Preparation and characterization of hybrid solid electrolyte consisted of Li conductive polyethylene oxide and inorganic electrolyte $Li_7La_3Zr_2O_{12}$

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Abstract

All-solid-state lithium batteries are desired to higher energy density, long cycle life, and better safety than conventional Li-ion batteries. Solid polymer electrolytes are one of candidate materials for all solid-state lithium ion battery in terms of high flexibility, compact, and the ability to prevent lithium dendrite formation [1-3].

$Li_7La_3Zr_2O_{12}$ (LLZO) with garnet structure is one of the most representative oxide-base inorganic solid electrolyte which shows high ionic conductivity at room temperature and suitable stability for lithium metal[4].

In this study, we prepared polyether-based polymer-LLZO composite electrolyte and measured ionic conductivity and glass transition temperature (T_g) used by AC impedance method and DSC. We investigated that the influence of LLZO addition for ionic conduction and thermal property by hybridization of LLZO and polyether-based solid polymer electrolyte.

Experimental

LiTFSA was dissolved in polyether-based macromonomer solution ([Li] / [O] =0.1, amount of O was based on oxide unit from polyether). Tetragonal $Li_7La_3Zr_2O_{12}$ (1.0wt%), DMPA photoinitiator) and acetonitrile were added to the solution and stirred by stirrer. The solution was dried over 10h and obtained complete homogenerous solution. The solution was casted on glass plate and covered by two glass plate and 0.5mm tefron spacer. Hybrid solid electrolyte films were fabricated by radical polymerization under UV irritation at 5 min.

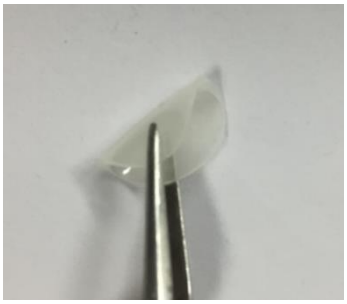

Fig.1 Photograph of electrolyte film.

Results and discussion

Fig.1 shows photograph of the obtained electrolyte film. Obtained hybrid electrolyte film exhibited high flexibility and mechanical stability.

Fig.2 shows the temperature dependences of ionic conductivity for hybrid electrolyte. Ionic conductivity of the hybrid solid electrolyte showed larger values than that of LLZO free electrolyte. This tendency was remarkable in the case of low temperature, such as 283K. Ionic conductivity of LLZO contained system showed ten times larger than that of LLZO free system. In this presentation, we will report ionic conduction mechanism and thermal properties of the hybrid electrolyte in detail.

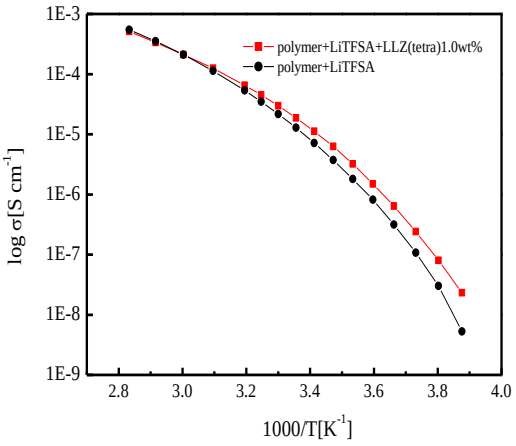

Fig.2 Temperature dependence of ionic conductivity.

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