Ta-LLZO/LZO solid electrolyte for solid-sate Li-S battery

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$Li_7La_3Zr_2O_{12}$ (LLZO), i.e, the Li-Garnet solid electrolytes have the properties of high conductivity, stability against lithium metal and feasibility of preparation in open air. Thence LLZO is one of the promising candidates for solid-state batteries [1]. Ta doped LLZO can be stabilized to cubic phase at room temperature. $La_2Zr_2O_7$ (LZO) is introduced as a second phase additive to further improve the conductivity.

$Li_{6.4}La_3Zr_{1.4}Ta_{0.6}O_{12}$/LZO pellets were prepared by conventional solid-state reaction method with a densification process at 1250℃ for 0.5h [2, 3]. Ceramic pellets had a diameter of ~14mm and a thickness of ~1.4mm. The sintering of ceramics was operated inside platinum crucibles. The ceramic pellets prepared by this process exhibited high reproducibility. Molten lithium metal was attached to a ceramic face with a modification. Sulfur-carbon positive electrode with a small amount of electrolyte (DOL/DME/LiTFSI, 10μL) at the interface to improve the positive contact is applied to construct a lithium-sulfur battery and electrochemical performance thereof was evaluated.

Appearance, cross-section morphology, impedance spectra and phase composition of Ta-LLZO/LZO ceramics are shown in Fig.1. The uniformity of ceramics is good with a high relative density of 97%. The microstructure of the section is dense with clear grain boundaries. Impedance spectroscopy analysis showed that the conductivity was as high as 9.25×10^{-4}S/cm at 26°C.

Solid-state lithium-sulfur battery's Coulomb efficiency is stabilized at 100% without any shuttle effect. The specific capacity remained 685mAh/g at 0.2C after 200 cycles.

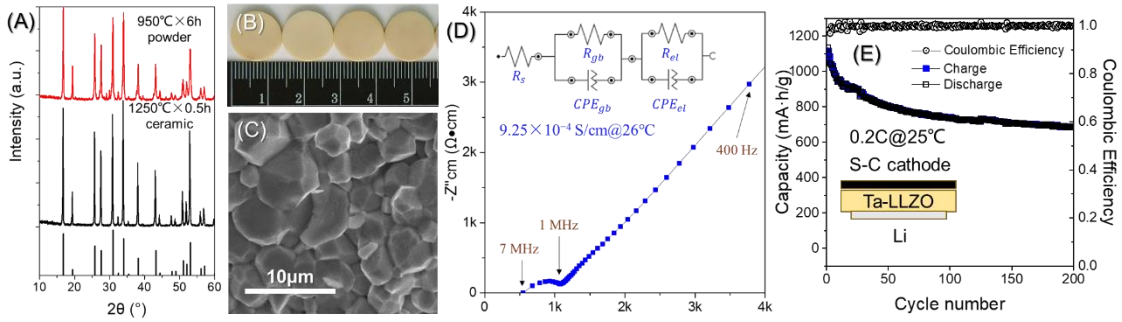

Fig. 1 (A): phases of Ta-LLZO powder and Ta-LLZO/LZO ceramic; (B): digital images; (C): cross-sectional microstructure; (D): EIS curves and fitted circuit; (E): cycling performance of solid-state Li-S battery.

References:

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