

## Local Ion Dynamics in $\beta$ -LiGaO<sub>2</sub>: A Solid-State NMR Study

C. Vinod Chandran<sup>1,4</sup>, Kai Volgmann<sup>1,4</sup>, Suliman Nakhal<sup>2</sup>, Reinhard Uecker<sup>3</sup>, Elena Witt<sup>1,4</sup>, Martin Lerch<sup>2</sup>, Paul Heitjans<sup>1,4</sup>

<sup>1</sup> Institut für Physikalische Chemie und Elektrochemie, Leibniz Universität Hannover, Callinstr. 3-3a, 30167 Hannover, Germany; <sup>2</sup> Institut für Chemie, Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany; <sup>3</sup> Leibniz Institute für Kristallzüchtung, Max-Born-Straße 2, 12489 Berlin, Germany <sup>4</sup> Zentrum für Festkörperchemie und Neue Materialien, Leibniz Universität Hannover, Callinstr. 3, 30167 Hannover, Germany;  
E-Mail: vinod.nair@pci.uni-hannover.de

Solid-state nuclear magnetic resonance is an excellent spectroscopic technique to characterize dynamics in materials. It is regularly employed to elucidate wide range of ion dynamics in lithium ion conductors [1]. Materials with fast moving lithium ions find applications in energy storage devices, whereas slow ion motion is used in some devices such as blankets in fusion reactors.  $\beta$ -lithium gallium oxide (LiGaO<sub>2</sub>) is a slow Li<sup>+</sup> ionic conductor like  $\gamma$ -lithium aluminium oxide (LiAlO<sub>2</sub>) [2, 3]. Localized motions (to-and-fro jumps) may be present in an ion conductor, in addition to the main diffusion process. In this work, with solid-state NMR experiments, we present our results suggesting localized movements of Li<sup>+</sup> ionic species in  $\beta$ -LiGaO<sub>2</sub> in the temperature range between 300 and 450 K. We have mainly extracted the ion dynamics parameters from <sup>7</sup>Li spin-alignment echo NMR measurements and the important observation of the partial motional narrowing of the central transition signal of <sup>7</sup>Li NMR of polycrystalline  $\beta$ -LiGaO<sub>2</sub> prepared by solid-state synthesis [4].

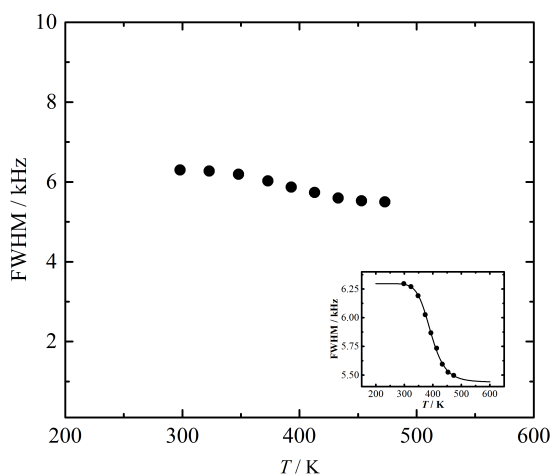


Figure 1: The Full-width at half-maximum of the central transition of static <sup>7</sup>Li NMR spectra of  $\beta$ -LiGaO<sub>2</sub> plotted against temperature showing partial motional narrowing corresponding to localized motion of a subgroup of the Li ions.

- [1] Solid-State NMR Studies of Lithium Ion Dynamics Across Materials Classes, C. V. Chandran, P. Heitjans, *Annu. Rep. NMR. Spectrosc.* 89 (2016) 1.
- [2] NMR and Impedance Spectroscopy Studies on Lithium Ion Diffusion in Microcrystalline  $\gamma$ -LiAlO<sub>2</sub>, E. Witt, S. Nakhal, C. V. Chandran, M. Lerch, P. Heitjans, *Z. Phys. Chem.* 229 (2015) 1327.
- [3] Unravelling Ultraslow Lithium-Ion Diffusion in  $\gamma$ -LiAlO<sub>2</sub>: Experiments with Tracers, Neutrons, and Charge Carriers, D. Wiedemann, S. Nakhal, J. Rahn, E. Witt, M. M. Islam, S. Zander, P. Heitjans, H. Schmidt, T. Bredow, M. Wilkening, M. Lerch, *Chem. Mater.* 28 (2016) 915.
- [4] Local Ion Dynamics in Polycrystalline  $\beta$ -LiGaO<sub>2</sub>: A Solid-State NMR Study, C. V. Chandran, K. Volgmann, S. Nakhal, R. Uecker, E. Witt, M. Lerch, P. Heitjans, *Z. Phys. Chem.*, in press, 2017 (DOI 10.1515/zpch-2016-0920).