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Symposium EE4 : Electrode Materials and Electrolytes for Lithium and Sodium Ion Batteries

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Symposium Organizers

Mariappan Parans Paranthaman, Oak Ridge National Laboratory

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Symposium Support

Aldrich Materials Science

EE4.4: Novel Electrolytes and Architectures

Session Chairs

Arumugam Manthiram

Wednesday AM, March 30, 2016

PCC North, 100 Level, Room 124 A

9:00 AM - *EE4.4.01

A New Class of Single Ion Conducting Electrolyte ($t^+ = 1$); Pure Alkali Cation Plastic Crystals

[C. Austen Angell](#) ₁

₁ Arizona State Univ Tempe United States,

[Show Abstract](#)

9:30 AM - EE4.4.02

Hierarchical MoS₂-Carbon Microspheres: A Robust Anode for High Performance Lithium Ion Battery

[Gen Chen](#) ₁, Hongmei Luo ₁

₁ New Mexico State University Las Cruces United States,

[Show Abstract](#)

9:45 AM - EE4.4.03

Understanding of the Electrochemical Mechanism of SnSb, a Promising Anode for LiB, by Operando Techniques#xD;

[Philippe Antitomaso](#) ₁, Françoise Morato ₁, Bernard Fraise ₁, Laure Monconduit ₂, David Ayme-Perrot ₃, Philippe Girard ₄

₁ Institut Charles Gerhardt de Montpellier UMR 5253 CNRS Montpellier France, ₁ Institut Charles Gerhardt de Montpellier UMR 5253 CNRS Montpellier France, ₂ Réseau sur le Stockage Electrochimique de l'Energie Paris France ₃ Hutchinson Chalette-sur-Loing France, ₄ Total Paris France

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10:00 AM -

BREAK

10:30 AM - *EE4.4.04

Epitaxial VO₂(B) Thin-Films as Capacity-Fading-Free Electrodes

Shinbuhm Lee ₁, Xiang Gao ₁, Xiao-Guang Sun ₁, Andrew Lubimtsev ₁, Panchapakesan Ganesh ₁, Tricia Meyer ₁, Yunchao Li ₁, Matthew Chisholm ₁, Sung Seok Seo ₂, John Freeland ₃, [Ho Nyung Lee](#) ₁

¹ Oak Ridge National Laboratory Oak Ridge United States,² University of Kentucky Lexington United States,³ Argonne National Laboratory Argonne United States

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11:00 AM - EE4.4.05

In Situ Mapping of State-of-Charge Dynamics in Lithium-Ion Batteries

Ming Ke ¹, Joon Sang Kang ¹, Yongjie Hu ¹

¹ Mechanical and Aerospace Engineering University of California, Los Angeles Los Angeles United States,

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11:15 AM - EE4.4.06

Synthesis and Characterization of Empty Silicon Clathrates for Anode Applications in Li-Ion Batteries

Kwai Chan ¹, Michael Miller ¹, Carol Ellis-Terrell ¹, Candace Chan ²

¹ Southwest Research Inst San Antonio United States,² Arizona State University Tempe United States

Show Abstract

11:30 AM - EE4.4.07

Cycling and Aging Studies of Li-Based Cathode Materials via Aberration-Corrected STEM

Patrick Phillips ¹, Javier Bareno ², Daniel Abraham ², Robert Klie ¹

¹ Univ of Illinois-Chicago Chicago United States,² Argonne National Lab Argonne United States

Show Abstract

11:45 AM - EE4.4.08

Development of Conjugated Organic Lithium Carboxylate with Improved Rate Capability for Li-Ion Battery

Lionel Fedele ³, Frederic Sauvage ³, Matthieu Becuwe ³

¹ Laboratoire de Réactivité et Chimie des Solides Amiens France,² Institut de Chimie de Picardie Amiens France,³ Réseau sur le Stockage Electrochimique de l'Energie Amiens France,

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EE4.5: Solid Electrolytes and Novel Electrodes

Session Chairs

Gao Liu

Wednesday PM, March 30, 2016
PCC North, 100 Level, Room 124 A

1:45 PM - *EE4.5.01

Self-Assembly Synthesis of Electrode Architectures for Energy Storage

Sheng Dai ²

¹ Chemical Sciences Division Oak Ridge National Laboratory Oak Ridge United States,² Department of Chemistry University of Tennessee Knoxville United States,

Show Abstract

2:15 PM - EE4.5.02Synthesis and Characterization of a New Fast Lithium-Ion Conductor $\text{Li}_{7-x-y}\text{La}_3\text{Zr}_{2-x-y}\text{Nb}_x\text{Ta}_y\text{O}_{12}$ Maria Maier¹, Thomas Mayerhoefer², Andreas Welzl³, Maurizio Musso¹, Sonja Hoefer², Daniel Rettenwander¹, Juergen Popp⁴, Juergen Fleig³, Georg Amthauer¹¹ Department of Chemistry and Physics of Materials Paris Lodron University of Salzburg Salzburg Austria, ² Leibniz Institute of Photonic Technologies Jena Germany, ³ Institute for Chemical Technologies and Analytics Vienna University of Technology Vienna Austria, ⁴ Leibniz Institute of Photonic Technologies Jena Germany, ⁴ Institute of Physical Chemistry and Abbe Center of Photonics Friedrich Schiller University Jena Jena Germany

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Technologies for renewably generated energy and its storage in delocalized stationary systems as well as portable devices belong to the important contemporary challenges. All-solid-state lithium-ion batteries have therefore been extensively studied in recent years. They offer high volumetric and gravimetric energy densities at high power densities, comply with safety requirements, and provide further desirable properties like thermal and mechanical stability.

Cubic, garnet-like ceramics $\text{Li}_{7-x-y}\text{La}_3\text{Zr}_{2-x-y}\text{Nb}_x\text{Ta}_y\text{O}_{12}$ ($0 \leq x, y \leq 2$) (LLZNTO) are promising solid-state electrolytes, not least because of their good chemical stability against various electrode materials, especially Li metal. A cubic structure is a necessary, although not a sufficient, condition for high ionic conductivity in these oxides. Not all LLZNTOs are cubic at ambient conditions. The endmember $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ and very low substituted samples exhibit a tetragonal structure. The phase transition occurs around $x+y = 0.25$ in $\text{Li}_{7-x-y}\text{La}_3\text{Zr}_{2-x-y}\text{Nb}_x\text{Ta}_y\text{O}_{12}$, depending on the synthesis conditions.

Practical applications in all-solid-state batteries demand electrolytes with ionic conductivities $\sigma \geq 10^{-4} \text{ Scm}^{-1}$. Generally speaking, the ion conductivity is a function of the amount of charge carriers and their mobility in a compound. In LLZNTOs low substitution concentrations (i.e. high lithium ion contents) and dense sintered materials (i.e. a highly disordered lithium-sublattice and a low grain-boundary resistance) promote the ion conductivity.

This study presents the preparation and characterization of fast Li-ion conductors LLZNTOs. The solid solutions are characterized by standard methods like powder XRD and SEM. Ionic conductivities are measured by conventional EIS. A special focus of the characterization lies on Raman-spectroscopy and FTIR-spectroscopy, because only very few articles concerning vibrational spectroscopy and LLZNTOs have been published so far. [1,2,3,4] Raman measurements with different laser wavelengths, at various (especially low) temperatures, and with an electrically gated (100 ps) Raman equipment for suppressing fluorescence will elucidate the LLZNTO-structure. FTIR data from the reststrahlen region between 85 – 900 cm^{-1} are gained by dispersion analysis, which gives further insight into the LLZNTO-structure.

Acknowledgements: The authors thank the team of TimeGate Instruments Ltd. (Oulu, Finland) for the Raman measurements with luminescence rejection. Andreas Reyer is kindly acknowledged for assistance in recording Raman spectra at the University of Salzburg. This work is financially supported by the Austrian Science Fund (FWF).

[1] Larraz G., Orera A., Sanjuán M.L., *J. Mater. Chem. A*, 2013, **1**, 11419.

[2] Tietz F., Wegener T., Gerhards M. T., et al., *Solid State Ionics*, 2013, **230**, 77.

[3] Thompson T., Wolfenstine J., Allen J. L., et al., *J. Mater. Chem. A*, 2014, **2**, 13431.

[4] Mukhopadhyay S., Thompson T., Sakamoto J., et al., *Chem. Mater.*, 2015, **27**, 3658.

2:30 PM - EE4.5.03

Enhancing Ionic Transport through the Mesoscopic Scale: A Case Study of the Perovskite Solid Electrolyte for Li Batteries

Miaofang Chi¹, Cheng Ma¹, Karren More¹, Ce-wen Nan², Nancy Dudney¹¹ Oak Ridge National Laboratory Oak Ridge United States, ² Tsinghua University Beijing China

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2:45 PM - EE4.5.04

Structural and Ionic Transport Properties of LISICON and NASICON Solid Electrolyte Materials

Yue Deng¹, Chris Eames², Jean-Noel Chotard¹, Oliver Pecher³, Clare Grey³, Christian Masquelier¹, Saiful Islam²¹ Laboratoire de Réactivité et Chimie des Solides Université de Picardie Jules Verne Amiens France, ² Department of Chemistry University of Bath Bath United Kingdom, ³ Department of Chemistry University of Cambridge Cambridge United Kingdom

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3:00 PM -

BREAK

3:30 PM - *EE4.5.05

Development of High Area Loading and Stable Sulfur Electrode through Interface Functionality Design for Lithium Sulfur Battery

Gao Liu ¹, [Min Ling](#) ¹¹ Energy Storage and Distributed Resource Division, Energy Technologies Area Lawrence Berkeley National Laboratory Berkeley United States,[Show Abstract](#)**4:00 PM - EE4.5.06**

A Low-Cost Carbon Composite Anode Material from Recycled Waste Tires for Lithium-Ion Batteries

[Joseph Gnanaraj](#) ¹, Rich Lee ¹, Alan Levine ¹, Jonathan Wistrom ², Skyler Wistrom ², Yunchao Li ³, Jianlin Li ⁵, Amit Naskar ⁴, Mariappan Paranthaman ³¹ Energy Division RJ Lee Group Monroeville United States, ² Practical Sustainability Maryville United States, ³ Chemical Sciences Division Oak Ridge National Laboratory Oak Ridge United States, ⁵ Energy and Transportation Science Division Oak Ridge National Laboratory Oak Ridge United States, ⁴ Materials Science and Technology Division Oak Ridge National Laboratory Oak Ridge United States[Show Abstract](#)**4:15 PM - EE4.5.07**

Solid-Like Biomimetic Ion-Channel Electrolytes for Lithium Metal Batteries

[Addis Fuhr](#) ², Li Shen ¹, Hao Bin Wu ¹, Xiao-Feng Wang ³, Anastassia Alexandrova ⁴, Yunfeng Lu ¹¹ Chemical and Biomolecular Engineering University of California, Los Angeles Los Angeles United States, ² C-PCS Los Alamos National Laboratory Los Alamos United States, ¹ Chemical and Biomolecular Engineering University of California, Los Angeles Los Angeles United States, ³ School of Chemistry and Chemical Engineering University of South China Hengyang China, ⁴ Chemistry and Biochemistry University of California, Los Angeles Los Angeles United States[Show Abstract](#)**4:30 PM - EE4.5.08**

Temperature Dependence of Electrolyte Oxidation at Charged NCM Cathode Surface

[Adam Tornheim](#) ¹, Meinan He ², Chi-Cheung Su ¹, Chen Liao ¹, Javier Bareno ¹, Ira Bloom ¹, Zhengcheng Zhang ¹¹ Argonne National Laboratory Lemont United States, ¹ Argonne National Laboratory Lemont United States, ² Worcester Polytechnic Institute Worcester United States[Show Abstract](#)**4:45 PM - EE4.5.09**

Hybridization of Transition Metal Carbides (MXene) and Oxides for High Performance Li-Ion Storage

[Mengqiang Zhao](#) ¹, Michelle Torelli ¹, Chang Ren ¹, Michael Ghidui ¹, Michel Barsoum ¹, Yury Gogotsi ¹¹ Drexel Univ Philadelphia United States,[Show Abstract](#)**EE4.6: Poster Session II****Session Chairs**

Joseph Gnanaraj

Wednesday PM, March 30, 2016

Sheraton, Third Level, Phoenix Ballroom

8:00 PM - EE4.6.01

N-Doping Effect of di-Vacancy Graphene on Oxygen Reduction Reaction (ORR) of Lithium-Air Battery

Young Hoon Yoon₁, Ji Hye Lee₁, Seung Geol Lee₁

₁ Pusan National University Busan Korea (the Republic of),

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8:00 PM - EE4.6.02

Conductive Interwoven Bamboo Carbon Fibers Membrane for Li-S Batteries

Xingxing Gu₂, Yanglong Hou₂, Shanqing Zhang₁

₁ School of Environment Griffith Univ Gold Coast Australia,₂ Department of Materials Science and Engineering, College of Engineering Peking University Beijing China,₂ Department of Materials Science and Engineering, College of Engineering Peking University Beijing China,₁ School of Environment Griffith Univ Gold Coast Australia

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8:00 PM - EE4.6.03

Enhanced Efficiency of Sulfur Cathode via Cryogenic Grinding of Glassy-Like Sulfur for Application in Li-s Batteries

Milos Krbal₁, Tomas Kazda₂, Miloslav Pouzar₃, Jan Macak₁, Andrea Strakova Fedorkova₄, Jiri Vondrak₂

₁ Center of Materials and Nanotechnologies (CEMNAT) University of Pardubice Pardubice Czech Republic,₂ Institute of Electrotechnology Brno University of Technology Brno Czech Republic,₃ Institute of Environmental and Chemical Engineering University of Pardubice Pardubice Czech Republic,₄ Department of Physical Chemistry P. J. Safarik University Kosice Slovakia

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8:00 PM - EE4.6.04

Synthesis and Characterization of Substituted Garnet and Perovskite Based Lithium-Ion Conducting Solid Electrolytes

Maria Abreu Sepulveda₂, Dominique Williams₂, Ashfia Huq₃, Chetan Dhital₃, Yunchao Li₃, Mariappan Parans Paranthaman₃, Karim Zaghib₄, A. Manivannan₅

₁ University of Rochester Rochester United States,₂ National Energy Technology Laboratory Morgantown United States,₂ National Energy Technology Laboratory Morgantown United States,₃ Chemical Sciences Division Oak Ridge National Laboratory Oak Ridge United States,₄ Hydro-Québec Quebec Canada,₅ West Virginia University Morgantown United States

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8:00 PM - EE4.6.05

Synergistic Sodiation of Transition Metal Oxide and Carbon Nanotubes (CNTs) Nanostructured Composite Electrodes for Sodium-Ion Battery

Qianqian Li₁, Jinsong Wu₁, Vinayak Dravid₁

₁ Department of Materials Science and Engineering, The NUANCE Center Northwestern University Evanston United States,

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8:00 PM - EE4.6.06

A Study of Tin Dioxide-Graphene Oxide Composite for Supercapacitor Applications

Frank Mendoza₂, Valerio Dorvilien₂, Laura Mendez₄, Samuel Escobar₂, Brad Weiner₂, Gerardo Morell₂

₁ University of Puerto Rico - Rio Piedras San Juan United States,₂ Institute for Functional Nanomaterials San Juan United States,₃ University of Puerto Rico San Juan United States,₄ Medica Sciences University of Puerto Rico San Juan United States

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8:00 PM - EE4.6.07

Effect of CeO₂ Nanoparticles Modification on Porous Carbon for High-Capacity Super-Capacitor Application

Mohammad Shuvo ¹, Hasanul Karim ¹, Md Islam ¹, Gerardo Rodriguez ¹, Ricardo Martinez ¹, Ivan Gastelum ¹, Manjula Nandasiri ², Ashleigh Schwarz ², Arun Devaraj ², Juan Noveron ¹, Murugesan Vijayakumar ², Yirong Lin ¹, [Hoejiun Kim](#) ¹

¹ University of Texas at El Paso El Paso United States, ² Pacific Northwest National Lab Richland United States

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8:00 PM - EE4.6.08

Neutron Scattering Studies of Lithium-Ion Diffusion in Ternary Phosphate Glasses

Gavin Hester ¹, Tom Heitmann ², Madhusudan Tyagi ³, Munesh Rathore ⁴, Anshuman Dalvi ⁴, [Saibal Mitra](#) ¹, Souleymane Diallo ⁵, Eugene Mamontov ⁵

¹ Physics, Astronomy, and Materials Science Missouri State University Springfield United States, ² Materials Science University of Missouri Research Reactor Columbia United States, ³ National Center for Neutron Research National Institute of Standards and Technology Gaithersburg United States, ⁴ Birla Institute of Science and Technology Pilani India, ⁵ Chemical and Engineering Materials Division Oak Ridge National Laboratory Oak Ridge United States

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8:00 PM - EE4.6.09

Morphological Evolution of Multilayer Ni/NiO Thin-Film Anodes during Lithiation

[Guennadi Evmenenko](#) ¹, Timothy Fister ², D. Bruce Buchholz ¹, Xiao Chen ¹, Jennifer Esbenschade ³, Qianqian Li ⁴, Jinsong Wu ⁴, Vinayak Dravid ⁴, Paul Fenter ², Michael Bedzyk ¹

¹ Department of Materials Science and Engineering Northwestern University Evanston United States, ² Chemical Science and Engineering Argonne National Laboratory Lemont United States, ³ Department of Chemistry University of Illinois at Urbana-Champaign Urbana United States, ⁴ EPIC, NUANCE Center Northwestern University Evanston United States

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8:00 PM - EE4.6.10Fabrication of a Novel Nanostructured SnO₂/LiCoO₂ Lithium-Ion Cell

[Mark Poyner](#) ¹, Indumini Jayasekara ¹, Dale Teeters ¹

¹ University of Tulsa Tulsa United States,

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8:00 PM - EE4.6.11

Pyrolyzed Cellulose Paper Based Sulfur Cathode for High-Performance and Cost-Effective Lithium-Sulfur Batteries

[Shiqi Li](#) ², Guofeng Ren ¹, Zhaoyang Fan ¹

¹ Department of Electrical and Computer Engineering Texas Tech University Lubbock United States, ² Department of Science and Technology Chongqing Public Security Bureau Chongqing China, ¹ Department of Electrical and Computer Engineering Texas Tech University Lubbock United States

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8:00 PM - EE4.6.12Synthesis and Li-Ion Transport Properties of Garnet-Type Li-Ion Conductor Li_{7-x}La₃Zr_{2-x}Bi_xO₁₂

[Reinhard Wagner](#) ¹, Daniel Rettenwander ¹, Gerold Tippelt ¹, Guenther Redhammer ¹, Walter Schmidt ², Martin Wilkening ², Georg Amthauer ¹

¹ Department of Materials Research and Physics University of Salzburg Salzburg Austria, ² Christian Doppler Laboratory for Lithium Batteries, Institute for Chemistry and Technology of Materials Graz University of Technology Graz Austria

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Li-stuffed oxide garnets combine a high Li-ion conductivity with an excellent chemical and thermal stability and electrochemical inertness, in particular against Li metal. Thus, these materials are excellent candidates for solid electrolytes in Li-ion and Li-oxygen batteries.^{1,2} Within this group, $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (LLZO) garnet and its variants are among the most promising materials. Pure LLZO occurs in at least two structural modifications: (i) a low-temperature tetragonal phase (space group $I4_1/acd$) and (ii) a high-temperature cubic phase (space group $Ia-3d$). In terms of applications, the cubic phase is much more desirable as its ion conductivity is two orders of magnitude higher (10^{-4} - 10^{-3} S/cm) compared to the tetragonal polymorph (about 10^{-6} S/cm).³ The cubic phase is not stable at room temperature and has to be stabilized by doping of LLZO with aliovalent cations.²

The unit-cell parameter and the Li content influence Li-ion conductivity properties of Li-stuffed oxide garnets.⁴ To obtain a larger unit-cell parameter as well as a high Li content, we partially replaced Zr^{4+} with Bi^{5+} ; as the unit-cell parameter of $\text{Li}_5\text{La}_3\text{Bi}_2\text{O}_{12}$ is as large as 13.065 Å.⁵ Cubic LLZO was successfully stabilized by partial replacement of Zr^{4+} with Bi^{5+} . A significant increase of the unit-cell parameter with increasing Bi^{5+} content was confirmed by X-ray powder diffraction. Bi^{5+} stabilized LLZO showed a unit-cell parameter of up to 13.07 Å, compared to a unit-cell parameter of 12.97 Å for LLZO doped with Ga^{3+} , Fe^{3+} or Al^{3+} .^{4,5} The reason for this different behavior might be related to the crystallographic position and crystal-chemical properties of the dopant cation. Long-range ion transport properties of Bi^{5+} stabilized LLZO as a function of the Bi^{5+} content and, therefore, the influence of the unit-cell parameter on ion dynamics will be investigated by electrochemical impedance spectroscopy as well as ^7Li NMR measurements. Results about Li-ion dynamics and electrochemical properties of Bi^{5+} stabilized LLZO will be presented as well.

¹ Cussen, E.J.; J. Mat. Chem. **2010**, *20*, 5167-5173.

² Thangadurai, V.; et al.; Chem. Soc. Rev. **2014**, *43*(13), 4714-4727.

³ Buschmann, H.; et al.; Phys. Chem. Chem. Phys. **2011**, *13*, 19378-19392.

⁴ Zeier, W. G.; Dalton Trans., **2014**, *43*, 16133-16138

⁵ Murugan, R.; et al.; Mat. Sci. Eng. B **2007**, *143*, 14-20

8:00 PM - EE4.6.13

Crystal Structure of Garnet-Related Li-Ion Conductor $\text{Li}_{7-3x}\text{Ga}_x\text{La}_3\text{Zr}_2\text{O}_{12}$: Fast Li-Ion Conduction Caused by a Different Cubic Modification

Reinhard Wagner ¹, Guenther Redhammer ¹, Daniel Rettenwander ¹, Maria Maier ¹, Walter Schmidt ², Martin Wilkening ², Anatoliy Senyshyn ³, Georg Anthauer ¹

¹ Department of Materials Research and Physics University of Salzburg Salzburg Austria, ² Christian Doppler Laboratory for Lithium Batteries, Institute for Chemistry and Technology of Materials Graz University of Technology Graz Austria, ³ Research Neutron Reactor ZWE FRM-II Munich University of Technology Garching Germany

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8:00 PM - EE4.6.14

Low-Cost Carbon Composite Anodes for Sodium-Ion Batteries

Yunchao Li ², Kokouvi Akato ², Alan Levine ³, Rich Lee ³, Amit Naskar ², Sang Kim ⁵, Arumugam Manthiram ⁵, Jinshui Zhang ¹, Sheng Dai ¹, Mariappan Paranthaman ²

¹ Chemical Sciences Division Oak Ridge National Laboratory Oak Ridge United States, ² The Bredeesen Center for Interdisciplinary Research and Graduate Education The University of Tennessee Knoxville United States, ³ RJ Lee Group Monroeville United States, ⁴ Materials Science and Technology Division Oak Ridge National Laboratory Oak Ridge United States, ² The Bredeesen Center for Interdisciplinary Research and Graduate Education The University of Tennessee Knoxville United States, ⁵ Texas Materials Institute The University of Texas at Austin Austin United States, ¹ Chemical Sciences Division Oak Ridge National Laboratory Oak Ridge United States

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8:00 PM - EE4.6.15

Effect of Carbon Coating on $\text{NaMn}_{0.33}\text{Ni}_{0.33}\text{Co}_{0.33}\text{O}_2$ by Functionalized MWCNTs for Sodium-Ion Batteries

Vijay Shankar Rangasamy ¹, Savitha Thayumanasundaram ¹, Seo Jin Won ¹, Jean-Pierre Locquet ¹

¹ KU Leuven Heverlee Belgium,

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8:00 PM - EE4.6.16

Highly Effective Water-Soluble Binder for Li-S Battery Inspired by Paper Wet-Strengthening Chemistry

Jaebeom Jeon¹, Yeon Sik Jung¹¹ Korea Advanced Institute of Science and Technology Daejeon Korea (the Republic of),[Show Abstract](#)**8:00 PM - EE4.6.17**A Microcontact Impedance Study on NASICON-Type $\text{Li}_{1+x}\text{Al}_x\text{Ti}_{2-x}(\text{PO}_4)_3$ ($0 \leq x \leq 0.5$) Single CrystalsDaniel Rettenwander¹, Andreas Welzl², Sylke Pristat³, Frank Tietz⁴, Stefanie Taibl², Guenther Redhammer¹, Juergen Fleig², Reinhard Wagner¹¹ Department of Material Science amp; Physics University of Salzburg Salzburg Austria, ² Institute for Chemical Technologies and Analytics Vienna University of Technology Vienna Austria, ³ Materials Synthesis and Processing (IEK-1) Forschungszentrum Jülich GmbH, Institute of Energy and Climate Research Jülich Germany, ⁴ Materials Synthesis and Processing (IEK-1) Forschungszentrum Jülich GmbH, Institute of Energy and Climate Research Jülich Germany, ⁴ Helmholtz-Institute Münster, c/o Forschungszentrum Jülich GmbH Jülich Germany[Show Abstract](#)**8:00 PM - EE4.6.18***In Situ* Transmission Electron Microscopy Observation of Conversion Reaction in SnO_2 Nanoparticle Using Graphene Liquid CellJoon Ha Chang², Jun Young Cheong², Sung Joo Kim², Hyeon Kook Seo², Jong Min Yuk², Il-Doo Kim², Jeong Yong Lee²¹ Center for Nanomaterials and Chemical Reactions, Institute for Basic Science (IBS) Daejeon Korea (the Republic of), ² Department of Materials Science and Engineering Korea Advanced Institute of Science and Technology (KAIST) Daejeon Korea (the Republic of), ² Department of Materials Science and Engineering Korea Advanced Institute of Science and Technology (KAIST) Daejeon Korea (the Republic of)[Show Abstract](#)**8:00 PM - EE4.6.19**

Design and Synthesis of New Quinone-Based Organic Materials for Long-Life and High-Rate Lithium Batteries

Joungphil Lee¹, Moon Jeong Park²¹ Chemistry POSTECH Pohang Korea (the Republic of), ¹ Chemistry POSTECH Pohang Korea (the Republic of), ² Advanced Materials Sciences POSTECH Pohang Korea (the Republic of)[Show Abstract](#)**8:00 PM - EE4.6.20**

Step Conformal Solid Electrolyte Deposited by ALD on Robust 3D Silicon Scaffold for on Chip Li-Ion Microbattery

Manon Letiche⁴, Etienne Eustache⁴, Jeremy Freixas⁴, Laurence Morgenroth², Pascal Tilmant², Pascal Roussel¹, Thierry Brousse⁴, Christophe Lethien⁴¹ UCCS Lille France, ² IEMN Lille France, ⁴ Réseau sur le Stockage Electrochimique de l'Énergie Amiens France, ³ IMN Nantes France, ² IEMN Lille France, ⁴ Réseau sur le Stockage Electrochimique de l'Énergie Amiens France, ² IEMN Lille France, ¹ UCCS Lille France, ³ IMN Nantes France, ⁴ Réseau sur le Stockage Electrochimique de l'Énergie Amiens France, ² IEMN Lille France, ⁴ Réseau sur le Stockage Electrochimique de l'Énergie Amiens France[Show Abstract](#)**8:00 PM - EE4.6.21**

Experimental Phase Studies in the La-X-Ni-O (X=Mg, Ca, Sr) System for Metal-Air Batteries

Gizem Soydan¹, Emin Kondakci¹, Nuri Solak¹

¹ Metallurgical and Materials Engineering Istanbul Technical University Istanbul Turkey,

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8:00 PM - EE4.6.22

TiO₂-Coated Mesoporous Carbon Cathode for Lithium-Sulfur Battery

Se Min Oh ¹, Yun Seok Choi ¹, [Xing Jin](#) ¹, Ji Man Kim ¹

¹ Chemistry Sungkyunkwan University Suwon Korea (the Republic of),

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8:00 PM - EE4.6.23

CNT Sponge-Based Sulfur Cathodes with GO-Enhanced Separator for Lithium-Sulfur Batteries

[Keisuke Hori](#) ¹, Kei Hasegawa ¹, Yuta Nishina ², Suguru Noda ¹

¹ Department of Applied Chemistry Waseda University Tokyo Japan, ² Research Core for Interdisciplinary Sciences Okayama University Okayama Japan

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8:00 PM - EE4.6.24

Preparation of Nanostructured Li₇La₃Zr₂O₁₂ Solid Electrolyte via Templating on Nanocellulose Fibrils and Size Dependency of Phase Transformation

[Zachary Gordon](#) ¹, Ting Yang ¹, Candace Chan ¹

¹ Arizona State University Tempe United States,

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8:00 PM - EE4.6.25

Preparation of High Lithium Ion Conductive, Multi-Doped Li₇La₃Zr₂O₁₂ Solid Electrolyte

[Dong Ok Shin](#) ¹, Kyungbae Oh ², Kwang Man Kim ¹, Kyu-Young Park ², Byungju Lee ², Young-Gi Lee ¹, Kisuk Kang ²

¹ Electronics and Telecommunications Research Institute (ETRI) Daejeon Korea (the Republic of), ² Seoul National University Seoul Korea (the Republic of)

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8:00 PM - EE4.6.27

Electrospinning of Nanostructured Li₇La₃Zr₂O₁₂ Solid Electrolytes and Its Particle Size-Dependent Phase Transformation

[Ting Yang](#) ¹, Zachary Gordon ², Ying Li ¹, Candace Chan ¹

¹ Materials Science and Engineering Arizona State University Tempe United States, ² Chemical Engineering Arizona State University Tempe United States

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8:00 PM - EE4.6.28

Inexpensively Synthesized Tin and Antimony-Based Nanocrystals as Electrode Material for Lithium-Ion and Sodium-Ion Batteries

[Marc Walter](#) ², Simon Doswald ², Maksym Kovalenko ²

¹ Laboratory of Inorganic Chemistry ETH Zurich Zurich Switzerland, ² Empa - Swiss Federal Laboratories for Materials Science and Technology Dübendorf Switzerland,

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8:00 PM - EE4.6.29

High Capacity, Safe and Stable Anode/Electrolyte for Lithium-Ion Batteries

Yuzi Zhang ¹, Yanjing Chen ¹, Brett Lucht ¹, Arijit Bose ¹

¹ Univ of Rhode Island Kingston United States,

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