Ion-Conducting and Electrochemical Properties of Garnet-Type Solid Electrolyte Thin Sheet Prepared by Tape-Casting Method

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Recently, rechargeable lithium-ion batteries are considered to be a next-generation power source for electric vehicles (EVs), mobile electronics, which now become more and more indispensable in our daily life. At the same time, safety issues have been viewed as extreme importance accompanying with the progress of performance improvement. Under such circumstance, all-solid-state lithium-ion batteries using solid electrolytes have attracted much attention as a next-generation battery due to their safety advantage over the batteries with liquid organic electrolytes.

Garnet-type $Li_7La_3Zr_2O_{12}$ (LLZO) solid electrolyte is an important material for all-solid-state lithium-ion batteries. In this study, a Ta-doped LLZO (LLZTO) thin sheet has been prepared by tape-casting method. The thin sheet shows a relative density of 96%, and a room temperature ionic conductivity of 5.0×10^{-4} S cm^{-1}. An Li/LLZTO/Electrolyte-soaked separator/$LiNi_{0.33}Co_{0.33}Mn_{0.33}O_2$ cell was assembled. The cell can charge and discharge normally at 60 °C and 0.1 C, and shows a first discharge capacity of 123 mAh g^{-1} and 93% capacity retention after 50 cycles. The results here demonstrate that the garnet-type solid electrolyte thin sheet is promising for development of high-performance solid-state lithium-ion batteries operated at medium temperature.

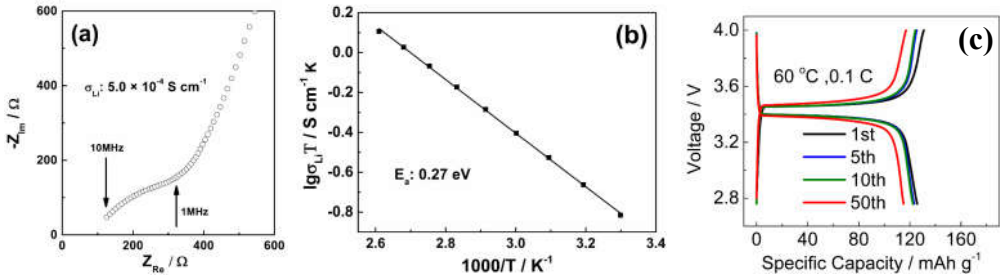

Fig. 1 (a) Impedance spectrum, (b) Arrhenius plot of LLZTO thin sheet. (c) Charge-discharge curves for a typical Li/LLZTO/Electrolyte-soaked separator/ $LiNi_{0.33}Co_{0.33}Mn_{0.33}O_2$ cell.

References:

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