Inorganic Solid Electrolytes for All-Solid-State Lithium Batteries

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As a typical type of energy storage devices, lithium-ion batteries (LiBs) play a more and more important role in the modern life. However, organic polymer-based electrolytes are widely used in commercial Li-ion batteries, which may cause a large number of safety issues, considering the flammability, electrochemical stability, and leakage. Fires and explosions of LiBs have been reported throughout the world, and thus, safety has become one of the main obstacles for the wide application of LiBs. Therefore, the continued drive for high-performance lithium-ion batteries has imposed stricter requirements on the electrolyte materials and all-solid-state lithium batteries (ASSLiBs) have entered the field. In contrast to organic liquid electrolytes, solid inorganic ones show better thermal and chemical stabilities and also present a great advantage to the point that they can enable the use of high capacity electrode materials. Accordingly, a great deal of effort is underway to improve further the ionic conductivity and electrochemical/chemical stability of inorganic solid electrolytes and the solid electrolyte/electrode interface as well, thereby pushing them further for practical applications. In this talk, I will present our research breakthroughs in studying the preparation, structure, electrochemical properties, and potential applications of several important inorganic solid electrolytes, such as Li-oxide garnets like $Li_7La_3Zr_2O_{12}$ (LLZO), perovskite-type $La_{2/3-x}Li_{3x}TiO_3$ (LLTO), NASICON-type $Li_{1+x}Al_xTi_{2-x}(PO_4)_3$ (LATP), and sulfide-based LGPS-type $Li_{10.35}Ge_{1.35}P_{1.65}S_{12}$.