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Characterisation of hydrogen storage materials with photons and neutrons

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Hydrogen is a promising energy carrier for the future, especially for mobile applications. It can be stored safely and reversibly at high volumetric densities in hydrogen storage tanks filled with light metal hydrides. Reactive Hydride Composites (RHCs) are metal hydride mixtures that are very promising hydrogen storage materials due to high hydrogen densities, stability and safety. The hydrogen sorption kinetics of the RHCs is distinctly improved by high-energy ball milling and the addition of suitable additives.
Phase transformations and changes in the nanostructure were characterised using in situ synchrotron radiation-powder X-ray diffraction (SR-PXD), X-ray absorption spectroscopy (XAS), anomalous small-angle X-ray scattering (ASAXS) and small-angle neutron scattering (SANS) in order to get a deeper insight into the complex hydrogen sorption processes in the different RHC systems.
In situ Neutron Radiography (NR) experiments were performed for time-resolved investigations of the hydrogenation process of metal hydride powder beds and pellets inside a hydrogen storage tank. Neutron Computerized Tomography (NCT) provided additional 3D information about material structure and quantitative hydrogen distribution and allowed correlation studies of the effect of temperature field and material packing density. The results give important information for tailoring of the hydrogen storage materials and tank systems in terms of capacity, kinetics and safety.

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