MM 38: Nanomaterials

Energy applications

Time: Wednesday 15:15–16:15 Location: H 0106

MM 38.1 Wed 15:15 H 0106

Structural Features of the Micromesoporous Carbons for Supercapacitors — •Eneli Härk[1], Albrecht Petzold[1], Günter Goerigk[1], Sebastian Risse[1], Nikolay Kardjilov[1], André Hilger[1], Sven Schneider[1], Matthias Ballauff[1], Uwe Keiderling[1], Indrek Tallo[2], and Enn Lust[2] — [1]Soft Matter and Functional Materials, Helmholtz-Zentrum für Materialien und Energie GmbH, Hahn-Meitner-Platz 1, 14109 Berlin, Germany — [2]Institute of Chemistry, University of Tartu, 14a Ravila Str., 50411, Tartu, Estonia

Depending on the synthesis route and conditions chosen, the carbons have different physico-chemical properties. A number of works led to the conclusions that the electrochemical properties vary widely depending on the hierarchical structure of the micromesoporous carbons. Several simulations have shown that an appropriate combination of three structural features determines at first the properties of the carbon, and consequently performance of the device. Due to the complexity of the morphology of the micromesoporous carbon there is still deficiency due date of the unambiguous correlation between the systematical structural features and electrochemical characteristics. A key structural features of micromesoporous carbons will be the subjects of a presentation. For characterization, the x-ray microcomputed tomography (μCT), small-angle neutron scattering (SANS), and small-angle x-ray scattering (SAXS) techniques were applied. The detailed structural information will be used for further optimization and development of the supercapacitors based on micromesoporous carbon.

MM 38.2 Wed 15:30 H 0106

Absolute Seebeck coefficient of individual silver nanowires — •Maximilian Kockert[1], Danny Kojda[1], Rüdiger Mitdank[1], Johannes Ruhhammer[2], Zhi Wang[2], Michael Kröner[2], Peter Woias[2], Toni Markurt[3], and Saskia F. Fischer[1] — [1]Novel Materials Group, Humboldt-Universität zu Berlin, D-12489 Berlin — [2]Laboratory for Design of Microsystems, University of Freiburg - IMTEK, D-79110 Freiburg — [3]Leibniz-Institute for Crystal Growth, D-12489 Berlin

The Seebeck coefficient S consists of the diffusion part and the phonon drag part. The first part occurs due to thermal diffusion of charge carriers in the material caused by a temperature gradient. The second part is due to the interactions between electrons and phonons. Phonon drag is still today not fully understood. In order to investigate the influence of the phonon-phonon interaction and electron-phonon interaction on S, the absolute S of individual, highly pure and single crystalline silver nanowires is determined. In a comparison between the absolute S of bulk silver and silver nanowires, we demonstrate the influence of micro- and nanostructuring on the temperature-dependent profile of S. We show a reduction of the thermodiffusion part of S of the silver nanowires and a shift of the phonon drag peak towards higher temperatures compared to the bulk material, but without changing the maximum value of S. Here, we present a model for the absolute S, which demonstrates a reduction of the phonon-phonon interaction with respect to the electron-phonon interaction in the silver nanowires compared to bulk silver.

MM 38.3 Wed 15:45 H 0106

Nanoscale engineering for thermoelectrics: an ab initio study — •Phil Hasnip[1], Matt Probert[1], and Mahmoud Hussein[2] — [1]University of York, UK — [2]University of Colorado-Boulder, USA

Thermoelectric materials have the potential to dramatically improve the energy efficiency of many devices by converting waste heat into electricity. An ideal thermoelectric material has high electrical conductivity and low thermal conductivity, requirements which are often in conflict. When the thermal conduction is mediated by phonons, some improvements can be made by introducing point scatters and other defects to reduce the thermal conductivity; however these same defects often scatter electrons too, causing a simultaneous decrease in the electrical conductivity. In this work we use ab initio simulations to show that the thermal conductivity can instead be reduced by introducing phononic resonators on the surface of a material, scattering heat-carrying phonons whilst leaving the electronic properties almost unchanged.

MM 38.4 Wed 16:00 H 0106

Hybrid Materials Made From Nanoporous Metals and Electrically Conductive Polymers for Electrochemical Actuation — •Benedikt Roschning[1] and Jörg Weissmüller[1,2] — [1]Institute of Materials Physics and Technology, Hamburg University of Technology, Hamburg, Germany — [2]Institute of Materials Research, Materials Mechanics, Helmholtz-Zentrum Geesthacht, Geesthacht, Germany

The variation of an applied electrical potential modifies the surface stress of solid metals immersed in electrolyte. This variation of surface stress is transferred to the underlying bulk material, where it causes compensating stresses. The associated strain strain may be exploited for electrochemical actuation. The effect is small in conventional macroscopic bodies, due to their small surface to volume ratio. By contrast, nanoporous metals have a high internal surface area; these materials may be suitable as functional materials like sensors or actuators. Electrically conductive polymers, such as polypyrrole, swell or shrink through the potential-controlled incorporation or removal of anions. They constitute another class of chemo-mechanical actuators. Fast ion exchange is possible within thin polymer layers on planar conductive substrates, but the stiffness of the substrate limits the actuation amplitude. Combining the two mentioned approaches we investigate the actuation with nanoporous gold functionalized by coating the internal surface with polypyrrole. We show that these hybrid materials exhibit significantly enhanced actuation. The presentation also addresses the underlying coupling mechanisms.