Nanocomposites and nanomaterials

Hydrogenation properties of Mg-based nanocomposites prepared by ball milling

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Hydrogen with its high energy capacity per weight unit and ecology safe oxidation reaction, when the only product is water, is one of the most efficient sources of alternative energy. Development of new concepts of hydrogen economy requires solution of many fundamental and applied problems, including generation of energy, hydrogen production, its storage and transportation. In the last case an efficient and safe (in contrast to the use of compressed hydrogen) method is its chemical bonding in metal hydrides. They can store large volumes of hydrogen and reversibly output it after minor changes in temperature and pressure.

The promising group of H-storage materials is based on Mg, which can reversibly store up to 7.7 wt.% hydrogen. However, there are two principal drawbacks of Mg and Mg-based alloys: sluggish kinetics and unfavorable thermodynamics of hydrogen absorption-desorption processes which require elevated operation temperatures (>300°C). During past 1-2 decades a great improvement in hydrogen sorption kinetics of Mg was achieved by the use of suitable catalysts and proper preparation methods such as mechanical ball milling, which leads to the formation of nano- or submicro-structured materials.

A lot of recent studies were devoted to the enhancement of the hydrogen absorption-desorption parameters, including preparation of magnesium by reactive ball milling in hydrogen medium (RBM) and its modification by different additions, e.g. transition metals, their oxides, intermetallic compounds (IMC), graphite etc. We have studied hydrogen absorption-desorption properties of Mg-based nanocomposite materials with different types of catalytic IMC additions (η-suboxides $Ti(Zr)_4Fe(Ni)_2O_x$, $Zr_3V_3O_x$, Zr_3NiO_x etc). Substantial improvement of hydrogen absorption-desorption properties was demonstrated for the Mg–IMC–C composites prepared by RBM. In our report new data about prepared by RBM Mg_2M hydrides (M = Co, Ni) and their properties will be discussed also.