

Dehydrogenation kinetics of CeCl₃-doped sodium alanate powder-pellets measured by simultaneous FTIR-ATR-spectroscopy and gravimetry

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Hydrogen storage in nanoporous powder materials is, besides high pressure and liquid storage of hydrogen, a further possibility for increasing hydrogen density at low pressure. For such powder tanks, a suitable level sensor is still lacking. Therefore, we utilized *in situ* FTIR-ATR-spectroscopy and gravimetry in parallel to determine the dehydrogenation reaction kinetics of 2 mol% CeCl₃-doped NaAlH₄. For achieving an optimum contact between the powder and the ATR element, we used compacts (pellets) of the powder. A special sample chamber for ATR spectroscopic measurements, combined with a high precision balance were used to follow on the one hand the changes of various Al-H vibration bands, caused by the changes in crystal structure of NaAlH₄ during desorption. On the other hand, we simultaneously measured the weight of the sample. Subsequently spectroscopic and gravimetric data were fitted by Johnson-Mehl-Avrami and Arrhenius equations to obtain the rate constants of the dehydrogenation and the activation energy of the NaAlH₄-Na₃AlH₆ phase change. The measurements showed that cycling of the powder compacts enhances the dehydrogenation reaction kinetics, whereby a decrease of the activation energy by 3.4 kJ/mol was measured.