The 98th GREEN Seminar

Design of Engineered Multilayer Solid-State Electrolytes for Li Metal Batteries with High Energy Storage

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In the run for the next generation of electrochemical energy storage beyond lithium-ion chemistry, safety hazards and short cycle life of Li metal batteries (LMBs) demand rational design of electrolytes1. A solid-state electrolyte as an alternative Li-ion conductor could remove the flammable solvent to improve the safety. However, interfacial challenges of solid-state electrolytes (SSEs) with Li metal anodes or high-energy cathodes (e.g., Ni-rich materials, 5V-class cathodes and O2) hinder the development of LMBs with high cycling stability2. High energy density in cell level also requires thin electrolytes (< 50 µm) and high Li areal capacity utilization (≥ 4 mAh/cm2) in practical solid-state batteries3. In front of this background, this work is focused on scalable manufacturing processes as well as the fundamental understanding of Li deposition/dissolution behavior.

Here, we report on a facile approach to produce engineered multilayer solid-state electrolytes (SSEs), comprising crosslinked-polymer, functional ionic liquid and oxide-based ceramics, reinforced via commercial polymeric separators. Well controlled thickness (20-50 µm) and enhanced mechanical strength of this multilayer SSE do pave the way for the roll-to-roll processing technology of SSEs. Rational design based on this engineered electrolyte shows improved compatibility with high Li areal capacity utilization (≥ 5 mAh/cm2) and high-energy cathodes. Electrochemical characterization, post mortem, in situ and operando analysis (SEM, XPS, X-ray tomography and electrochemical dilatometry) elucidated several interesting electro-chemo-mechanical effects at the interfaces/interphases.

Venue: Rm. 409/410, 4F, Collaborative Research Bldg., Namiki-site

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Time: 13:30-14:30

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