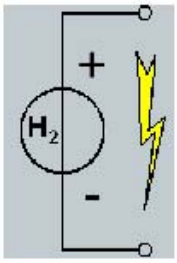
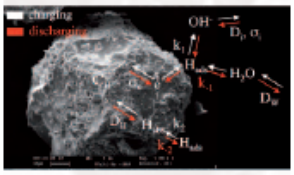


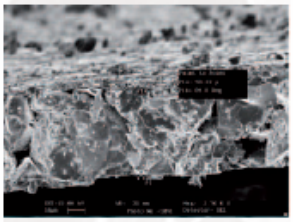
HydroNanoPol

High capacity nickel-metal hydride batteries could boost European industry (2006-2009)

Polymer-coated hydride storage alloys increase battery capacity while solving production problems.



The MH Electrode Process



New limited volume electrode (LVE) for study of metal hybride materials

The market for electrical storage batteries is a global battlefield, in which European manufacturers are falling behind Far Eastern suppliers. Development of the technology for higher capacity nickel-metal hydride (NiMH) batteries could help to redress this balance by providing more ecologically benign replacements for NiCd types in such high-current-density applications as power tools, hybrid vehicles and small portable devices.

High gains possible

Large gains in the current storage capacity of NiMH batteries can be achieved by reducing the size of the active particles from a few hundreds of microns down to the nanometre range – and thus increasing the surface/volume ratio. However, the high surface energy of such extremely small particles makes them extremely flammable in contact with air, which is very difficult to manage in production processes.

The consortium of the HYDRONANOPOL project is exploring the application of polymeric nanocoatings as a solution to this problem. This entails studying the behaviour of suitable polymers in terms of their ability to prevent combustion without impairing the ion conductivity of the dispersed nanoparticles. In addition, it requires the development of novel multifunctional hydride storage alloys for the negative electrodes of the batteries. These must also be assessed for electrochemical connection efficiency and stability in the alkaline medium.

Project successes

Functional system. An early-stage advance was the synthesis of Ormocer® **inorganic-organic** hybrid polymers in which the organic part provides the necessary passivation and ion conduction properties. Samples were characterised for particle size distribution, structure, shape, composition and density.

Various nickel alloys (H(La, M) Ni_5) were nano-encapsulated using milling and coating processes, after which the coatings were optically analysed and tested for solubility in KOH solution.

Mechanism confirmed. The mechanism of hydrogen absorption/desorption and the influence of the state of charge (SOC) on the hydrogen diffusion were determined.

Test protocol. A standard electrochemical testing protocol allows reliable characterisation of hydride-forming powders prepared in the course of the project.

Optimisation continues. It has been shown that Ormocer® does not affect charge transfer kinetics; nor does it influence double layer capacitance. However, in order to eliminate small losses in the hydrogen storage capacity of milled and coated materials, (probably because of electrical insulation of some particles by the polymer), optimisation of the Ormocer® coating is being pursued.

Low energy milling is found to facilitate activation of the materials, but accelerated self-discharging requires further investigation and remedying. Refinement of the small-particle preparation procedure is also being undertaken to compensate for a less-than-expected improvement in the hydrogen diffusion rate for milled samples, compared with unmilled particles.

NMP3-CT-2006-32517 – **HYDRONANOPOL**
Advancement in storage capability and hydrogen kinetics of hydride storage alloys through nanocoating with multifunctional hybrid polymer
Total cost | € 2 228 586 – EC contribution | € 1 866 792
Project duration | October 2006 – September 2009 (36 months)
Coordinator | Martin Krebs – Varta Microbattery GmBH,
R&D Nickel Metal Hydride Button Cells, Hanover, Germany

Extract from the brochure „Materials for energy applications“, EU Commission, 2008