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Synthesis, atomic structure and hydrogen storage properties of aluminum hydride

Kazutaka Ikeda

High Energy Accelerator Research Organization, Japan

Abstract

Aluminum trihydride (AlH_3, alane) is one of the potential candidates for hydrogen storage materials because of high gravimetric and volumetric hydrogen densities (10 mass% and 149 kgH_2/m^3, respectively) and a simple hydrogen desorption reaction ($AlH_3 \rightarrow Al + 3/2H_2$) at 370–470 K. In-situ microscopic observations combined with thermal, surface and atomic structural analyses confirmed that primary AlH_3 particles of size 100 nm–1 μm were covered by an oxide layer of thickness 3–5 nm. Both the precipitation/grain-growth of metallic Al of size 1–50 nm and an increase in boundary space were clearly observed inside the particles, while the morphologies of the particles covered by the layer did not change during the hydrogen desorption reaction. We investigated the structures of AlD_3/AlH_3 before the hydrogen desorption reaction by high intensity neutron (BL21 High Intensity Neutron Total Diffractometer (NOVA) in J-PARC)/X-ray diffraction (BL02B2 in SPring-8) measurements. The presence of chi-Al_2O_3 on the surface may prevent the deuterium/hydrogen desorption reaction of AlD_3/AlH_3 to Al at room temperature.

Biography

Kazutaka IKEDA received his Ph.D. from Tohoku University in 2006. During his Ph.D. and postdoctoral studies at Institute for Materials Research, Tohoku University, he was also a research fellow for young scientists of the Japan Society for the Promotion of Science. After serving as an assistant professor at the same institute, he moved to Institute of Materials Structure Science, High Energy Accelerator Research Organization (KEK) as a research associate professor. His current research interests include material design of hydrogen storage materials and structural study by comprehensive use of multi-probes such as high intensity neutrons and synchrotron light.