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High-Pressure Hydrogen Cell for in-situ Characterisation of Hydrogen Storage Materials

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One way to store hydrogen is the use of Reactive Hydride Composites (RHCs), like Ca(BH4)2-Mg2NiH4. These materials have high capacities and suitable kinetics for hydrogen storage. On the other hand, the challenges of these compounds are the high pressures and temperatures, needed for hydrogen absorption and desorption. Ca(BH4)2-Mg2NiH4, e.g., requires 400 bar H2 and 450℃. Tanks used in industrial applications can even bear 700 bar H2 pressure.
For the characterisation of such hydrogen storage systems, a high-pressure cell for in-situ neutron studies at pressures up to 700 bar and temperatures up to 500℃ was developed, constructed and tested. The setup of cell and loading station was designed to match the requirements of the different neutron methods and instruments at European neutron facilities.
Using this cell for neutron diffraction, small-angle neutron scattering and inealstic neutron scattering experiments, the in-situ characterisation of phase transformations, nanostructures, dynamic properties and hydrogen diffusion in hydrogen storage materials are possible during hydrogen desorption/absorption. The basic design of the cell includes a heated sapphire capillary. In October 2017 test measurements were performed at different MLZ instruments. The measurements delivered important information for optimisation and further development of setup and corresponding safety procedure.

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