SW8 : 산화물 기반 전고상 이차전지 연구회

SW8-1 | Status of Rapid thermal processing for All-Solid-State Batteries

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All-solid-state batteries (ASSBs) are expected to become the next generation power sources because of their safety, reliability, high energy density, and incombustibility. The typical ASSBs consist of cathode, solid electrolyte and anode material. Especially, according to the development of various industries, ASSBs can be used at various fields. However, to fabricate ASSBs, the high-temperature sintering affects the formation of secondary phases in the composite electrode composed of active materials and solid electrolytes. In this talk, I will introduce rapid thermal processing to make the composite electrode and ASSBs. Recent literature and my study will be discussed.

SW8-2 | 산화물계 전고체전지 이슈와 KRISS 연구동향

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산화물계 전고체전지는 소재성능 향상과 공정기술의 높은 난이도로 인해 연구계와 산업계의 관심에도 불구하고 기술적 진보가 매우 더디다. 유기계 소재와의 하이브리드 타입이 아닌 100% 산화물계 고체전지의 실현을 위한 그간의 노력과 한계를 집어보고 기술적 이슈를 중심으로 최근의 연구개발 동향과 방향에 대해 관련 연구자들과 논의해 보고자 한다.

SW8-3 | Conductivity measurements and characteristics in dense and porous microstructures

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When operating electrochemical cells composed of cathode, electrolyte, and anode materials, the cathode polarization significantly surpasses to over 50% of the total cell polarization. Consequently, careful selection of cathode materials exhibiting exceptional reduction characteristics is vital for achieving high power density and stable electrochemical performance. To meet the requirements of electrochemical cells, cathode materials should demonstrate an electrical conductivity exceeding 100 S/cm at the operational temperature. This conductivity can be achieved through compact microstructures of the specimen. However, it is necessary to fabricate cathodes with porous microstructure characteristics to ensure efficient oxygen supply, establish an extended triple phase boundary, and minimize concentration loss. As a result, contrasting electrical conductivity properties are expected between the measured dense microstructure and the measured porous microstructure. In this study, analyses of the characteristics resulting from the microstructure- dependent difference in electrical conductivity are presented.

SW8-4 | Investigating the Crystal Structure and Interface Dynamics of Garnet-Type Solid Electrolyte using Advanced Diffraction Techniques

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Garnet-type $Li_7La_3Zr_2O_{12}$ (LLZO) has emerged as a notable solid electrolyte material due to its exceptional ionic conductivity. However, synthesizing and fabricating the cubic-phase garnet solid electrolyte remains a challenge, primarily because of the thermodynamically stable tetragonal phase, which showcases well-ordered lithium sites without vacancies. A strategy involving aliovalent doping (Al, Ga, Ta, Nb, etc.) has been employed to stabilize the cubic phase. Yet, this can inadvertently reduce stability against lithium metal, affecting the interfacial integrity and compatibility with certain electrode materials. In our study, we used X-ray and neutron diffraction techniques to investigate the crystal structure and interface dynamics between the solid electrolyte and electrode materials. Leveraging in-situ high-temperature X-ray diffraction, we observed the structural evolution during the sintering and co-sintering processes. Complementary neutron diffraction provided insights into the precise lithium positions and occupancy within the sintered outcomes. Our findings promise to shed light on the characterization of crystalline and interfacial transformations in garnet-type solid electrolytes, offering a pathway for designing more resilient and stable solid electrolyte materials.

SW8-5 | Solid-state NMR for solid-state batteries

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Materials chemists often start any investigation by trying to understand the structure of their compounds. Whether the material of interest are anodes and cathodes for secondary batteries or solid electrolytes, crystalline and/or amorphous, the key knowledge of how the atoms and molecules are arranged within the solid is crucial for understanding the structure-property relationship which provides us with a guided opportunity to design novel materials. In this talk, I will introduce the power of solid-state NMR, a relatively obscure technique in materials chemistry, in providing key information on the local structure and dynamics of materials for solid-state batteries, in particular the solid electrolyte. Recent examples from literature and from my collaborations will be discussed.