Grand Technion Energy Program
תוכנית האנרגיה ע"ש גרנד

הפקולטה למדע והנדסה של חומרים
Department of Materials Science and Engineering

Technion
Israel Institute of Technology

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Will lecture on:

When Lithium Travels in Solid State Disorder

Next generation of energy storage and sensors may largely benefit from fast Li+ ceramic electrolyte conductors to allow for safe and efficient batteries and real-time monitoring anthropogenic CO2. Recently, Li-solid state conductors based on Li-garnet structures received attention due to their fast transfer properties and safe operation over a wide temperature range. Through this presentation basic theory and history of Li-garnets will first be introduced and critically reflected towards new device opportunities. Central to our research is the fundamental investigation of the electro-chemo-mechanic characteristics and design of disordered to crystallizing Li-garnet strucure types and their description. Understanding the fundamental transport in solid state and asking the provokative question: how do Li-amorphous to crystalline structures conduct? As well, as how can we alter their charge-and mass transport properties for solid electrolytes and towards electrodes is discussed. Here, we firstly present new Li-garnet battery architectures for which we discuss lithium titanate and antimony electrodes in their making, electrochemistry and assembly to full battery architectures1-4. Secondly, new insights on degree of glassy to crystalline Li-garnet thin films are presented based on model experiments of the structure types. Here, the thermodynamic stability range of maximum Li-conduction, phase, nucleation and growth of nanostructure is discussed using high resolution TEM studies, near order Raman investigations on the Li-bands and electrochemical transport measurements. The insights provide novel aspects of material structure designs for both the Li-garnet structures (bulk to films) and their interfaces to electrodes, which we either functionalize to store energy for next generation solid state batteries or ... make new applications such as Li-operated CO2 sensor tracker chips.

1) Interface-Engineered All-Solid-State Li-Ion Batteries Based on Garnet-Type Fast Li+ Conductors
J van den Broek, S Afyon, JLM Rupp
Advanced Energy Materials 6 (19), 2016

2) A shortcut to garnet-type fast Li-ion conductors for all-solid state batteries
S Afyon, F Krumeich, JLM Rupp
Journal of Materials Chemistry A 3 (36), 18636-18648, 2015

3) On the chemical stability of post-lithiated garnet Al-stabilized Li 7 La 3 Zr 2 O 12 solid state electrolyte thin films
M Rawlence, I Garbayo, S Buecheler, JLM Rupp
Nanoscale 8, 14746-14753, 2016

4) Investigating the all-solid-state batteries based on lithium garnets and a high potential cathode-LiMn1. 5Ni0. 5O4.
C Hänsel, S Afyon, JLM Rupp
Nanoscale 8, 14746-14753, 2016

Tuesday, June 6, 2017, 16:30

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