Invited Talk

O 2.1 Mon 9:30 HSZ 02
Interfacial challenges in solid-state Li ion: some perspectives from theory

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Unfortunately, interfacial challenges severely limit power and cycle life in all solid-state Li ion batteries. We use theory to investigate some of the origins of these limitations with both continuum theory and DFT. The obvious ones are electrochemical stability of the electrolyte at the anode/cathode interfaces and mechanical issues relating to maintaining interfacial contact during cycling while inhibiting Li dendrite growth. We are especially trying to understand if any fundamental limitations exist from the structures of the double layers that form at the solid electrolyte-electrode or other interfaces in the solid-state stack. These can be quite different than in conventional liquid Li ion batteries. We use LiSOCl2 as a prototypical Li ion superionic conductor and discuss its properties and discuss its interface with model electrode interfaces.

15 min. break

Invited Talk

O 2.4 Mon 11:15 HSZ 02
Neutron diffraction on solid-state battery materials

— HELMUT EHRENBERG1, ANATOLIY SENYSYNY2, MYKHAILO MONCHAK3, SYLVIO INDIRO1, and JOACHIM BINDER1 — 1Karlsruhe Institute of Technology (KIT), Institute for Applied Materials (IAM) — 2Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität Muenchen, Garching, Germany

Solid-state batteries are a promising approach to safer electrochemical energy storage and higher energy densities. Bottleneck interfaces reactions and transport limitations in the solids. Advanced and optimized materials must provide dedicated properties, for example, a good Li ion conductivity for sufficiently high current densities and only small volume changes to preserve mechanical integrity. Neutron diffraction offers unique features to elucidate the underlying structure-property relationships, which determine the resulting performance parameters on cell level. Selected examples are shown, which demonstrate the capabilities of neutron diffraction to reveal Li ion diffusion pathways as in the Li13Al0.3Ti1.7(PO4)3 (LATP) superionic conductor. Li occupation numbers at intermediate states of charge as for LiCoPO4 or a comparison of volume changes between commercial and alternative zero-strain electrode materials. The capabilities of solid-state batteries are discussed.

Invited Talk

O 2.5 Mon 11:45 HSZ 02
Sulfate-based Solid-State Batteries

— YUKI KATO1 — Toyota Motor Europe NV/SA, Hoge Wei 33, Zaventem, Belgium

Large-scale batteries are in high demand for applications such as plug-in electric hybrid or electric vehicles, and smart electric power grids. The all-solid-state battery is the most promising candidate for future battery systems, due to the high energy density obtaining by direct-series-stacking of the battery cells. However, the poor electrochemical characteristics of the all-solid-state battery, due to higher cell-resistance than conventional liquid electrolyte batteries, still remain as an unsolved issue. We will demonstrate an all-solid-state battery with extremely high power performance that employs the superionic conductors having the Li10GeP2S12-type crystal structure. The battery can operate over a wide temperature range with extremely high current drains of 3 mAc-m (-30 C), 100 mAc-m (25 C), and 1000 mAc-m (100 C). Careful electrochemical examination of the all-solid-state battery with the same battery configuration as a liquid electrolyte system revealed that the rate characteristics are simply dependent on the difference in state of electrolyte. The vert high power characteristics of solid state battery comes from intrinsic ion transporation mechanism of solid electrolyte.