INFLUENCE OF IMC ADDITIONS ON THE HYDROLYSIS PROPERTIES OF MgH₂

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Magnesium hydride has a hydrogen capacity of 7.6 wt.% and is much cheaper than other metal hydride materials. However, the practical use of MgH₂ in hydrogen storage systems is limited due to a number of significant disadvantages: high hydrogen sorption-desorption temperatures, low sorption-desorption rates, difficulty of activation, low cyclic stability. Improvement of hydrogen sorption-desorption parameters can be achieved by mechanochemical milling with various catalytic additives. Another application of this hydride is their use in hydrolysis reactions to obtain hydrogen and supply it to fuel cells (FC). MgH₂ hydrolysis reactions in water were characterized by a low yield of hydrogen and very slow rate of hydrolysis process. To increase the speed and yield of hydrogen, hydrolysis is carried out in solutions of acids or salts [1]. Therefore MgH₂ is often synthesized by mechanochemical milling, which allows obtaining a nanostructured hydride with uniform inclusion of catalyst particles, increasing the effective reaction area and concentration of defects.

This report will present an overview of the works carried out with the author’s participation in order to show the catalytic effect of the oxygen-stabilized η-phases Zr₃V₃O₀.₆, Ti₄₋ₓFe₂ₓOₙ, Ti₃Fe₂O on the mechanochemical synthesis of hydride composites, their sorption-desorption properties and hydrogen generation in hydrolysis reactions. In our recent studies, it was shown that the use of Zr₃V₃O₀.₆ suboxide and C as catalytic additives is an effective way to obtain composites based on MgH₂ with dual applications: for hydrogen storage and for obtaining hydrogen by hydrolysis [2]. Our recent studies also show the influence of Ti₃Fe₂O and C additions on the hydrogen sorption properties of the composites and on the generation of hydrogen by hydrolysis. For the same purpose, composites with additions of the oxygen-stabilized compound Ti₄Fe₂O₀.₃ and graphite were studied.

It was shown that the rate of hydrogen absorption depends on the quality and dispersion of the original magnesium. The use of finely dispersed magnesium reduces the time of hydride formation by 5 times compared to shavings. Prolonged ball milling increases the reaction rate and hydrogen yield in hydrolysis reactions. The influence of catalytic additives on the yield of hydrogen in hydrolysis reactions in distilled water in the first 2000 s has the following sequence: Ti₃Fe₂O > Ti₄Fe₂O₀.₃ > Zr₃V₃O₀.₆. When using MgCl₂ solution the degree of conversion increases significantly. A strong dependence of the conversion rate on the concentration of MgCl₂ was observed. For a concentration of 0.05 M MgCl₂, the degree of conversion for all composites was in the range 70-80 %. It is shown that the proposed MgH₂–η-phase – C composites can be used both in hydrogen storage systems and in hydrolysis devices for powering FCs.