DEPARTMENT OF CHEMISTRY AND PHYSICS OF MATERIALS

ANNOUNCEMENT

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Prof. Dr. Volker Presser

INM-Leibniz, Institute for New Materials, Saarbrücken
Saarland University, Saarbrücken

"Electrochemical ion management and nanomaterial design for the energy/water research nexus"

The growing population, increased impact on the environment, and mounting environmental impact call for a different way of storing energy and using/interacting with water resources. Rather than just focusing on energy storage, it is essential to broaden the view to address the broad energy/water research nexus. Doing so unlocks surprising synergy and rich cross-fertilization across the seamless transfer of knowledge, materials, and technologies.

Electrochemical materials and processes have enabled high-performance energy storage. As the demand and requirements for energy storage devices ever increase, novel nanomaterials and designs have emerged. Examples of this development include hybridizing different materials on a nanoscopic level, engineering of crystal structure defects to tailor electrochemical properties, and the use of low-dimensional electrodes materials, such as the recently discovered material class of MXenes. These approaches allow for faster charge/discharge cycles and higher energy storage capacity than present-day battery materials.

Reversible electrochemical processes are also promising for energy-efficient water treatment. Electrochemical desalination is based on the compensation of electric charge by ionic species, through which the ions are immobilized. Thereby, ions are being removed from a feed-water stream flowing through a desalination cell. For decades, electrochemical desalination has focused on using carbon electrodes, but their salt-removal ability is limited by ion electrosorption mechanism at low molar concentrations and low charge-storage capacity. Recently, charge-transfer materials, often found in batteries, have demonstrated much larger charge-storage capacities and energy-efficient desalination at low and high molar strengths. Such desalination batteries allow for ion-specific separation, for example, to recover Lithium from hydrothermal or mine water sources, giving a new tool to the established field of mining engineering in Leoben (and the world).