Nanostructures (and Metallic Glasses) for Hydrogen Storage

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Hydrogen is an energy carrier which holds tremendous promise as a renewable and clean energy option. For automotive applications the onboard hydrogen storage is inevitable and an integral part of the system. Hydrogen can be stored using different methods and phenomena, for example in (1) high-pressure gas cylinders, as (2) liquid hydrogen in cryogenic tanks, or as (3) adsorbed hydrogen in materials (the safest storage method). Critical properties of hydrogen storage materials are (a) high volumetric and gravimetric density of hydrogen, (b) cost and availability, (c) fast kinetics and (d) low temperature of dissociation or decomposition, (e) high degree of reversibility, and (f) long-term cycling stability. Any success for a hydrogen technology for future application will depend on materials development.

The present paper will review advantages as well as disadvantages for the three principle forms of hydrogen storage, in particular for hydrogen storage in rechargeable metal hydrides. Such nanostructured materials have potential promise in hydrogen storage because of their unique features such as faster diffusion and adsorption on the surface, inter- and intragrain boundaries, and bulk absorption. In addition, amorphous or quasicrystalline Mg- as well as Ti- and Zr-based materials will be evaluated.

It seems that currently no hydrogen storage material can reach the required storage densities for a hydrogen-powered vehicle and new strategies for storage systems are necessary. Therefore, finally a number of new storage methods/systems will be mentioned and prospects for improvement are given.