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Neutron Imaging of Complex Metal Hydrides

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Hydrogen is a promising energy carrier for the future, especially for mobile applications. It can be stored safely and reversibly at high volumetric densities in hydrogen storage tanks filled with light metal hydrides. Due to the sensitivity of neutrons towards hydrogen, in situ Neutron Radiography (NR) is the ideal technique for time-resolved investigations of the hydrogenation process of metal hydride powder beds and pellets inside a hydrogen storage storage tank. Neutron Computerized Tomography (NCT) provides additional 3D information about the material structure and hydrogen distribution.

While low and medium temperature hydrides [1,2] have already been studied by NR and NCT, first-time in situ NR measurements of a hydrogen storage tank filled with the high-temperature complex hydride LiBH4-MgH2 at NECTAR and ANTARES beamlines at FRM II have been performed. Combining cold and fission neutron spectra of both instruments and using a new method for the quantitative investigation of neturon imaging data [3,4], a precise study of the hydrogen distribution in this high-temperature hydride is possible. Effects of temperature field and material packing density were investigated and the 3D struture was analyzed additionally by NCT. The results allow for tailoring of the material in terms of capacity, kinetics and safety.

[1] P. K. Pranzas et al. , Advanced Engineering Materials 13 (8) (2011) 730-736
[2] Bellosta von Colbe, J.M. et.al.; Int. Journal of Hydrogen Energy 37, 2012
[3] S. Börries et al., Scattering influences in quantitative fission neutron radiography for the in situ analysis of hydrogen distribution in metal hydrides, NIM A 797, 2015
[4] S.Börries et al., submitted

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