Project H-14: Search for non-conventional Li-based hydrides with hydrogen clusters

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Background

S. Orimo and his collaborator Y. Nakamori have started-up a new research laboratory in the Institute for Materials Research (IMR), Tohoku University. In their lab, some specific experimental apparatuses have been installed from viewpoints of both sample syntheses (e.g., ultra-high-pressure booster for the synthesis of new complex hydrides under controlled gas-atmospheres) and also sample characterizations (e.g., *in-situ* visual Raman spectroscopy for the characterization of atomistic vibrations under controlled gas-atmospheres).

Status as of December, 2003

First, we have studied the correlation between B-H atomistic vibrations in $[BH_4]^-$-anions and melting temperatures of MBH_4 (M = Li, Na, and K) as indexes of hydrogen desorption (decomposition) temperatures. This investigation implied that partial cation substitutions using smaller sized- and/or higher valenced-cations with higher electronegativities might provide higher energy modes of Raman spectra, and then lower hydrogen desorption (decomposition) temperatures. Next, as an example, the hydrogen desorption properties of $LiNH_2$ and its partial cation substitution were preliminarily examined. The starting temperature for the hydrogen desoprtion reaction actually lowered about 180 K by the partial cation substitution of Li by Mg. In addition to the Li-B-H and Li-N-H systems mention above, the synthesis of the Li-B-C-H system, which can be easily/safely handled even in air, has been successful. Furthermore, a new processing technique, using a thin film method, has been also developed for the Li-based complex hydrides. (The contents have been widely reported by the media of Nikkei-, Asahi-, and the other newspapers. The details will be soon published in some journals.)

Activities in 2004

Nanostructures (including the addition of some kinds of catalysts) will be designed for the Li-B-H, Li-N-H and Li-B-C-H systems. The goal is to thermodynamically and kinetically promote the hydrogen storage reaction of Li-based complex hydrides. This project has been and will be financially supported by NEDO (New Energy and Industrial Technology Development Organization, directed by Japanese Ministry of Economy, Trade and Industry) as a “Basic Technology Development Project for Hydrogen Safety and Utilization (2003-2008)”. An international collaboration with Prof. A. Züttel (Fribourg University, Switzerland) is also in place.