$Li_7La_3Zr_2O_{12}$-based all solid state thin film batteries

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Liquid organic electrolytes cause safety problems due to an insufficient thermal and electrochemical stability. One approach to avoid such disadvantages is the replacement of the liquid electrolyte by a solid one. Next to sulfides and phosphates, current research is focused on Li conducting ceramic oxide materials like $Li_7La_3Zr_2O_{12}$ (LLZ), a promising garnet-structured material with a Li ion conductivity of about 10^{-4} S/cm. Li ion conductivity can increased by partial substitution of Li or Zr. Since the ionic conductivity is about two orders of magnitude lower compared to liquid electrolytes, thin electrolyte layers are necessary for a low internal resistance of the cell.

Complete thin film batteries based on a current collector substrate, a thin cathode, LLZ electrolyte layer and Li or a Li alloy thin film as anode are deposited by physical vapor deposition techniques. The deposition conditions are optimized for each compound and adjusted to the overall system.

The resulting thin film batteries are analyzed with regard to electrochemical behavior, structural and morphological properties and element distribution.