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The transparent all- solid-state rechargeable micro-battery manufacturing by RF magnetron sputtering

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Abstract:

In this paper, a transparent all-solid-state battery was manufactured by RF magnetron sputter, for the first time. $LiFePO_4$ and $Li_4Ti_5O_{12}$ are popular cathode and anode materials, respectively. For the solid-state electrolyte coating, the Li_3PO_4 material is also promising solid electrolyte materials due to the high ionic conductivity. The stack structure of the battery was *silver paste/anode ($Li_4Ti_5O_{12}$)/electrolyte (Li_3PO_4)/cathode ($LiFePO_4$)/ITO/glass*. An indium tin oxide (ITO) coated glass substrate was used as a transparent and conductive material. The resistance of the coated ITO layer is 40 Ω. RF power for the $LiFePO_4$, Li_3PO_4, and $Li_4Ti_5O_{12}$ layers deposition process was adjusted to 100 Watt at argon atmosphere. This stack structure didn't contain any liquid or gel electrolyte layer. The fully solid electrolyte was deposited by the RF magnetron sputter. The mean crystallite sizes of the deposited layers approximately 30 nm, 21 nm and 30 nm for $LiFePO_4$, Li_3PO_4 and $Li_4Ti_5O_{12}$ layer, respectively. The transparency of the manufactured battery is approximately 80 %. Electrochemical impedance analyses and cyclic voltammetry measurements were done. The Nyquist diagram and equivalent circuit model were determined. Warburg constant and Li-ion diffusion coefficient were calculated approximately 38 $\Omega/s^{-1/2}$ and $4.2x10^{-10}$ cm^2/s,