Nanostructured Mg and Ti based alloys for hydrogen storage

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Amorphous and nanocrystalline alloys on the base of Mg and Ti, produced by rapid solidification and ball milling, were studied as hydrogen storage materials. Through alloying and variation of the preparation conditions materials with different microstructure were synthesized.

The hydriding and dehydriding properties of the nanostructured alloys were investigated in a hydrogen gas atmosphere as well as electrochemically. It was proved that the microstructure of the nanocrystalline materials has a strong influence on their hydrogen capacity and hydriding thermodynamics and kinetics. Smaller nanocrystallites size generally results in noticeable enhancement of the hydriding kinetics and reduction of the temperature of hydrogen sorption as well as in an increase of the electrochemical capacity. The presence of amorphous phase between the nanocrystallites leads to additional raise of the electrochemical capacity of the alloys. The influence of different alloying elements on the hydriding and dehydriding of Mg and Ti based alloys has been studied and optimization of the alloys composition with respect to the hydrogen capacity has been carried out.

The comprehensive set of methods (volumetric Sievert's type technique, high pressure DSC and electrochemical methods), applied for studying the hydrogen sorption processes, allowed new results concerning the thermodynamics and kinetics of the low temperature hydrogen sorption in nanostructured and amorphous materials to be obtained. Additionally, the dependence of the corrosion stability on the chemical composition and microstructure of the alloys was elucidated. All these issues are directly related to the potential application of amorphous and nanocrystalline Mg and Ti based materials for hydrogen storage.