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ABSTRACT:

Impact of Zero- and Two-Dimensional Defects on the Partial Electronic Conductivity of Solid Electrolytes

Matthias T. Elm

Institute of Experimental Physics I, Justus-Liebig University, Giessen, Germany

The functionality of the most electrochemical energy storage or energy conversion devices rely on ion-conducting electrolytes. Ideally, an electrolyte possesses a high ionic conductivity and no electronic one. This is true for liquid electrolytes used in conventional lithium-ion batteries. However, solid electrolytes for solid state batteries or solid oxide fuel cells intrinsically exhibit electronic partial conductivity, whose magnitude is governed by the defect chemistry of the solid compounds. Although the electronic conductivity of solid electrolytes is typically several orders of magnitude lower than the ionic one, the ability to transport electrons can significantly affect the device performance, e.g., by contributing to self-discharge effects or accelerating parasitic side reactions at the electrodes. Therefore, a detailed understanding of the influence of defects on the electronic conductivity of solid electrolytes is essential for optimizing device performance.

The talk will give some examples on how defects affect the partial electronic conductivity in solid electrolytes. This includes the impact of extrinsic impurities on the electronic conductivity in lithium-ion conducting halides, which plays an important role in the formation of a solid electrolyte interface and, thus, affects stability and performance of all-solid state batteries.^[1] It will also be demonstrated how the surface as a two-dimensional defect alters the electrical properties of porous oxygen-ion conductors.^[2]

[1] C.D. Alt, J. Kessler-Kühn, J.K. Eckhardt, M. Stein, S. Chatterjee, M.T. Elm, J. Janek, Solid State Ionics 429, 116991 (2025)

[2] E. Celik, A. Usler, M. Wiche, A. Mazilkin, T. Brezesinski, R.A. DeSouza, M.T. Elm, J. Phys. Chem. C 129, 12585 (2025)