Investigating $Li_{7-3x}Al_xLa_3Zr_2O_{12}$ garnets using laser based spectroscopic analysis techniques

S. Smetaczek[a], *M. Bonta*[a], *A. Wachter-Welzl*[a], *S. Taibl*[a], *R. Wagner*[b], *D. Rettenwander*[c], *J. Fleig*[a], *A. Limbeck*[a]

[a] Institute for Chemical Technologies and Analytics, TU Wien, Austria.
[b] Department of Chemistry and Physics of Materials, University of Salzburg, Austria
[c] Department of Materials Science and Engineering, Massachusetts Institute of Technology, USA

Due to their high Li-ion conductivity as well as chemical and electrochemical stability, cubic $Li_7La_3Zr_2O_{12}$ (LLZO) garnets are among the most promising candidates for solid-state electrolytes to be used in future Li-ion batteries [1]. Although LLZO has been studied extensively in recent years, the reproducible synthesis of highly conductive garnets remains challenging. In order to investigate the processes involved in the synthesis as well as to study the relationship between chemical composition and conductivity behaviour, information about the exact stoichiometry of the garnets is required.

In this contribution, we present a LA-ICP-OES procedure for the laterally resolved stoichiometry determination of aluminium stabilized LLZO ($Li_{7-3x}Al_xLa_3Zr_2O_{12}$). Matrix-matched standards were successfully prepared by pressing ground LLZO powders with varying Al content into pellets. For signal quantification, an internal-standard independent calibration strategy based on the normalization of the sum of all metal oxides to 100 wt% was applied [2]. Using this approach, two-dimensional elemental distribution images of whole LLZO pellets were created, which revealed significant local variations in sample stoichiometry.

[1] R. Murugan, V. Thangadurai, W. Weppner (2007), *Angew. Chem. Int. Ed.*, 46: p. 7778-7781.
[2] Y. Liu et al (2008), *Chemical Geology*, 257: p. 34-43.