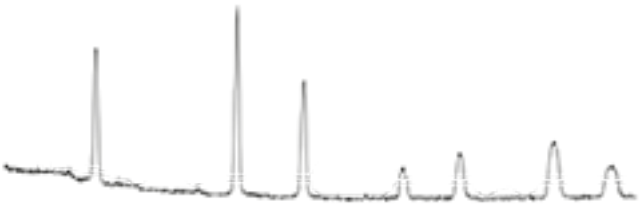

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Design of Solid State Battery Materials and Prototypes

Wednesday, 1 June 2022 13:45 (45 minutes)

Design of Solid State Battery Materials and Prototypes
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Next generation of energy storage devices may largely benefit from fast and solid Li+ ceramic electrolyte conductors to allow for safe and efficient batteries and fast data calculation. For those applications, the ability of Li-oxides to be processed as thin film structures and with high control over Lithiation and phases at low temperature is of essence to control conductivity. Through this presentation we review the field from a new angle, not only focused on the classics such as Li-ionic transport and electrochemical stability window for Li-solid state battery electrolytes, but focusing on opportunities and challenges routes in thermal and ceramic processing of the components and their assemblies with electrodes. Oxide vs. Sulfide based solid state battery materials and designs will be reflected on.Also, we will carefully review and give perspectives on the role of solid state battery ceramic strategies for the electrolyte on the electrode interfaces and towards charge transfer and vs. current densities. In other words, it will be a little ceramicist (own) love story on the good and the evil we can design by smart ceramic manufacture at the interfaces originating by the very first choices made in the electrolyte ceramic structure and material design. In the second part of the talk we will discuss new opportunities on low temperature processing of solid state electrolyte ceramics that do not technically require "classic sintering"and avoid prior particle calcination; instead demonstrating opportunities to use unique liquid based direct densification routes and vacuum techniques to design solid electrolytes and grafting interfaces to new hybrid and solid state battery prototypes targeted at processing below 700C for all parts. Collectively, the insights on solid state energy storage provide evidence for the functionalities that those Li-solid state material designs can have for cost and mass manufacturable solid state and hybrid battery prototypes.

References for further reads
Photo-enhanced ionic conductivity across grain boundaries in polycrystalline ceramics
T. Defferriere, D. Klotz, J.C. Gonzalez-Rosillo, J.L.M. Rupp, H.L. Tuller
Nature Materials, 1-7 (2022)

Processing thin but robust electrolytes for solid-state batteries
M. Balaish, *J.C. Gonzalez-Rosillo*, K.J. Kim, Y. Zhu, Z.D. Hood, J.L.M. Rupp
Nature Energy, 6, 227–239 (2021)
Photo-enhanced ionic conductivity across grain boundaries in polycrystalline ceramics
T. Defferriere, D. Klotz, J.C. Gonzalez-Rosillo, J.L.M. Rupp, H.L. Tuller
Nature Materials, in press (2022)

Solid-State Li–Metal Batteries: Challenges and Horizons of Oxide and Sulfide Solid Electrolytes and Their Interfaces
K.J. Kim, *M. Balaish*, M. Wadaguchi, L. Kong, J.L.M Rupp
Advanced Energy Materials, 202002689 (2021)
Lithium-film ceramics for solid-state lithionic devices
Y. Zhu, J.C. Gonzalez-Rosillo, M. Balaish, Z.D. Hood, K.J. Kim, J.L.M. Rupp
Nature Review Materials, 6, 313–331 (2020)
High energy and long cycles
K.J. Kim, J.J. Hinricher, J.L.M. Rupp
Nature Energy, 5, 278–279 (2020)
All ceramic cathode composite design and manufacturing towards low interfacial resistance for garnet-based

solid-state lithium batteries
K.J. Kim and J.L.M. Rupp
Energy & Environmental Science, 13, 4930-4945 (2020)
A low ride on processing temperature for fast lithium conduction in garnet solid-state battery films
R. Pfenninger, M. Struzik, I. Garbayo, E. Stilp, J.L.M. Rupp
Nature Energy, 4, 475–4832019 (2019)
Spray Pyrolysis Processing of The Electron - Ion Insulator for Metal Anode Adhesion in Solid State Batteries
S. Chakravarthy, W.S. Chang, H. Chu, J. Hinricher, Z.D. Hood, Y. Huang, S.Y. Kim, J. Li, A. Maurano, K. Pei, J.L.M. Rupp, Z. Wang, Y. Zhu MIT-Samsung IP case : 23978J (2022)

Dual-Phase Composite Li-Conducting Thin Film and Method of Making the Same
Y. Zhu, Z. Hood, J. Hinricher, W.S. Chang, H.C. Lee, L. Miara, J.L.M. Rupp IP: US 63/180,150 (2021)

Electron-ion insulator for metal anode adhesion in solid state batteries.
Z. Wang, J. Rupp, Y. Chen, A. Maurano, S. Chakvararthy, K. Pei, J. Li IP: US 17/144,687 (2021)

Amorphous Nitrogen-Rich Solid State Electrolyte
J.L.M. Rupp, W.S. Chang, Z. Hood, L. Miara IP: US 63/051024 (2020)

Bilayer component for Li metal battery and their use therein.
Z.D. Hood, W.S. Chang, L. Miara, J.L.M. Rupp. IP: US 62/994,466 (2020)

Lithium Solid Electrolyte and Method of Manufacture Thereof
Y. Zhu, W.S. Chang, L. Miara, J.L.M. Rupp IP: US 62/863,059 (2019

Presenter: Prof. RUPP, Jennifer (Technical University of Munich)

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