New Materials for Light-Weight Hydrogen Storage

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A new generation of vehicles powered by fuel cells is on the horizon. These automobiles will require an on-board supply of high-purity hydrogen. Ideally the hydrogen should be stored in a highly compact and lightweight manner at near ambient conditions. Neither, cryogenic or high-pressure gaseous hydrogen meet these requirements. Fortunately, a new generation of reversible lightweight hydrides are being developed with these desired properties. These are Ti/Zr doped Alkali-metal aluminum complex-hydrides. Unlike the common interstitial metal hydrides, these compounds release hydrogen through a series of decomposition reactions. The breakthrough for storage applications is that chemical doping with Ti, Zr and other transition metals allows these reactions to take place reversibly under moderate conditions. Initial studies focused on $NaAlH_4$ which has a theoretical reversible hydrogen capacity of 5.5 wt.%. Direct synthesis combined with dry doping using $TiCl_3$ as a precursor has improved hydriding rates and completely eliminated hydrocarbon contaminants found in previous wet doping techniques. The current challenge is to improve the practical storage capacity which is reduced from the theoretical value to about 4 wt.% by the doping process. New approaches to the materials preparation show promise in improved capacity as well as the hydrogen absorption and desorption rates.