Enhanced Ionic Conductivity of PEO-based Hybrid Solid Electrolyte Filled with Cubic $Li_7La_3Zr_2O_{12}$ for Lithium Metal Battery

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To address the safety issue relate to conventional lithium-ion batteries (LIBs) exploiting the flammable organic liquid electrolytes, the research developing the inorganic solid electrolyte where only Li^+ could pass through solid network has gained much attention. Among many solid electrolytes reported until now, garnet-type cubic phase $Li_7La_3Zr_2O_{12}$ (LLZO) has a potential to be a promising alternative because of it's a practical ionic conductivity of above 10^{-4} S/cm, a wide range of operation voltage and a stable contact with lithium metal. However, the intrinsic rigid surface of LLZO hinders the conformal contact with the electrode. Therefore, the huge resistance arising from the electrolyte/electrode interface is unavoidable.

Recently, research on the hybrid electrolyte consisting of polymer matrix and inorganic materials has also attracted much attention in order to solve limitations such as mechanical properties of inorganic materials.

In this study, organic/inorganic hybrid solid electrolytes were prepared by the combination of poly(ethylene oxide)(PEO) and LLZO. The crystallinity of PEO decreased upon the addition of LLZO, resuling in the enhanced ionic conductivity. The XRD analysis of the organic/inorganic hybrid solid electrolyte showed that the crystallinity of LLZO does not change after mixing with PEO. Furthermore, the addition of nano-sized LLZO increases the amorphous region of PEO rather than the micro-sized LLZO, and the extended surface of LLZO creates a pathway which Li can move faster.

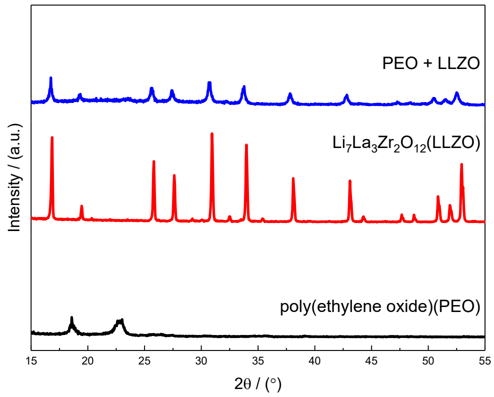

Figure 1. XRD patterns of PEO(BLACK), LLZO(RED) and Hybrid Solid Electrolyte(BLUE).

References:

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