World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:10, No:05, 2016

Synthesis and Characterization of Pure and Doped Li7La3Zr2O12 Li-Ion Conducting Solid Electrolyte for Lithium Batteries

Authors : Shari Ann S. Botin, Ruziel Larmae T. Gimpaya, Rembrant Rockwell Gamboa, Rinlee Butch M. Cervera

Abstract : In recent years, demand for the use of solid electrolytes as alternatives to liquid electrolytes has increased due to recurring battery safety and stability issues, in addition to an increase in energy density requirement which can be made possible by using solid electrolytes. Among the solid electrolyte systems, Li7La3Zr2O12 (LLZ) is one of the most promising as it exhibits good chemical stability against Li metal and has a relatively high ionic conductivity. In this study, pure and doped LLZ were synthesized via conventional solid state reaction. The precursor chemicals (such as LiOH, La2O3, Ga2O3 and ZrO2) were ground and then calcined at 900 °C, pressed into pellets and finally sintered at 1000 °C to 1200 °C. The microstructure and ionic conductivity of the obtained samples have been investigated. Results show that for pure LLZ, sintering at lower temperature (1000 °C) produced tetragonal LLZ while sintering at higher temperatures (≥ 1150 °C) produced cubic LLZ based from the XRD results. However, doping with Ga produces an easier formation of LLZ with cubic structure at lower sintering duration. On the other hand, the lithium conductivity of the samples was investigated using electrochemical impedance spectroscopy at room temperature. Among the obtained samples, Ga-doped LLZ sintered at 1150 °C obtained the highest ionic conductivity reaching to about $1x10^{-4}$ S/cm at room temperature. In addition, fabrication and initial investigation of an all-solid state Lithium Battery using the synthesized LLZ sample with the use of commercial cathode materials have been investigated.

Keywords : doped LLZ, lithium-ion battery, pure LLZ, solid electrolytes
Conference Title : ICCMME 2016 : International Conference on Composite Materials and Materials Engineering
Conference Location : Tokyo, Japan
Conference Dates : May 26-27, 2016