

Nanocomposites and nanomaterials

Mechano-chemically prepared composites of Mg with Ti, Nb or V additives synthesized under hydrogen pressure

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Last decades of research in the field of new materials for hydrogen storage were directed to a large degree towards magnesium and Mg-based alloys, which can reversibly store ~ 7.6 wt% of hydrogen. Such sorption capacity combined with low cost suggests that magnesium and its alloys may have advantages in the systems for hydrogen storage [1]. However, the cyclic stability of these materials and their performance at mild temperature conditions are far from satisfactory [2]. Hydrogenation / dehydrogenation properties of the Mg-MgH₂ system can be improved by mechanochemical treatment of magnesium with the addition of transition metals (TM). In this study the influence of TM additives on the room temperature (RT) hydrogen absorption characteristics of nanocomposites based on magnesium, prepared by reactive ball milling under hydrogen in a high energy planetary mill, was explored. On the base of calculated values of the Gibbs free energy for reaction of hydrogen absorption ($\Delta G < 0$) it can be concluded that hydrogenation reaction could thermodynamically proceed at room temperature, which was experimentally confirmed for all of the studied composites. Comparative analysis of the Mg-Ti, Mg-V and Mg-Nb systems makes it possible to establish that the most effective additive facilitating hydrogen uptake at RT is vanadium. It provides the degree of conversion into hydride phase $\alpha = 0.86$ for the first minute of hydrogenation. In contrast, additives of Nb and Ti provide only $\alpha = 0.62$ and 0.36 , respectively, indeed after 30 min of exposure.

1. *Varin R.A., Zbroniec L., Polanski M., Bystrzycki J.* A review of recent advances on the effects of microstructural refinement and nano-catalytic additives on the hydrogen storage properties of metal and complex hydrides // *Energies*.-2011.-**4**.-P. 1-25.
2. *Paskevicius M., Sheppard D.A., Buckley C.E.* Thermodynamic changes in mechanochemically synthesized magnesium hydride nanoparticles // *J Am Chem Soc*.-2010.-**132**.-P. 5077-5083.