

Lithium Nucleation and Dynamics in Ionic Liquid Electrolytes

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Ionic liquids (ILs) have garnered significant attention as potentially replacing conventional electrolytes in important electrochemical energy storage and energy conversion systems, due to their inherent characteristics. To tailor the properties of ILs, the exact knowledge of the influence of different compositions of the electrolyte and about the behavior of the ionic arrangement in confined situations is of crucial importance.

In this contribution the deposition of metallic Lithium from ionic liquids of different compositions on a Nickel current collector in an anode-free or zero-excess approach is studied by means of *in operando* atomic force microscopy (AFM).¹ To investigate the temporal evolution of the initial nucleation of lithium, the topography and adhesion properties of individual points on the current collector are recorded while applying a plating current of $-80 \mu\text{A cm}^{-2}$ for 60 minutes. Every ten minutes an AFM image has been recorded, providing an overview of the nucleation process. Strong deviations in the structures of deposited Lithium are found, depending on the exact electrolyte composition. The results verify that a higher concentration of Lithium salt in the electrolyte causes a more homogeneous deposition.

Moreover, the dynamics of ionic liquids confined in carbon black have been investigated using pulsed gradient stimulated echo nuclear magnetic resonance and spin-lattice NMR relaxation time distributions.² The results reveal a strong influence of the loading fraction of the pores in carbon black on the individual ion mobility. In agreement with AFM experiments, a largely immobile layer directly adjacent to the surface is indicated, followed by an intermediate layer of highest mobility.

References (in ACS Style, 10-point, justified with 1.0 line spacing, a sample format is given below)

1. Stepien, D.; Wolff, B.; Diemant, T.; Kim, G.-T.; Hausen, F.*; Bresser, D.*; Passerini, S*. *ACS Appl. Mater. Interfaces* **2023**, *15*, 25462–25472.
2. Merz, S.*; Jakes, P.; Taranenko, S.; Eichel, R.-A.; Granwehr, J.; *Phys. Chem. Chem. Phys.* **2019**, *21*, 17018–17028.



I am Professor for Applied Interface Electrochemistry at RWTH Aachen University and leads the scanning probe microscopy focused group at the Institute of Energy Technologies (IET-1) at Forschungszentrum Jülich, Germany. During my PhD at INM Saarbrücken, Germany, and my postdoc stay at the University of Oxford, I investigated tribological properties of ionic liquids. After that I obtained my current positions. My research interests include *in operando* correlative microscopy and spectroscopy to study processes at interfaces and interphases in energy materials as well as mechanical properties under electrochemical control.