MM 14 Hydrogen in Metals I

Time: Tuesday 10:15–11:15 Room: IFW D

MM 14.1 Tue 10:15 IFW D

Modified Li-based alanate for hydrogen storage — •Stefania Doppiu, Ludwig Schultz, and Oliver Gutfleisch — IFW Dresden, Institute for Metallic Materials, P.O. Box 270116, D-01171 Dresden, Germany

The development of new lightweight materials for hydrogen storage is an important requirement to use hydrogen as fuel for on-board application. Recently, alkali complex hydrides such as Li-alanates have attracted growing interest due to their high gravimetric and volumetric hydrogen densities. Efforts have been done to optimize the overall stability and, as a consequence, the hydriding temperature and the rehydriding pressure, by partial substitution of the alkali metal or the aluminum. In this study, LiAlH4 and LiAlH4 modified by adding MgH2 and TiCl3, subjected to mechanical milling under argon or hydrogen atmosphere, were investigated. Full structural characterization was performed by x-ray diffraction analysis using a full profile fitting procedure (Rietveld). The thermal stability was studied by high-pressure differential scanning calorimetry in a pressure range of 1-150 bar. Milling pure LiAlH4 induces a partial decomposition of the hydride into Li3AlH6. DSC performed on the as-received and the milled samples shows a complex sequence of decomposition steps during heating. In the case of the samples doped with MgH2 and TiCl3, milling under argon induces almost complete decomposition of LiAlH4 into nanocrystalline LiH, MgH2, Al and H2. Further, it is demonstrated that milling under high hydrogen pressure (80 bar) allows to hinder to some extent the undesired decomposition reaction.

MM 14.2 Tue 10:30 IFW D

New hydride electrodes for Ni-MH batteries on basis of Mg-Ni-Y metastable alloys — •Bogdan Khorkounov, Annett Gebert , Christine Mickel, Margitta Uhlemann, and Ludwig Schultz — IFW Dresden, PF 27 01 16, Dresden, Germany

This work aims at characterizing of novel Mg-Ni-Y amorphous and nanocrystalline alloys with view to their possible application as new hydride electrode materials in Ni-MH batteries. On the example of Mg63Ni30Y7, the alloying conditions were optimised so that alloys with an amorphous or a nanocrystalline-amorphous microstructure were obtained. On basis of these alloy powders, hydride electrodes were fabricated and their electrode characteristics under battery operation conditions were investigated. The alloys with mixed nanocrystalline-amorphous microstructure prepared under use of a SPEX shaker mill and more considerable fraction of nanocrystalls reveal a higher electrochemical activity for hydrogen reduction at cathodic potentials and a higher maximum discharge capacity (247 mAh/g) than the alloys with predominantly amorphous microstructure (216 mAh/g) obtained when using a Retsch planetary ball mill at lowered temperatures. The positive role of increasing Y and Ni concentration in the alloy was observed. The influence of surface modification by coating of the alloy particles by graphite or nickel on the electrodes stability and reactivity was studied in detail.

MM 14.3 Tue 10:45 IFW D

Mechanism of hydrogen embrittlement in nickel, studied with in situ electrochemical nanoindentation — •Afrooz Barnoush and Horst Vehoff — Saarland University, Department of Materials Science, Bldg. D22. P.O. Box 151150, D-66041 Saarbruecken, Germany

The effect of hydrogen on the nucleation and multiplication of dislocations is examined on precisely oriented Ni (111) surfaces with a specifically designed nanoindentation set up for in-situ electrochemical experiments. With this set up, for the first time hydrogen/deformation interaction has been studied in-situ on a nano-scale under realistic conditions. The effect of the electrochemical potential on the indent load displacement curve, especially the unstable elastic plastic transition is studied in detail. Not only the surface films but also the local plasticity is influenced strongly by the potential. The experiments allowed to exclude surface from hydrogen effects. Clear evidence is provided that hydrogen atoms facilitate homogenous dislocation nucleation.

MM 14.4 Tue 11:00 IFW D

Local resolved hydrogen detection in technical alloys — •Christian Lenk, Matz Haaks, and Karl Maier — Helmholtz Institut für Strahlen- und Kernphysik, Universität Bonn, Nußalle 14-16 , D-53115 Bonn, Germany

The weldable aluminium alloy AA6013 used in aircraft construction shows during cyclic load in a corrosive medium an increased crack growth speed compared with deformation under normal atmosphere, as well as a slower annealing of point defects in the plastic zone. One assumes this behaviour is due to the uptake and diffusion of hydrogen during crack growth. This hypothesis has to be confirmed with an analytical detection of hydrogen in the plastic zone. For that purpose chips in the micrometer scale were cut from the sample in vacuum and in-situ heated under UHV conditions. The following increase of the partial pressure of hydrogen is recorded with a mass spectrometer. As a proof of principle, a sample made of a NiCu-alloy was loaded with a deuterium-concentration-structure. The distribution of the deuterium concentration was confirmed by the experiment.