Nanocomposites and nanomaterials

Hydrogenation properties of nanopowders of transition metals and alloys

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Hydrogen-containing materials are one of the important sources of alternative energy. Ultra-dispersive or nano-sized Mg-based materials, usually obtained by mechanochemical milling, are used as high capacity hydrogen storage materials (5-7 wt.%). Metal hydrides are used also as negative electrodes of rechargeable Ni-MH batteries. For this application, the *RE*-Ni and *RE*-Mg-Ni alloys are often studied as composites with Ni or Cu powders as a binder. The understanding of the influence of their dispersive state on working parameters of the electrodes is very important.

In this work, we studied different types of nanopowders (Ni, Co, Cu or their alloys) individually or as the additives to hydrogen storage or electrode materials. The synthesized materials by the authors and commercial ones were characterized by X-ray diffraction (DRON-3.0 and Bruker-D8 powder diffractometers), SEM and electron probe microanalysis. The gas hydrogenation has been studied using Sivert's type apparatus. Electrochemical charge-discharge characteristics were studied using PGStat-8 equipment.

It was revealed that the nano-state substantially enhances gas or electrochemical hydrogenation of Ni as individual metal. The hydrogenation of nanosized Ni-Cu alloys demonstrated interesting peculiarities depending on the Ni/Cu ratio. The prepared in this work and commercial nanopowders (NP) we used also for the preparation of composites (*RE*-Mg-Ni+NP) and studies their charge-discharge properties. Small synergetic effect was observed for the *RE*-Mg-Ni+NP composites in comparison with individual components.

Nanopowders of Ni and Ni-based alloys demonstrated the ability to absorb hydrogen at ambient conditions. The influence of nano-additives on the hydrogenation properties of composite materials will be demonstrated in the report. The possible explanations for the observed hydrogenation behavior of the studied nanomaterials will be proposed.