

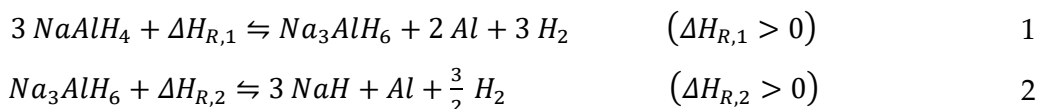
MEASUREMENT OF THE EFFECTIVE THERMAL CONDUCTIVITY OF COMPLEX METAL HYDRIDES FOR HYDROGEN STORAGE APPLICATIONS UNDER OPERATING CONDITIONS

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Due to its high gravimetric hydrogen storage capacity and its absorption and desorption behaviour at mild conditions, sodium tetrahydroaluminate (NaAlH₄) with addition of 4 mol-% titanium trichloride (TiCl₃) is a promising candidate as a hydrogen storage material. NaAlH₄ releases hydrogen in two steps following equation 1-2 [1]:



Addition of a catalytic precursor like TiCl₃ to the system leads to the formation of Ti_xAl_y-species and NaCl, which lowers the overall storage capacity. One common drawback in metal hydride powder beds is the relatively low effective thermal conductivity (ETC) [2]. In addition, the formation of NaAlH₄ (equation 1) requires high pressures and after decomposition the remaining Al in the system decreases the hydrogen capacity of the second step (equation 2).

Na₃AlH₆ (without left over Al) can also be obtained by mechanical milling of 2 NaH + NaAlH₄. Since Al has a high thermal conductivity, the question arises how the ETC changes from the Al presence in reaction (1) to the Al absence in Na₃AlH₆ obtained by a ball-milling synthesis of 2 NaH + NaAlH₄. To answer this, the ETC of NaAlH₄ + 4 mol-% TiCl₃ and its decomposition products, as well as the ETC of milled 2 NaH + NaAlH₄ + 4 mol-% TiCl₃ (Na₃AlH₆ + 4 mol-% TiCl₃) and its decomposition products have been measured under operating conditions in a temperature/hydrogen-pressure range of 30 °C-180 °C/1 bar-90 bar using an in-house built high-pressure autoclave equipped with a transient plane (heat) source (TPS)-sensor [3]. The comparison shows a tendency towards a lower ETC with less Al. The hydrogen capacity was estimated according to the pressure change during the dehydrogenation and later compared with results of TGA-DSC measurements.

References

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