Project HC-7: Development and characterization of advanced materials for hydrogen storage

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During 2003 we studied potential carbon-based and metal-based materials for hydrogen storage capacities. The following conclusions were made.

Carbon based: Single wall nanotubes (SWNT) and nanohorns

1. SWNTs' defect density varies with different synthesis techniques. The defects in the SWNT's lattice, however, do not appear to affect their ability to store hydrogen.
2. The thermal reduction technique was used to eliminate defects in SWNTs. Repeated thermal reduction treatment of the SWNTs drastically modified their structure (radial expansion) and caused a significant amount of amorphous and crystalline carbon growth on their lattice.
3. The hydrogen storage capacity of SWNTs was found to be ~ 2 wt%.
4. The surface Plasmon Resonance (SPR) technique provides a non-invasive analysis of the level of hydrogen content in SWNTs.
5. Hydrogen absorption and desorption capacities of nanohorns are insignificant.

Metal based: Characteristics of Mg-x wt.% Mm alloys (Mm = mischmetal)

1. Low-cost, lightweight, easy to fabricate by mechanical alloying technique.
2. Good hydriding and dehydriding kinetics.
3. Respectable hydrogen storage capacity (Ave = 3.18 - 3.85 H wt %).
4. Alloys pellets show low degree of decrepitation and high resistance to oxidation.
5. Bear promise, but still have high hydriding/dehydriding temperatures and low volumetric density (same as liquid H_2, 0.07 gH_2/cm^3).