zr2O12 (LLZO), with garnet structure have been developed as promising solid electrolytes for use in all solid-state batteries. However, the performance of these types of materials is very sensitive to both composition and processing. In this work, we carefully explore the relationship between composition, processing, and performance using systematic experimental approaches.

11:40 Solid-State Lithium Metal/Glass Electrodes for Next-Generation Batteries

Steven J. Visco, PhD, CEO & CTO, PolyPlus Battery Company

PolyPlus is developing rechargeable lithium metal batteries based on the use of continuous ultra-thin conductive glass as a separator. These high conductivity glasses are single-ion conductors (~10-3 S/cm), have a high shear modulus, and are enabling for high cycle life lithium metal batteries.

12:00 pm Solid-State Polymer with Room Temperature Conductivity – Higher Performing Solution

Mike Zimmerman, Founder, Ionic Materials

12:20 Q&A

12:40 Networking Lunch



1:35 Dessert Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

LITHIUM-ION BATTERIES

2:35 Chairperson's Remarks

Martin Winter, PhD, Chair, Applied Material Science for Energy Conversion and Storage, MEET Battery, Research Center, Institute of Physical Chemistry, University of Muenster

2:40 Electrode Behavior during Fast Charging of Lithium-Ion Cells

Daniel P. Abraham, PhD, Senior Materials Scientist, Chemical Sciences and Engineering, National Laboratory

Rapid charging of lithium-ion batteries would enable wider adoption of electric vehicles but the high-current regimes affect electrochemical characteristics and longevity of the battery cells. Formation of Li metal deposits is a recognized hazard of high-rate charging. We will highlight the use of a microprobe reference electrode to monitor the onset of Li plating conditions *in situ* and discuss lithium concentration gradients that develop in the electrodes during fast charging.

3:00 High-Nickel, Low-Cobalt Cathodes for Lithium-Ion Batteries

Arumugam Manthiram, PhD, Professor, Mechanical Engineering, University of Texas at Austin

Lithium-ion batteries are beginning to transform the transportation sector, but the scarcity and high cost of cobalt pose serious problems for their deployment for electric vehicles and grid storage. This presentation will focus on the design and development of high-nickel, low-cobalt cathodes for lithium-ion batteries. Full cell data with graphite anode for thousands of cycles and an in-depth characterization of the cycled electrodes after extensive cycling will be presented.

3:20 High Nickel NCA Cathode Materials with Grain Boundary Enhancement

Kenan Sahin, PhD, President and Founder, CAMX Power LLC

Suresh Sriramulu, PhD, Head, Advanced Development, CAMX Power LLC

This talk will discuss the benefits of adding other elements (in addition to cobalt) to the grain boundaries using materials from the NCA family. Specifically, we will discuss scaling-up the synthesis of these materials, their implementation in multi-Ah cells, as well as the economics of synthesizing grain boundary enriched materials relative to conventional materials.

3:40 Why ALD Nanofilms on Cathode Materials Improve Li-ion Battery Performance

Sponsored by



Alan Weimer, PhD, H.T. Sears Memorial Professor, Chemical and Biological Engineering, University of Colorado, Boulder

The true nature of low-cycle number ALD films on NMC materials is elucidated using focused surface characterization. It is commonly assumed that several ALD cycles form a uniform film that optimally is thin enough to facilitate lithium diffusion while blocking side reactions of the electrolyte with the cathode material. We show that ALD films are not uniform and grow preferentially on metal oxides, stabilizing them in the presence of electrolyte without blocking lithium intercalation pathways.

4:00 Q&A

4:20 Networking Reception in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

5:25 Close of Symposium

HOTEL & TRAVEL INFORMATION

CONFERENCE HOTEL & VENUE:

Hotel Del Coronado
1500 Orange Ave
Coronado, CA 92118

DISCOUNTED ROOM RATE: \$294

DISCOUNTED CUT-OFF DATE EXTENDED TO: May 28, 2019

For more information: visit the Hotel & Travel page of AdvancedAutoBat.com/US

In 1958, Hollywood icon Marilyn Monroe, left, filmed "Some Like It Hot" at Hotel del Coronado. Sixty years later, "the Del" has stood the test of time on the San Diego shore.





BATTERY ENGINEERING FOR AUTOMOTIVE APPLICATIONS

Building Better Batteries

MONDAY, JUNE 24**12:30 pm Symposia Registration**

BATTERY SAFETY

1:30 Chairperson's Opening Remarks

Eric Darcy, PhD, Battery Technical Discipline Lead, Propulsion and Power Division, NASA-JSC/EP5

1:35 Combining Fractional Calorimetry with Statistical Methods to Characterize Thermal Runaway

William Q. Walker, PhD, Aerospace Technologist, Engineering Directorate (EA), Structural Engineering Division (ES), Thermal Design Branch (ES3), NASA Johnson Space Center

Fractional thermal runaway calorimetry (FTRC) techniques were introduced to examine thermal runaway (TR) behavior of lithium-ion (Li-ion) cells. Specifically, FTRC considers the total energy released vs. the fraction of the total energy that is released through the cell casing vs. through the ejecta material. This device has been expanded to universally support FTRC testing of additional cell types including 21700-format, D-Cell format, and large prismatic format Li-ion cells. The TR behavior as influenced by cell format, manufacturer, chemistry, capacity, and *in situ* safety features are described in this presentation.

1:55 Anode Improvements for Better Fast Charge Tolerance in Cells of High Energy and Powder Density

Mohan Karulkar, PhD, Principal Staff Member, Power Sources R&D, Sandia National Laboratories

Sandia National Laboratories has implemented diagnostics across multiple time and resolution scales to identify safe and effective battery operating conditions. Methods like high precision cycling, advanced EIS, and differential coulometry will be linked to more traditional current/voltage/temperature measurements to assess applications like fast charge, cell abuse, and second use. The impact of charge rate, SOC window, and cell capacity on safety and performance will be discussed.

2:15 Failure Propagation Work and Abuse Testing

Joshua Lamb, PhD, Senior Member of the Technical Staff, Advanced Power Sources R&D, Sandia National Laboratories

The increasing energy and power demands from various applications drive the need for higher energy density batteries, which typically means an increased reliance on lithium-ion batteries. Because of this, complex and high energy density systems composed of lithium-ion cells are becoming more prevalent. This talk shows how Sandia National Laboratories uses abusive battery testing to better understand the potential risks surrounding high energy batteries.

2:35 Test as a Competitive Advantage: Approaches to Overcome EV Battery Test Challenges

Ty Prather, EV Validation Solution Manager, Automotive Strategy, National Instruments

Battery test challenges include managing a massive heterogeneous mix of concurrent testing. Using a flexible, platform-based approach increases the operational efficiency of doing so. See how this approach provides advantages in control and sequencing, measurements, and systems and data management.

2:55 Talk Title to be Announced

Michael Roach, North American & European Sales Manager, Sales & Marketing, AEM Components USA, Inc.

This presentation highlights some potential safety concerns in circuit protection associated with EV applications. It demonstrates how advanced "Wire-in-Air" fuse technology could yield much more consistent and reliable performance. The newly developed solid, robust structure of CMF fuses assures the best safe power density in higher power applications.

3:15 Refreshment Break**3:35 Battery Module Assembly Materials for Design and Safety Considerations**

Greg Becker, Technical Service and Development Specialist, Dow Performance Silicones

Engineers are continually focused on designing battery modules for optimal efficiency and performance. In the design phase, module assembly materials selection can aid in the manufacturing process, help to ensure module reliability and also address safety concerns. These assembly materials can include adhesive materials for component bonding, conductive materials for thermal management of the modules as well as encapsulant materials for cell protection. This presentation will focus on examining encapsulant materials primarily from a module safety perspective.

3:55 Enabling battery safety while also improving performance with Atomic Layer Deposition

Paul Lichty, PhD, Founder, CEO, Forge Nano

This talk will discuss the various safety and performance benefits that atomic layer deposition (ALD) has been demonstrated to provide when properly applied to battery materials. ALD can improve the energy density, charge rate of battery materials while concurrently improving safety. In this talk we will discuss how ALD has been demonstrated to increase battery safety such as reduced gassing, higher thermal stability, improved handling of sensitive materials.

4:15 Functional Safety for Electric Vehicles Under the ISO 26262 Standard

Ken Ferguson, PhD, Senior Scientific Consultant, Vehicle Practice, Exponent

With increasing complexity pervading the automotive industry, increased efforts have been focused on providing safety-compliant electrical and electronic systems. ISO 26262 utilizes a system of steps to manage functional safety and reduce risk to acceptable levels for road-vehicles, motorcycles, and heavy trucks. In this presentation we will discuss how the newly published second-edition of ISO 26262 applies to the battery pack and battery management system in electric vehicles.

4:35 NTSB Investigations of EV Crashes and Incidents with Battery Fires

Thomas Barth, PhD, Senior Accident Investigator and Biomechanics Engineer, Office of Highway Safety Board, National Transportation Safety Board

The National Transportation Safety Board has conducted several investigations of electric vehicle crashes and incidents that involved fires and stranded energy of the high voltage battery. The investigations focused on the emergency response, secondary response, and stranded energy. This presentation will summarize the investigations and current issues being developed for an NTSB Special Report on Electric Vehicle Battery Fire Safety.

4:55 Q&A**5:20 Close of Day****TUESDAY, JUNE 25****8:30 am Morning Coffee**

BATTERY MANAGEMENT SYSTEMS

9:00 Chairperson's Remarks

Eric Darcy, PhD, Battery Technical Discipline Lead, Propulsion and Power Division, NASA-JSC/EP5

9:05 Bridging Modeling Scales via Multiphysics Numerical Methods: Successes and Challenges

Victor Oancea, PhD, Director of Technology, Chief Scientific Officer, Dassault Systemes

9:25 Modeling and Controlling Diffusion-Induced Particle Stresses in Lithium-Ion Battery Cells

Gregory Plett, PhD, Professor, Electrical and Computer Engineering, University of Colorado, Colorado Springs

One significant degradation mechanism that can be controlled by a BMS is diffusion-induced particle stress. When cells are operated at high rates (including during fast-charge), particle stresses can lead to particle fracture and resulting capacity and power fade. This talk describes computationally simple ways to predict particle stresses in order to be able to control battery packs to slow down aging due to particle fracture.

9:45 A Glance at Next-Generation Battery Management System Requirements: Safety and Security

Stefan Goede, Managing Director, Munich Electrification GmbH

This presentation will detail the importance of cyber security of vehicles and how to prevent safety events using vehicle software.

10:05 Grand Opening Coffee Break in the Exhibit Hall with Poster Viewing

Sponsored by



11:00 Accelerating EV System Qualification while Ensuring Battery Safety, Performance and Reliability

Tal Sholklapper, PhD, CEO, Voltaiq

Rapid, strategic shifts in electrification and vehicle usage models are putting enormous pressure on automotive OEMs to accelerate time-to-market through advanced modelling and validation of battery vendors and pack designs. This presentation will discuss how OEMs are using data analytics to accelerate qualification while ensuring safety, performance and reliability.

Sponsored by



11:20 Technical Excerpts from the Energy Storage System Evaluation and Safety Consortium

Bapi Surampudi, PhD, Staff Engineer, Electric Powertrain, Southwest Research Institute

The SwRI Energy Storage Systems and Evaluation consortium has been conducting lithium ion cell benchmarking, xEV testing and BMS calibration/ algorithms development since 2011. The poster presentation will cover the following research mini topics. Mild accelerated aging of LFP cells with USABC 12 V Start-stop cycling. Effect on aging on overcharge tolerance of LMO cells. Performance of a PWM fast charge profile in comparison with OEM fast charge approach on Chevy Bolt cell. Test data from more than three years of testing will be distilled to provide insights and possible application.

11:40 Approaches to Evaluating Battery Cell Components for Automotive Applications

Zoe Zhou, PhD, Research Engineer, Ford Motor Company

Battery cell internal components and materials can impact a variety of performance and durability characteristics of individual cells and associated battery pack systems. This study investigates some of these impacts on the response behavior of cells in exposure to varied abuse conditions. Related trends will be illustrated and unique diagnostic approaches to evaluate component changes will be highlighted.

12:00 pm Battery Modules & Packs: Digital Performance Assessment

Fabien Letailleur, Solutions Manager, SIMULIA User Experience, Dassault Systemes Americas Corporation

The audience can learn about ways to predict many aspects of the performance of battery modules and packs before the first prototype is ever built. A

combination of 3D and homogenized 0D/1D modeling strategies are discussed spanning structural integrity, thermal management and electrical performance of batteries at the module and at the pack level. Examples include fatigue and crash analysis, thermal analysis, assembly related constraints, charging-discharging cycles.

12:20 Q&A

12:40 Networking Lunch

1:35 Dessert Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

Sponsored by

CELL ENGINEERING

2:35 Chairperson's Remarks

Mark Verbrugge, PhD, Director, Chemical and Materials Systems Laboratory, General Motors

2:40 Modeling of Porous Insertion Electrodes: The Utility of Cyclic Voltammetry and Differential Voltage Spectroscopy

Mark Verbrugge, PhD, Director, Chemical and Materials Systems Laboratory, General Motors

After a brief update on GM's electrification initiatives, we develop and compare methods to determine when electrochemical reactions take place within intercalation electrodes used in lithium-ion cells. Second, we (1) formulate a porous electrode model including multiple lithium-insertion species and associated electrochemical and homogenous reactions, (2) simulate linear-sweep voltammetry data at different scan rates, and (3) describe a method to obtain values for transport, kinetic, and thermodynamic parameters.

3:00 Next Generation of Primed Al/Cu Foils to Support the Battery Market Evolution

Thierry Dagron, Business Development Director, ARMOR Films for Batteries, ARMOR

In order to increase the energy density and cope with supply chain and safety regulations, most of the battery manufacturers look to develop nickel-rich cathodes, silicone-based anodes, higher voltages, water-based processes, etc. With such changes, new technical issues may occur at the interface between the electrode and the current collector. We demonstrate how primed current collectors (Al/Cu foils with a protective and conductive coating) solve these problems. ARMOR has developed specific primed Al/Cu foils for these new electro-chemistries. Benefits are longer cycle life, increased safety, fast charging, high power and energy density.

3:20 Grinding and Dispersing Technology for the Battery Industry

Jake Dagen, Inside Sale/Battery, Processing Specialist, NETZSCH Premier Technologies

This talk will focus on the topic of how grinding and dispersing equipment can help battery manufacturers improve their product.

3:40 Comparing Thermal Pads and Gap Fillers for Thermal Management in EV Battery Packs

Sarah Ledbetter, Global Market Specialist – Electrification, LORD Corporation

Sponsored by

An overview of thermal interface materials used in EV systems with focus on comparing gaps pad versus liquid-dispensed, gap fillers. Thermal transfer properties will be reviewed as well as real-world application data obtained via a representative battery module. Conclusions will be drawn that include trade-offs on cost, manufacturability and performance.

4:00 Q&A

4:20 Networking Reception in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

5:25 Close of Symposium

“The AABC meeting is what I consider the premier automotive battery meeting in the world.”

- Greg MacLean, PhD, General Motors



EV TECHNOLOGY FOR SPECIALTY TRANSPORTATION

High-Energy Battery Development for Light to Heavy Duty Applications

MONDAY, JUNE 24

12:30 pm Symposia Registration

HEAVY DUTY EV MARKET OVERVIEW

1:30 Chairperson's Opening Remarks

Leslie Goodbody, Engineer, Innovative Heavy-Duty Strategies, Mobile Source Control Division, California Air Resources Board

1:35 Advancing Zero-Emission Technology in Heavy-Duty Trucks, Buses, and Cargo Handling Equipment – A California Imperative

Leslie Goodbody, Engineer, Innovative Heavy-Duty Strategies, Mobile Source Control Division, California Air Resources Board

Heavy-duty vehicles and off-road equipment are responsible for a significant portion of California's particulate, smog-forming, and climate change emissions, and for causing disproportionate health impacts to communities near the ports and along freight corridors. This talk will provide an overview of plans, strategies, and regulatory efforts underway to reduce emissions in heavy-duty and off-road vehicle fleets. It will cover CARB's programs, such as Cap-and-Trade, Community Air Protection Program and Volkswagen, that provide funding for projects that spur clean and zero-emission technology innovation and commercialization.

OEM & USER PERSPECTIVES ON SPECIALTY BATTERY DEVELOPMENT

1:55 Toyota Motor North America's Project Portal Class 8 Heavy Duty Hydrogen Fuel Cell Electric Vehicle

Scott Friedman, Senior Engineer, Research & Development, Toyota's Project Portal, Toyota North America

Toyota Motor North America, including its partners Kenworth and the Port of Los Angeles, are working to push the envelope of zero emission class 8 heavy duty shore-to-store (drayage) trucking. With currently two trucks on the road and another ten coming by the middle of 2020, Project Portal is no longer just a proof of concept. Toyota will discuss Project Portal's mission, design concept and its application of high-power batteries which supplement the Toyota Mirai's Fuel Cell Stacks.

2:15 Overcoming the Challenges to Heavy Duty Vehicle Electrification – TransPower's ZEV/NZEV Class 8 Vehicles

Joshua Goldman, Vice President, TransPower

A reliable electric drive system for Class 8 trucks has finally been demonstrated, but challenges remain including weight, range and charging infrastructure. In addition, the affordability for fleet operators - capital costs are presently about three times the cost of a high-end diesel truck or tractor. Critical to the commercialization of Class 8 EV trucks are OEMs, Dealers, Tier 1 Suppliers and Funding Subsidies. This presentation will address these challenges and highlight TransPower's solutions.

2:35 Designing, Ruggedizing, Testing, and Manufacturing Battery Systems for the Heavy-Duty Market

Thomas Blazak, Director of Test & Validation, Battery Engineering, Proterra

Reliable ruggedized high capacity battery systems that were buy America compliant did not exist with the specs that Proterra's customers needed. In less than 2 years Proterra built a team that has designed and tested and a manufacturing line that builds an industry leading HD battery system that has attracted the attention of multiple other HD manufacturers to the point where they are deploying the system in their HD battery electric efforts.

2:55 Sponsored Presentation (Opportunity Available)

3:15 Refreshment Break

3:35 San Diego Metropolitan Transit System Zero Emission Bus (ZEB) Pilot Program

Michael Wygant, Director of Fleet and Facilities Maintenance, San Diego Metropolitan Transit System

MTS is currently constructing a ZEB Pilot Program that will further help the

agency reduce their Greenhouse Gas Emissions (GHG). The nearly \$10 million project is designed to support MTS in complying with the California Air Resources Board's (CARB) proposed Initiative Clean Transit (ICT) regulation. The ICT will require California transit systems to transition to ZEB technologies meeting the State's zero emission goal of 2040. This pilot program is set to commence service in mid-2019.

INNOVATIONS IN BATTERY SYSTEMS FOR SPECIALTY APPLICATIONS

3:55 ACTIA & Toshiba Battery Pack Innovation for Transit Bus, Mining & Rail Applications

Greg Fritz, EV Unit Manager, ACTIA Corporation

The successful commercialization of clean, efficient medium and heavy duty vehicles in a large part depends upon battery packs that last the life of the vehicle. The Toshiba LTO cells have over five times the life and power of other lithium cells, which when packaged and managed properly, last the life of the vehicle. The presentation will focus on field data from ACTIA+Toshiba battery packs in numerous demanding applications such as transit buses, mining, rail, theme park rides and autonomous guided vehicles with special focus on hybrid, fuel cell and fast charge EV applications.

4:15 Thermal and Stress Analysis of a Battery Pack for a Light Weight Sports Car

Kaushik Illa, Global Application Specialist, e-Powertrain, Siemens PLM Software

In this presentation we would like to address how simulation would assist in minimizing the research, analysis, and experiments to analyze the behavior of battery systems where there is a need for strongly coupled resolution of flow, heat transfer, electrochemistry and stress due to expansion and contraction during operation to provide the best possible prediction to maintain the integrity of the system and identifying potential problems at an early stage. In all, it is becoming more vital to analyze packs and modules through simulation to capture the complexity of a thermal management at component and system level.

4:35 Prototyping and Industrialization of Solid-State Battery Technology for Performance BEV and Electric Aircraft Propulsion System Applications

Martin Talke, Associate Principal, P3 Group

The technology maturity and feasibility of mass production of solid-state battery technology is one of the greatest mind-term challenges for electric propulsion systems, both on land and in the air. After prototyping has led to the desired battery cell design, the industrialization and production ramp-up are the next milestones before reaching series production. Together with strong partners, P3 has developed the skills to assess the feasibility of such next-generation battery production. Lastly, the application of mass produced next-generation battery technology for high-performance powertrain systems will be considered.

4:55 Q&A

5:20 Close of Day

TUESDAY, JUNE 25

8:30 am Morning Coffee

INNOVATIONS IN BATTERY SYSTEMS FOR SPECIALTY APPLICATIONS

9:00 Chairperson's Remarks

Colin Wessells, PhD, CEO, Natron Energy

9:05 BMS Requirements for High Energy and High Power EV Battery Packs

Anil Paryani, PhD, CEO, Auto Motive Power

This presentation will focus on contactor management, current sensing, fuse management, thermal controls, bleeding and of course touch on SOC. I will also

compare and contrast different approaches in the marketplace of OEMs based on public information. This presentation will discuss a novel method to predict the parameters and useful remaining life of lithium-ion batteries used in xEVs using data pieces from the normal operation of the vehicle, without the need of a complete charge/discharge test of the battery pack.

9:25 Ultra-high Energy Battery Performance Enabled through Metallic Li Anode Cell Designs

Michael Fetcenko, Chairman of the Board, Sion Power

Sion Power has a long history in the development of Li-Sulfur chemistry for high energy aerospace applications. We have applied our long experience with metallic Li anodes to replace sulfur with Li-Ion cathodes such as NCM, NCA and achieved 500 Wh/kg, 1000 Wh/L with long cycle life and outstanding safety. We have a technology roadmap to achieve 630 Wh/kg, 1300 Wh/L.

9:45 E-Bus Battery Market 2019

Shmuel De-Leon, CEO, Shmuel De-Leon Energy, Ltd.

10:05 Grand Opening Coffee Break in the Exhibit Hall with Poster Viewing



LIB CHEMISTRIES AND ALTERNATIVE TECHNOLOGIES

11:00 Energy Storage Considerations for 48V Hybrid-Electric Powertrains

Andrew Burke, PhD, Research Engineer, Institute of Transportation Studies, University of California-Davis

There is considerable interest worldwide in the development of 48V hybrid-electric powertrains for light-duty vehicles of various sizes. This paper investigates in detail, based on laboratory tests at UC Davis of high-power cells of various lithium-ion chemistries and advisor simulations of hybrid vehicles using 48V powertrains, the likelihood that the DOE targets can be met and the likely fuel economy of light-duty vehicles using 48V hybrid-electric powertrains.

GRID-SCALE ENERGY STORAGE

11:20 Grid-Integration of Batteries as the Solution for Use of Renewable Energies

Michael Keller, Head of Coordination for Battery and Charging Technologies, Volkswagen Group R&D

How grid-integration of batteries can increase the percentage use of renewable energies for electric cars (including stationary batteries). This is an extended view of the use of batteries for the increased fluctuation of electric energy in the grid due to higher share or renewable energy sources.

11:40 Battery Energy Storage: Advancement in Generation Applications

Haresh Kamath, Senior Program Manager for Distributed Energy Resources (DER) at the Electric Power Research Institute (EPRI)

As lithium-ion battery costs fall, increasingly large battery storage systems are being proposed for deployment. Although some of these storage systems are standalone units designed for limited duration application, others are being proposed as support for solar, wind, gas, or nuclear generation to improve efficiency, reduce wear and tear, and to make systems more dispatchable. This presentation will discuss these developments, and potential future directions that may become possible with lower costs and advanced storage technologies.

12:00 pm Vehicle to Grid: No Longer Theory – Real World Implementation and Lessons

Kevin Matthews, Managing Director, Sustainability Sector, National Strategies, LLC

This session will provide attendees with an understanding of the realities of V2G, including V2B. The panelist will explore the technical and policy challenges and how they are met; the economic possibilities, and in some cases, lack thereof; and the changes needed to expand the reality. The session will also discuss the importance of knowing all the stakeholders and how to engage them.

12:20 Q&A

12:40 Networking Lunch



1:35 Dessert Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

ULTRA-FAST CHARGING SYSTEMS

2:35 Chairperson's Remarks

Haresh Kamath, Senior Program Manager for Distributed Energy Resources (DER) at the Electric Power Research Institute (EPRI)

2:40 Wireless Inductive Charging Systems for Heavy Duty Applications

Michael Masquelier, CEO, CTO, Wave

WAVE's inductive charging systems of 50 kW and 250 kW, currently powering buses on routes throughout the U.S., are the nation's only solutions to have successfully undergone multiple rigorous commercial deployments. Today, WAVE has 50 kW commercial deployments at six U.S. locations. This technology has demonstrated the capability to develop and integrate high power charging systems onto heavy-duty electric vehicles.

3:00 Energy Storage Systems Based on Prussian Blue Batteries for EV Fast Charge Support

Colin Wessells, PhD, CEO, Natron Energy

Fast charging minimizes downtime for fleet vehicles and mitigates range anxiety for passenger vehicles. However, the grid may not provide adequate capacity for fast charging without costly upgrades, and high demand charges threaten to make fast charging prohibitively expensive. This presentation considers the value proposition of energy storage systems for demand charge management at fast charging stations. Optimally sized and dispatched storage reduces stations' grid tariffs by 30% or more.

INNOVATION IN SECOND LIFE APPLICATIONS

3:20 Extracting Value from Second-Life Electric Vehicle Batteries

Na Jiao, Technology Analyst, IDTechX

Recycling retired batteries is still at a cost today and entails extra energy and potential pollution. Repurposing a second-life for those retired but still capable batteries in less-demanding applications such as stationary energy storage, on the other hand, could potentially bring tremendous value to a wide range of stakeholders in the automotive and energy sectors. Insights into the market potential of second-life electric vehicle batteries (a ten-year forecast), along with the markets and applications, existing industrial implementations, value chain as well as innovative business models for second-life batteries will be discussed.

3:40 A Sustainable Perspective for Lithium-ion Battery Recycling



Benoit Couture, President, Lithion Recycling

As electric vehicles are getting more and more popular in the public transportation segment, there is a need to implement a sustainable solution for the recycling of spent lithium-ion batteries. Fleet operators are at the front line to impact positively the end-of-life management of their batteries.

4:00 Q&A

4:20 Networking Reception in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

5:25 Close of Symposium



xEV BATTERY TECHNOLOGY, APPLICATIONS AND MARKET

WEDNESDAY, JUNE 26

8:00 am Conference Registration & Morning Coffee

PLENARY SESSION: xEV BATTERY MARKET EXPANSION

See page 3 for full abstracts.

9:00 Chairperson's Opening Remarks

Menahem Anderman, PhD, President, Total Battery Consulting, Inc.

9:05 Vehicle Electrification: Opportunities and Challenges

Norman Lu, Senior Program Manager Powertrain, Powertrain Planning & Research, Toyota Motor North America

9:25 Energy, Propulsion, and Sustainability – The New Watchwords in Automotive Powertrain

Ted Miller, Senior Manager of Energy Storage Strategy and Research, Ford Motor Company

9:45 California Emission Regulations and EV Market Expansion

Michael McCarthy, CTO ECARS, California Air Resources Board

10:05 Coffee Break in the Exhibit Hall with Poster Viewing

11:00 xEV Market Expansion

Menahem Anderman, PhD, President, Total Battery Consulting, Inc.

11:20 xEV Expansion in China: Vehicle, Battery, and Materials Impact

Mark Lu, PhD, Certified Senior Industrial Analyst, Industrial Economics & Knowledge Center (IEK), Industrial Technology Research Institute (ITRI).

11:40 Latest Market Status and Forecast for Li-Ion Batteries

Hideo Takeshita, President and CEO, B3 Corporation

12:00 pm The LiB-Industry: Status and Outlook

Wolfgang Bernhart, PhD, Senior Partner/Automotive, Roland Berger GmbH

12:20 Q&A

12:40 Networking Lunch (Sponsorship Opportunity Available)

1:25 Dessert Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

BATTERIES FOR xEVs

2:20 Chairperson's Remarks

Pablo Valencia, Senior Manager for Battery Lifecycle Management, Battery Systems Engineering, Battery Cell and Algorithms, General Motors

2:25 Balancing EV Battery Requirements: Life, Energy Density, Charge Rate and Cost

Andrew Oury, Global Lead Engineer – Power Battery Packs, General Motors
General Motors believes in an all-electric future with zero crashes, zero emissions, and zero congestion. GM is pushing to launch 20 new all-electric vehicles by 2023. With insight from GM's experience with the Bolt EV, Mr. Oury will discuss balancing pack and cell requirements for life, energy density, charge rate, and cost for next-generation electric vehicles.

2:45 Rising to the Challenge: Rechargeable Battery SCiB™ with LTO Anode for LV-xEV Applications

Dai Yamamoto, PhD, Specialist, Battery Systems Division, Toshiba Infrastructure Systems & Solutions Corporation

Toshiba has been supplying high power lithium-ion battery (SCiB™) with LTO anode for 12V mild hybrid applications, and also for other expanding applications. This presentation will introduce the newly developed battery cell and pack prototypes for 48V hybrid segment, which are not only compact and lightweight, but also capable of reducing CO2 emissions as shown in system simulations.

3:05 EV Battery Benchmarking

Wenzel Prochazka, PhD, Battery Manager, Battery Benchmarking Program, AVL List GmbH

3:25 Refreshment Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

4:20 Fast Charge Batteries with High Specific Energy for Electric Vehicle Application

Sujeet Kumar, CEO, Zenlabs Energy

Zenlabs has developed high specific energy (>300 Wh/kg) lithium-ion batteries integrating silicon-based anodes and nickel-rich nickel-cobalt-manganese oxide (NCM) cathodes. Our 300 Wh/kg pouch cells cycling at a 1C charge and 1C discharge rate have achieved over 500 cycles before reaching 90% capacity retention. Cells exhibit excellent fast charge capability enabled by porous electrodes and high conductivity electrolytes. This newly developed technology addresses two major barriers to mass adoption of EVs, namely, range anxiety and fast charge.

4:40 Single-Active-Material Silicon Battery Technology for EV Applications – Extreme Fast Charge with No Compromise

Benjamin Park, PhD, Founder & CTO, Enevate Corporation

Enevate's pure silicon-dominant anode (>70% silicon) utilizes a self-standing active material film vs. powder mixtures of silicon and graphite. Unique properties of cells made using this technology include extreme fast charge with high energy density, wide temperature operation, and safety with the potential for bringing cell costs down. The mechanism for the cell operation as well as cell and anode design principles will be described.

Sponsored by
 ENEVATE

5:00 Q&A

5:20 Networking Reception in the Exhibit Hall with Poster Viewing

Sponsored by
 TOYOTA

6:30 Close of Day

THURSDAY, JUNE 27

8:30 am Continental Breakfast Roundtable Discussions

Join your colleagues and fellow delegates over breakfast for a focused, informal discussion moderated by a member of our speaking faculty. A small group format allows participants to meet potential collaborators, share examples from their own work and discuss ideas with peers. Visit our website to see the full listing of topics and moderators.

BATTERY LIFE AND RELIABILITY

9:30 Chairperson's Remarks

Xiao Guang Yang, PhD, Battery Cell Supervisor, Ford Motor Company

9:35 For Service Replacement Needs for xEV Batteries After the End of Production

Xiao Guang Yang, PhD, Battery Cell Supervisor, Ford Motor Company

EV batteries must be designed not only to meet warranty and operational design life targets that are often 8-10 years, but provision must be made to have service replacement batteries available for as long as 10-15 years after the end of xEV battery and vehicle production. This paper describes the technical needs of a service replacement battery, as well as strategies for making them available for 10+ years after the end of battery cell and battery pack mass production.

9:55 Presentation to be Announced**10:15 The Trends of Electric Drive Vehicles in India**

Koji Tamenori, Chief Engineer – Department Manager, Advanced Product Planning, Honda Cars India Limited HGID

For the following reasons, India has had high expectations as the biggest BEV market. India is one of the few CAFE regulators introduced in Asia, and exhaust emissions are strictly regulated as in economically advanced countries. Exhaust gas regulation began to regulate the BS 6 equal level as Euro 6b since 2020. CAFÉ regulation becomes stricter from 2022, and it will cut under 100 g in 2027. The hurdles of purchasing diesel vehicles from exhaust gas regulation have increased. It means the demand for HEV and BEV has increased in CAFE regulation. BEV is being introduced with incentives. BEV is required in the urban area as in economically developed countries, but there are unique features in how to use it. I will introduce how cars are used and the requirements of BEV in India.

10:35 Coffee Break in the Exhibit Hall with Poster Viewing

(Sponsorship Opportunity Available)

11:35 Wireless Charging of Electric Vehicle Batteries for Enhanced Safety, Longevity, and Economics

Chris Mi, PhD, Professor and Chair, Electrical and Computer Engineering, San Diego State University

EV battery charging with wireless power transfer technology, which provides enhanced safety, reduce cost, improve reliability and longevity.

11:55 Battery Module Assembly Materials for Design and Safety Considerations

Liangkai Ma, PhD, Research Scientist, Corporate Research and Development, Dow

Engineers are continually focused on designing battery cells and modules for optimal performance, efficiency and safety. In the design phase, module assembly materials should also be taken into account. A diligent approach to assembly materials selection can aid in the manufacturing process, help to ensure module reliability and also address safety concerns. These assembly materials can include adhesive materials for component bonding, conductive materials for thermal management of the cells and modules, as well as encapsulant materials for cell protection. This presentation will focus on examining thermally conductive gap filler materials primarily from a module thermal stress perspective during normal battery operations.

12:15 pm xEV Industry Trends of Charging & Battery Systems

Kevin Konecky, Battery Systems Consultant, Total Battery Consulting, Inc.

Lithium-ion battery systems are an enabling technology in the propagation of xEVs with longer range and higher-energy-density batteries. Further enabling public acceptance are convenient and time-effective charging options. This presentation will review many xEVs currently in production and discuss trends and diversity in the subsystem design choices that were implemented in each production system including charge capabilities. Different charging protocols and standards across the globe will be discussed with trends analyzed, as well as improvements to user convenience including faster DC-charging and wireless charging.

12:35 Q&A**12:50 Networking Lunch****1:40 Dessert Break in the Exhibit Hall with Poster Viewing**

(Sponsorship Opportunity Available)

INFRASTRUCTURE AND RECYCLING**2:25 Chairperson's Remarks**

Kevin Konecky, Battery Systems Consultant, Total Battery Consulting, Inc.

2:30 Grid-Integration of Batteries as the Solution for Use of Renewable Energies

Michael Keller, Head of Volkswagen Group R&D coordination for Battery and Charging Technologies, Volkswagen

How can Grid-Integration of Batteries increase the percentage use of renewable energies for electric cars (including stationary batteries).

2:50 Designing for Repurposing

Oliver Gross, Technical Fellow - Energy Storage Systems, Advanced Electrification and Technology, FCA US LLC

When an EV battery reaches the end of its useful life, it will be repurposed. Repurposing can be recycling of the battery, or re-use in some manner. Battery re-use often considers the disassembly of the battery and salvaging of components, for use in other applications. This presentation will cover the culmination of a series of investigations, which produced a Best Practice for re-purposing, and considerations, to be taken into account when designing a battery system for re-purposing.

3:10 Refreshment Break**3:30 Lithium-Ion Battery Recycling Research at the ReCell Center**

Linda Gaines, PhD, Transportation System Analyst, Energy Systems Division, Argonne National Laboratory

The U.S. Department of Energy has created the ReCell Center (and is offering a Recycling Prize) to develop an economical recycling process by the time large volumes of batteries from electric vehicles and other uses reach end of life. The work will be performed at lead-lab Argonne National Laboratory, its partner labs Oak Ridge and NREL, and several universities. This presentation will describe research projects in the center that focus on recovering usable cathode.

3:50 Opportunities and Challenges of Lithium-Ion Battery Recycling

Kunal Phalpher, Chief Commercial Officer, Business Development and Operations, Li-Cycle

This presentation will explore the opportunities and challenges of lithium-ion battery recycling. With the development of megafactories for lithium-ion batteries, there is a need to recycle these batteries at a 'mega' scale. Li-Cycle Technology™ meets this need. Li-Cycle Technology™ is a low cost, safe, and environmentally friendly solution to the global end-of-life lithium-ion battery problem. The technology can recycle all types of lithium-ion batteries with unparalleled recoveries of 80-100%.

4:10 Q&A**4:30 Closing Remarks****4:40 Close of Conference**

Simultaneous English to Japanese Translation Available

英語から日本語への同時翻訳



GLOBAL BATTERY RAW MATERIALS

Balancing Supply, Demand & Costs for Battery Component Materials

WEDNESDAY, JUNE 26

8:00 am Conference Registration & Morning Coffee

PLENARY SESSION: xEV BATTERY MARKET EXPANSION

See page 3 for full abstracts.

9:00 Chairperson's Opening Remarks

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9:05 Vehicle Electrification: Opportunities and Challenges

Norman Lu, Senior Program Manager Powertrain, Powertrain Planning & Research, Toyota Motor North America

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Michael McCarthy, CTO ECARS, California Air Resources Board

10:05 Coffee Break in the Exhibit Hall with Poster Viewing

11:00 xEV Market Expansion

Menahem Anderman, PhD, President, Total Battery Consulting, Inc.

11:20 xEV Expansion in China: Vehicle, Battery, and Materials Impact

Mark Lu, PhD, Certified Senior Industrial Analyst, Industrial Economics & Knowledge Center (IEK), Industrial Technology Research Institute (ITRI).

11:40 Latest Market Status and Forecast for Li-Ion Batteries

Hideo Takeshita, President and CEO, B3 Corporation

12:00 pm The LiB-Industry: Status and Outlook

Wolfgang Bernhart, PhD, Senior Partner/Automotive, Roland Berger GmbH

12:20 Q&A

12:40 Networking Lunch (Sponsorship Opportunity Available)

1:25 Dessert Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

GLOBAL MARKET DEMAND FOR BATTERY RAW MATERIALS

2:20 Chairperson's Remarks

Sam Jaffe, Managing Director, Cairn Energy Research Advisors

2:25 North America's Battery Ecosystem: Back to the Future as Cell Manufacturers Start Re-Investing in the USA?

Robert Baylis, Managing Director, Roskill Information Services, Ltd.

This presentation looks at the evolving North American supply chain ecosystem for batteries and the plans and opportunities for raw material supply, in the context of geological, economic and other constraints, and the appetite of downstream consumers for provenance over price which may ultimately be the determining factor. Key topics to be addressed include The North American lithium-ion battery landscape, its drivers and future. Current status and new investment in the battery supply chain and likely evolution. Existing and potential North American raw material supply. How do the North American, European and Asian battery ecosystems compare.

2:45 The End of the Beginning: Where Do We Go from Here with Energy Metals Investment?

Chris Berry, Founder and President at House Mountain Partners

By many accounts, 2018 was a lost year for upstream investment in lithium, cobalt, and associated mining companies with broadly negative returns across the entire sector. Is this same theme set to play out in 2019 and beyond? This presentation points to several themes to watch for going forward which are likely to play a role in reigniting interest in this critical aspect of the lithium-ion supply chain.

3:05 Lowest Cost, Longest Life Li-Ion Cells with Advanced Anode Graphite

Sponsored by
Pyrotek

Jeremy Schrooten, PhD, Technical Director, Pyrotek Inc.

New data will be presented to validate the performance of Pyrotek's advanced anode materials. Full cells tested at Dr. Jeff Dahn's Dalhousie University laboratory and Pyrotek's Spokane Research and Development Centre demonstrated the highest coulombic efficiency compared to other commercial options. Data for swelling, capacity, rate, efficiency, and safety will be presented. Synthetic graphite grades starting at \$5,000/MT are made possible by Pyrotek's 25 years of advanced anode manufacturing experience.

3:25 Refreshment Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)

4:20 The Impact on the EV Revolution on Battery Materials – Will Lack of Supply Crunch Demand?

Ken Hoffman, Basic Materials Practice Senior Expert & MineLens/MineSpans Solutions, McKinsey and Company

Cobalt – with 2/3 of global cobalt coming from the DRC, will cobalt be the limiting factor of EV demand? Nickel – we see severe tightness post 2025. Lithium – lithium is interesting today, but with the future fight coming in anodes for solid-state batteries, it's really interesting for the future. Other materials such as Neodymium and Graphene are of special interest.

4:40 Pricing and Price Outlook for Battery Raw Materials

William Adams, Head of Battery Research, Fastmarkets Research

A look at the different ways lithium and cobalt are priced and how that is likely to evolve – so from 1 to 1 pricing, to pricing via a PRA, to Exchange pricing. Why the downstream supply chain is likely to demand this pricing evolution. And, the look at the outlook for cobalt and lithium supply/demand and prices.

5:00 Q&A

5:20 Networking Reception in the Exhibit Hall with Poster Viewing

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6:30 Close of Day

THURSDAY, JUNE 27

8:30 am Continental Breakfast Roundtable Discussions

Join your colleagues and fellow delegates over breakfast for a focused, informal discussion moderated by a member of our speaking faculty. A small group format allows participants to meet potential collaborators, share examples from their own work and discuss ideas with peers. Visit our website to see the full listing of topics and moderators.

GLOBAL MARKET DEMAND FOR BATTERY RAW MATERIALS

9:30 Chairperson's Remarks

Robert Baylis, Managing Director, Roskill Information Services, Ltd.

9:35 Evolution of Lithium-Ion Battery to EV Raw Material Contracts over the Last Decade

Simon Moores, Managing Director, Benchmark Mineral Intelligence

Lithium, Cobalt, Graphite, Nickel prices and contracts – how are they changing? Exchange traded lithium: is the world ready? Demand Projection: Lithium-ion battery megafactory capacity versus demand.

9:55 Nickel: How Will the Market Respond to Rapid Growth?*Alex Laugharne, Principal Consultant, CRU*

Nickel is an increasingly vital component of LIB raw materials, but this end use currently accounts for only a small part of total nickel demand. At the same time, this sector is growing far more quickly than other applications, and requires a product form that not all producers can readily supply. Against a background of generally weak nickel pricing but high capital costs for new plants, which suppliers can and will step in to help avoid shortages of battery grade nickel?

10:15 Innovating toward Low-Cost, Zero-Emissions Battery Materials*David Deak, PhD, President, Marbex LLC, formerly of Lithium Americas Corp, and Tesla, Inc.*

Today's "Cradle-to-Gate" approach for producing battery materials is based on the assumption that energy is a necessary consumable cost, typically in the form of carbon-based fuels. This talk articulates the economic and environmental challenges associated with such approach, and then discusses possible solutions. A case can be made that materials such as lithium, nickel, cobalt and copper can be extracted and refined more profitably, with a lower environmental footprint, by leveraging existing engineering concepts from other industries.

10:35 Coffee Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)**BATTERY RAW MATERIALS SUPPLY****11:35 Lithium Fueled Geopolitics. Secure, Sustainable Supply. Oligopolistic Profitability***Howard Klein, Founder & Partner, RK Equity*

While meaningful investments by incumbent producers are being made to grow lithium chemical supply, significantly more is needed for greenfield lithium project development. 5-10 new and currently unfunded projects need to be financed and into construction over the next few years if EV demand forecasts for 2025, 2030 are to be met. China and US trade and broader global geopolitics is increasing capital market volatility for project funding, setting the stage for a potential shortage and price spike. National Security and Public Health are two additional lithium demand tailwinds influencing policy in Europe and the United States and supporting project development in those regions which currently produce very limited supply.

11:55 Nickel & Cobalt Market Update*Denis Sharypin, Head, Market Research, MMC Norilsk Nickel*

Assessing Ni and Co market development in the light of the booming battery industry. Development of new projects in Indonesia and other regions: progress status, economics and issues. Evaluating trends in major Ni & Co consuming industries.

12:15 pm Manganese: The Forgotten Battery Material*Sam Jaffe, Managing Director, Cairn Energy Research Advisors*

While Lithium, Cobalt and Graphite have received all the shouting in the battery materials space, discussion about the manganese market has only reached whisper levels so far. That should end soon as recognition of manganese' importance starts to gain recognition. Like nickel, manganese is a plentiful and heavily mined material. But only high-purity manganese can be used for the battery industry, and supplies of it are extremely limited today. This talk will explore the manganese supply chain, dynamics of the industry and new developments.

12:35 Q&A**12:50 Networking Lunch****1:40 Dessert Break in the Exhibit Hall with Poster Viewing (Sponsorship Opportunity Available)****BATTERY RAW MATERIALS SUPPLY****2:25 Chairperson's Remarks***Steven E. Sloop, President, OnTo Technology LLC***2:30 Chvaletic Manganese Project: Ultra High Purity Manganese Products in Europe***Marco Romero, President and CEO, Euro Manganese*

The development of the Chvaletic Manganese Project represents a strategic opportunity to produce Ultra High Purity Manganese products in the heart of Europe. It is ideally situated amidst an important cluster of emerging precursor and battery production plants. By recycling Communist Era waste and restoring a previously impacted mine site, it is expected to produce manganese products with exceptional green credentials.

INNOVATIONS IN RECYCLING BATTERY MATERIALS**2:50 Opportunities and Approaches for Low-Cost and Safety with End-of-Life Materials***Steven E. Sloop, President, OnTo Technology LLC*

This presentation will address three parts: (1) Elimination of hazards to make batteries safe for transport, which addresses half of the end-of-life liability (2) Reclamation of candidate materials with cathode-healing™ for less than \$10/kg, and reclamation of the remaining materials to (3) make clean-precursors with a value opportunity of \$2-10/kg. For such a developed industry, the realities of a wholistic approach for sustainable (economic and otherwise) lithium-ion battery manufacturing are largely untapped. These approaches offer unique, scalable, patented methods to address it.

3:10 Refreshment Break**3:30 Subsea Mining – A Practical Path Around the Cobalt Cliff***John Petersen, Director, Giyani Metals; Advisor, Ocean Minerals LLC*

Until 2021, terrestrial cobalt supplies should be sufficient to support expected growth in EV sales. By 2022, growth in EV sales is likely to eclipse the mining sector's ability to increase cobalt production and battery manufacturers will have to contend with a permanent cobalt supply deficit. This presentation will focus on medium- to long-term cobalt supply dynamics and the economic, geological, geopolitical, and other constraints on increasing production to keep pace with growth in the EV market. Special consideration will be given the potential of seabed mining as a scalable and cost-effective alternative.

3:50 Life Cycle Energy and Emission Analysis for Lithium-Ion Battery Cathode Materials Production*Robert Privette, Business Development Manager, North America, Umicore Rechargeable Battery Materials*

Lithium-ion batteries (LIBs) are an important component in the BEV powertrain and the manufacture of their constituent components must be considered when evaluating the BEV carbon footprint. This presentation will describe a life cycle energy and emission analysis (LCA) for NMC materials used in the cathode of modern LIBs. Employing low-carbon LIB electrode material production processes is key to realizing the environmental benefits available through the market adoption of BEVs.

4:10 Q&A**4:30 Closing Remarks****4:40 Close of Conference**

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PROGRAM SELECTIONS

JUNE 24, 2019 | 8:00-10:00 am

TUT1: The Rechargeable Battery Market:

Value Chain and Main Trends 2018-2028

TUT2: Computation-Guided Design of Solid Electrolyte Materials and Interfaces in All-Solid-State Li-Ion Batteries

TUT3: Improving the Energy Density of Batteries with Silicon-Based Anodes

TUT4: Battery Safety and Abuse Tolerance Validation

JUNE 24, 2019 | 10:30 am-12:30 pm

TUT5: Managing and Understanding the Risks of Li-Ion Battery Safety

TUT6: Materials for Next Generation Batteries

TUT7: Battery Pack Engineering for xEVs

TUT8: xEV Lithium-Ion Recycling Methods

JUNE 24, 2019 | 8:15 am-5:20 pm

PF1: Renewable Energy Partnering & Investment Forum

JUNE 24-25, 2019

S1: Battery Chemistries for Automotive Applications

S2: Battery Engineering for Automotive Applications

S3: EV Technology for Specialty Transportation

JUNE 26-27, 2019

C1: xEV Battery Technology, Applications and Market

C2: Global Battery Raw Materials

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