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ABSTRACT:

On the Conductivity in NaSICON Glass-Ceramics and the Volatility of Na_2O

F. Tietz[1,2], Q. Ma[1], M.-T. Gerhards[1], M. Bhardwaj[1], D. Sebold[1]
1 Forschungszentrum Jülich GmbH, Institute of Energy Materials and Devices,
IMD-2: Materials Synthesis and Processing, 52425 Jülich, Germany
2 Forschungszentrum Jülich GmbH, Institute of Energy Materials and Devices,
IMD-4: Helmholtz Institute Münster – Ionics in Energy Storage, 52425 Jülich, Germany

Two composition series of Zr-deficient NaSICON materials were investigated with respect to their ionic transport properties [1]. The bulk conductivity varied between 1.4 and 6.6 mS cm-1. In the case of total conductivity, both composition series show decreasing values with increasing Zr deficiency due to the impact of the increasing fraction of the glass phase. The calculated “grain boundary” conductivity is about two orders of magnitude lower than the total conductivity but does not correspond to the conductivity of any known glass composition of sodium silicates/phosphates. Using atomic probe tomography, the composition of specific microstructural regions containing Na_2O in the glass phase was precisely quantified.
Therefore the volatilization of Na2O from the NaSICON material with the composition Na3.4Zr2Si2.4P0.6O12 was investigated [2] with the aim of addressing the often arbitrarily chosen amount of additional sodium source used to compensate for mass loss during sintering. The measured and calculated mass losses allow for a more precise estimate of the necessary Na2O additions during component manufacturing. In addition, the volatilization of Na2O from molten sodium silicophosphate glass and sodium phosphate was measured. With knowledge of thermodynamic processes and the vapor pressure curve, mass losses can be calculated in very good agreement with the observed data.

[1] F. Tietz, Ph. Odenwald, D. Sebold, M. Schaller, T. Böger, J. Köttgen, Q. Ma, S. Indris, W. G. Zeier, O. Cojocaru-Miredin, D. Fattakhova-Rohlfing, Batteries & Supercaps, 8 (2025) e202500093
[2] F. Tietz, M.-T. Gerhards, M. Bhardwaj, D. Sebold, J. Am. Ceram. Soc., 109 (2026) e71236