# 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 ($NaAlH_4$) with addition of 4 mol-% titanium trichloride ($TiCl_3$) is a promising candidate as a hydrogen storage material. $NaAlH_4$ releases hydrogen in two steps following equation 1-2 [1]:

$$3\,NaAlH_4 + \Delta H_{R,1} \leftrightharpoons Na_3AlH_6 + 2\,Al + 3\,H_2 \qquad (\Delta H_{R,1} > 0) \qquad 1$$

$$Na_3AlH_6 + \Delta H_{R,2} \leftrightharpoons 3\,NaH + Al + \frac{3}{2}\,H_2 \qquad (\Delta H_{R,2} > 0) \qquad 2$$

Addition of a catalytic precursor like $TiCl_3$ 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 $NaAlH_4$ (equation 1) requires high pressures and after decomposition the remaining Al in the system decreases the hydrogen capacity of the second step (equation 2).

$Na_3AlH_6$ (without left over Al) can also be obtained by mechanical milling of 2 NaH + $NaAlH_4$. 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 $Na_3AlH_6$ obtained by a ball-milling synthesis of 2 NaH + $NaAlH_4$. To answer this, the ETC of $NaAlH_4$ + 4 mol-% $TiCl_3$ and its decomposition products, as well as the ETC of milled 2 NaH + $NaAlH_4$ + 4 mol-% $TiCl_3$ ($Na_3AlH_6$ + 4 mol-% $TiCl_3$) 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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