



spectroscopy investigations and temperature-dependent ^7Li NMR spectroscopy, respectively. The lithium ion conductivity at room temperature was determined to be around $9.2 \cdot 10^{-5} \text{ S cm}^{-1}$ (at 230°C : $1.3 \cdot 10^{-3} \text{ S cm}^{-1}$) and an activation energy of 0.39 eV (at 230°C : 0.23 eV), values that make the compound interesting as SE in ASSBs.

A13 **The Effect of Lithium and Gallium Content on Phase Evolution in Fast Lithium Ion Conducting Garnet $\text{Li}_{7-3x}\text{La}_3\text{Zr}_2\text{Ga}_x\text{O}_{12}$ Thin Films**

RAWLENCE, Michael (Dept. of Thin Films & Photovoltaics, EMPA, Switzerland & Electrochemical Materials, ETH Zurich, Switzerland), FILIPPIN, Alejandro Dr. (Dept. of Thin Films & Photovoltaics, EMPA, Switzerland), RUPP, Jennifer Prof. Dr. (Electrochemical Materials, ETH Zurich, Switzerland), BUECHELER, Stephan Dr. (Dept. of Thin Films & Photovoltaics, EMPA, Switzerland)

The solid state electrolyte $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ has been the subject of intensive study in recent years due to its relatively high lithium ion conductivity and wide voltage stability window. The challenges surrounding thin film processing of this material are still not fully understood and further insights are required to enable their successful integration into solid state batteries. In this work thin films of $\text{Li}_{7-x}\text{La}_3\text{Zr}_2\text{Ga}_x\text{O}_{12}$ are deposited via co-sputtering from ceramic $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$, Li_2O , and Ga_2O_3 targets in order to keep stoichiometric lithium content and stabilize the cubic phase. The evolution of phases during crystallization is studied via grazing incidence XRD with in-situ annealing for various Ga and Li contents, and the resulting ionic conductivities are presented. Through this work we are able to achieve thin films of dense, cubic $\text{Li}_{7-x}\text{La}_3\text{Zr}_2\text{Ga}_x\text{O}_{12}$ with in-plane lithium ion conductivities above $1 \times 10^{-5} \text{ S cm}^{-1}$ at room temperature.

A14 **The Superior Garnet: Fast Li-Ion Conducting $\text{Li}_{7-3x}\text{M}_x\text{La}_3\text{Zr}_2\text{O}_{12}$ ($\text{M} = \text{Ga}^{3+}, \text{Fe}^{3+}$) with Uncommon I43d Structure**

WAGNER, Reinhard, REDHAMMER, Günther Prof. Dr. (Department of Chemistry and Physics of Materials; Universität Salzburg), RETTENWANDER, Daniel Dr. (Center for Materials Science and Engineering, Massachusetts Institute of Technology), TIPPELT, Gerold (Department of Chemistry and Physics of Materials; Universität Salzburg), WILKENING, Martin Prof. Dr., SCHMIDT, Walter Dr. (Christian Doppler Laboratory for Lithium Batteries, Institute for Chemistry and Technology of Materials, Graz University of Technology), WELZL, Andreas, TAIBL, Stefanie Dr., FLEIG, Jürgen Prof. Dr. (Institute of Chemical Technologies and Analytics, Vienna University of Technology) AMTHAUER, Georg Prof. Dr. (Department of Chemistry and Physics of Materials; Universität Salzburg)

Li-stuffed oxide garnets are among the most promising candidates for solid-state Li electrolytes. $\text{Li}_7\text{La}_3\text{Zr}_2\text{O}_{12}$ (LLZO) is of particular interest as it shows a high Li-ion conductivity as well as electrochemical inertness over a wide potential window and stability against metallic Li. Therefore, LLZO is exceptionally well suited to be used as solid-state electrolyte for Li-metal based battery concepts.

Until recently, LLZO was known to occur in two different modifications. A tetragonal low-temperature modification with space group $I4_1/acd$ exhibits a poor Li-ion conductivity of $\sim 10^{-6} \text{ S cm}^{-1}$ at room temperature. The cubic "high-temperature" modification with space group $Ia3d$ shows a Li-ion conductivity of about $10^{-4} \text{ S cm}^{-1}$ at room temperature. A stabilization of the cubic $Ia3d$ modification at room temperature can be achieved by the introduction of supervalent cations.

Recent studies have shown that the introduction of Ga^{3+} and Fe^{3+} leads to the formation of a different cubic structural modification showing the acentric cubic space group $I43d$. The symmetry reduction compared to the common garnet structure is caused by the site preference of Ga^{3+} and Fe^{3+} .