Fundamental Properties of Materials for Energy

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Research on energy storage and conversion materials is of great importance for the development of a sustainable energy economy. This includes materials for high power lithium ion batteries, hydrogen storage materials, solar cell and other (opto-)electronic materials, fuel cell materials and magneto-caloric materials. Also advanced structural materials are suited to improve the sustainability. Here we are aiming at optimizing the functionality of high strength metal alloys and self-healing materials.

We are performing research on the relations between the structure, dynamics, and function of materials on a microscopic level, aiming at fundamental understanding of the relevant chemical and physical processes, to improve the performance of functional materials with emphasis on energy applications. Neutron scattering, synchrotron X-ray scattering, (spin-polarized) positron annihilation, NMR, electron microscopy and muon spectroscopy are used as research tools, supported by ab-initio or empirical modelling. The physical processes like phase transformations, nucleation, diffusion and growth are relevant for all these materials with very different applications in the energy domain.

We have performed pioneering research with observations of dynamical processes like phase transformations in steels, hydrogen cycling of storage materials, opto-electronic materials including active layers for solar cell devices and lithium diffusion in battery electrodes, and in revealing the atomic and electronic structure of metal and semiconductor nanocrystalline materials.