Destabilization of magnesium hydride by embedding in TiH_2 matrix

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Magnesium is a promising hydrogen storage metal due to its high gravimetric and volumetric hydrogen uptake to form MgH_2 (7.7 wt%, 109 kg H_2/m^3)[1]. However, bulk Mg suffers from slow sorption kinetics and MgH_2 has a high thermodynamic stability with an equilibrium desorption pressure of 1 bar at 278°C[2]. One strategy to overcome these hurdles is by Mg nanostructuration, as crystallite size reduction is expected to enhance hydrogen sorption kinetics and destabilize the hydride[3,4].

This work aims at embedding MgH_2 nanoclusters in a TiH_2 matrix. For that purpose, MgH_2-TiH_2 composites with Mg:Ti ratios between 20 and 60 mol% of Mg have been prepared by mechanochemistry under hydrogen pressure (P_{H2} = 8 MPa)[5]. Their structural properties were determined by X-Ray Diffraction and hydrogenation properties measured in Sieverts' rigs. The crystallite size of MgH_2 phase decreases from 6 nm (Mg60%) to 2nm (Mg20%) with the increase of Ti-content, enhancing kinetics for reversible hydrogen sorption in Mg nanoclusters. Pressure-Composition-Isotherms of Ti-rich nanocomposites exhibit high hysteresis and thermodynamic destabilization as displayed in Figure 1. Complementary thermal characterisations by Temperature Programmed Desorption in closed systems and Thermal Desorption Spectroscopy under high vacuum (< 10^{-6} mbar) confirmed destabilization effects not only for MgH_2 nanoclusters but also for TiH_2 matrix.

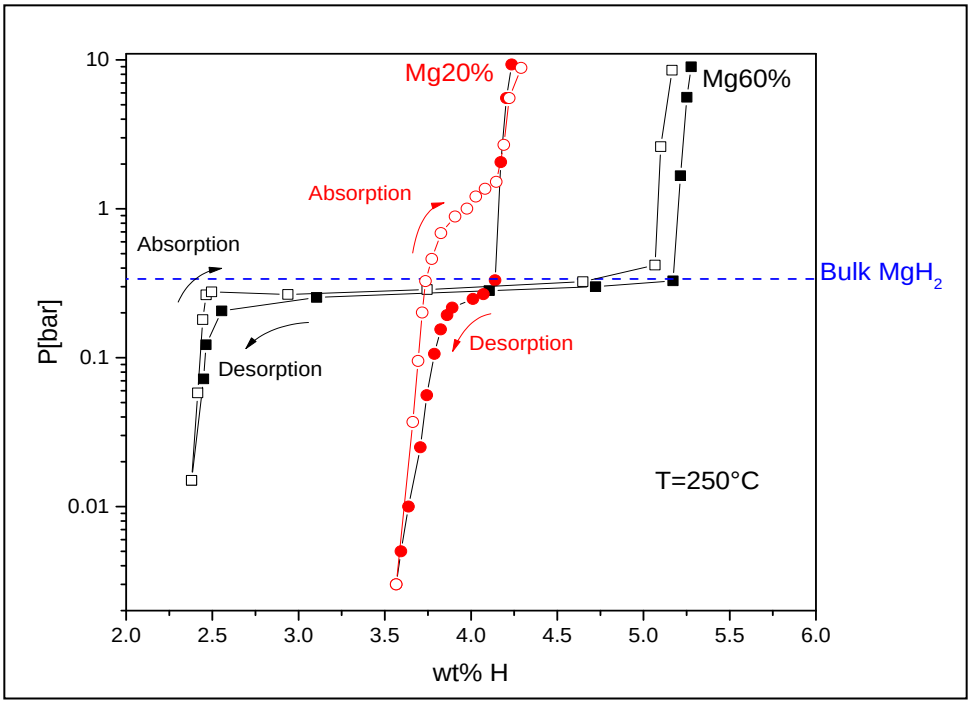

Figure 1: PCI absorption and desorption curves for Mg60% ($60MgH_2$-$40TiH_2$) and Mg20% ($20MgH_2$-$80TiH_2$) at 250°C

References

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