Poster Presentation

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A system for time-resolved XRD measurements on hydrogen absorption processes

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To improve performance of hydrogen storage materials, it is essential to understand detailed mechanism of hydrogenation and dehydrogenation reactions. In-situ powder diffraction measurements provide direct information about structural changes accompanying the reactions. We therefore installed a time-resolved x-ray diffraction (XRD) system at a beamline BL22XU at the SPrign-8, a synchrotron radiation facility in Japan. The system was equipped with two area detectors, a flat panel sensor for precise structural analyses and a high speed video camera connected to an x-ray image intensifier for observation of rapid phase changes. Maximum frame rate for the flat panel sensor and high-speed video camera was 2 fps and 125 fps (effective), respectively. A sample cell was connected to a hydrogen supply system. Opening of upstream valve of the sample cell or a change of the pressure at the sample triggered the recording of the diffraction patterns. The pressure of hydrogen gas was limited to 1 MPa. To demonstrate the performance of the system, we have performed time-resolved XRD experiments for LaNi4.5Al0.5. LaNi5 exhibits the significant broadening of the diffraction peaks by hydrogen absorption; however, LaNi4.5Al0.5 shows the no significant broadening. We have succeeded in the measurements of the structural change from the solid solution phase to the hydride phase and have found the formation of the transient intermediate phase on this reaction process. The system is currently used to study several materials. This work was partly supported by New Energy and Industrial Technology Development Organization (NEDO) under "Advanced Fundamental Research Project on Hydrogen Storage Materials".

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