HYDROGEN STORAGE IN NANOSTRUCTURED METAL HYDRIDES

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Metal hydrides are a fascinating class of materials that can be used for several energy applications and devices, such as hydrogen storage, heat storage, heating/cooling systems, batteries, smart solar collectors and various types of sensors. Their properties and range of applications strongly depend on the thermodynamics of hydrogen sorption, i.e. on the enthalpy / entropy changes, which dictate the equilibrium temperature and pressure for the metal-hydride transformation. In addition, the kinetics of hydrogen sorption are determined by the interplay between dissociation/recombination of the hydrogen molecule, hydrogen diffusion in subsurface and bulk layers, and nucleation of the new phase. Quite often, in order to fulfill specific application-dependent requirements, the speed of these basic mechanisms must be increased using suitable catalysts or realizing peculiar microstructures.

The intensive investigation of nanostructured metal hydrides during the last decade [1] has been driven by the ambition to tune the thermodynamics and kinetics of hydrogen absorption and release through the exploitation of several size- and surface-related phenomena. In this talk, I will first discuss the main ideas in this field, such as physical confinement, elastic strain engineering, interface tailoring, reactive hydride composites. I will then present selected examples of how the thermodynamics and kinetics of hydrogen sorption can be improved through careful control over material's structure, morphology and composition at the nanoscale. Several aspects related to nanostructured hydrides, from novel synthesis techniques, to advanced structural characterization with *in situ* capabilities, to measurements of hydrogen sorption behavior, will be surveyed. Particular emphasis will be given to lightweight hydrides with different morphologies and composition, including nanoparticles/nanodots, thin films and multilayers, nanoconfined alloys, and core-shell structures.

[1] http://www.cost-mp1103.eu/WebPages/cost.php (web site of COST Action MP1103 "Nanostructured materials for solid-state hydrogen storage")

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