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S E M I N A R
on
Semiconductor Physics and Nanotechnology

Mo, 21.11.2022, 11:15 Uhr,

Seminar in
person in the Physics lecture hall *or* via Zoom

"Electrochemical phase transformation in confined geometry"

Dr. Christian Prehal, ETH Zürich, Switzerland

Ionic charge storage in nanoporous carbons represents a sustainable high-power alternative to electrochemical energy storage in bulk materials. Yet, the storage capacity with purely physical, electrostatic charge storage is limited, despite the effective shielding of Coulomb interactions in sub-nm pores. Only electrochemical reactions can significantly improve storage capacities in nanoporous carbons and approach those of standard battery materials. Achieving both high storage capacities and power densities requires a fundamental understanding of structure formation during electrochemical reactions in confined geometry.

Here, we present operando small and wide angle X-ray scattering (SAXS/WAXS) to track the growth and dissolution of solid iodine deposits during electrochemical operation of an aqueous NaI-based hybrid supercapacitor [1]. Stochastic modelling based on the SAXS data [1, 2] allows quantification of the nanoscale phase evolution during discharge and charge. Combined with operando Raman spectroscopy, we show that electrochemical oxidation of iodide in nanoporous carbons forms persistent solid iodine deposits. Confinement slows dissolution into soluble polyiodides, responsible for otherwise significant self-discharge. Knowing this provides guidelines for significantly improved capacities and less self-discharge.

Next to aqueous iodide based hybrid supercapacitors, the potential of the used methods is demonstrated by quantifying the nanoscale phase evolution of solid discharge products in Li-O2 batteries [3].

References:

[1] C. Prehal, Q. Abbas et al. Nature Communications 11, 4838, (2020)

[2] C. Prehal, V. Wood et al. Nature Communications 13, 6326 (2022)

[3] C. Prehal, S. Freunberger et al. PNAS 118, e2021893118, (2021)

Zoom – Link:

https://zoom.us/j/96375934537?pwd=RTlKTWhSdzRHU211YTY1bGFxTUtpZz09

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