In-Situ Studies on Li-Mobility in Compacted Powdered Solids

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Ionic transport properties of powdered solid electrolytes can be strongly modified by pressure treatment (*e.g.*, compaction) at elevated temperatures. Here, the focus lies on the compaction-behavior of powdered $Li_2Si_3O_7$-glass, powdered $Li_2Mg(PO_3)_4$-glass and amorphous $LiTaO_3$-powder produced via sol-gel-synthesis. *In situ* measurements of electrical conductivity were carried out in an experimental apparatus described in [1]. Isothermal compaction experiments on glass powders were conducted at pressures up to 930 MPa and at temperatures ranging from 373 to 667 K. Due to the instability of the amorphous $LiTaO_3$, impedance spectra were recorded during isobaric heating and cooling at pressures ranging from 0.1 to 720 MPa and temperatures from 298 to 585 K. In order to study the effect of adsorbed water on the surface of a $Li_2Si_3O_7$-powder, the apparatus was flushed with water-bearing nitrogen before the experiment. Upon pressurization, electrical conductivity continuously increased for all particle size fractions both in the brittle and in the plastic deformation regime (see Fig. 2). When heated and cooled in the temperature range between 298 and 454 K the measured electrical conductivity of the $LiTaO_3$-powder features a hysteresis. The conductivity during the cooling process is significantly lower than during the heating process. This is likely caused by the reversible ad- and desorption of water by the $LiTaO_3$-particles. Hygroscopic properties of amorphous tantalates have been described by Glass *et al.* [2]. For the $Li_2Si_3O_7$-glass, the surface modification by adsorbed water resulted in enhancement of electrical conductivity only at high temperatures. This is probably caused by lowering of viscosity at grain surfaces, which facilitates welding of particles.

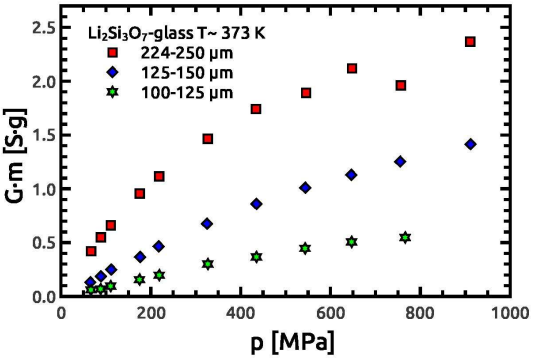

Figure 2: Evolution of the electrical conductance (multiplied with sample weight) for three selected particle fractions of powdered $Li_2Si_3O_7$-glass during compaction at 373 K.

[1] A Novel Cell for Studying Ionic Transport in Powders During Compaction and Its Application to Lithium Silicate Glass Powder, D. Murawski, S. Roß, H. Behrens, Z. Phys. Chem. 229 (2015) 1313.

[2] Ionic Conductivity of Quenched Alkali Niobate and Tantalum Glasses, A. M. Glass, K. Nassau, T. J. Negran J. Appl. Phys. 49 (1978) 4808.