

## Structured Negative Electrodes for NiMH Cells

Adam H. Whitehead, Martin Harrer, Martha Schreiber

Funktionswerkstoffe F & E GmbH  
Technologiezentrum, Marktstrasse 3  
A-7000 Eisenstadt, Austria

Nickel-metal hydride (NiMH) cells are largely replacing nickel-cadmium (NiCd) cells in consumer electronics and offer a cheaper alternative to lithium cells for certain applications. They are similar, in several respects, to NiCd cells: the main difference being that the negative electrode is a hydridable metal alloy as opposed to cadmium hydroxide. The electrolyte is a concentrated, aqueous solution of potassium hydroxide (sometimes with other hydroxides).

NiMH cells, although more environmentally friendly than NiCd and lead acid cells, suffer certain drawbacks. One disadvantage of the NiMH system is a relatively high self-discharge rate (especially at elevated temperatures), another is a limited cycle life. A further disadvantage is that an "activation" routine of perhaps several charge and discharge cycles is required before the full capacity of the cell may be realised. During the activation routine hydrogen is inserted into the metal alloy. This causes large volume changes between different regions of the alloy particles, leading to high internal stresses. As activation proceeds the alloy particles rapidly become "pulverised" to a much finer powder. The charge and discharge characteristics of the fine activated powder are significantly different from those of the original coarse material. The freshly exposed metal surfaces are relatively free of oxides (unlike the original powders) and must be protected to prevent irreversible oxidation.

In general NiMH negative electrodes are fabricated by firstly microencapsulating the alloy powders with copper or nickel<sup>[1, 2]</sup> and then cold pressing onto a nickel current collector. The microencapsulated alloy powders may be pressed with a PTFE binder and/ or additional metal powder. Further treatments, for example with fluoride ions, may also be used to reduce oxidation<sup>[3]</sup>.

In this work we investigated the performance of NiMH negative electrodes prepared from a standard metal alloy but formed into a novel electrode structure. The electrode performance was investigated by cyclic voltammetry and impedance measurements (see Fig. 1) in 6 M KOH electrolyte with an Hg/HgO reference electrode. In addition the electrode performance will be contrasted with that of different electrode structures in terms of the initial cycle performance during the activation period.

Results of examination of the electrodes before and after cycling by scanning electron microscopy will also be shown.

The novel electrode structures were flexible because of the incorporation of a flexible current collector. In comparison, many commercial electrodes are rather stiff due to the use of thick perforated nickel current collectors. The electrodes described here were also relatively easy to manipulate and cut. These differences may facilitate the formation of cells, where electrodes and separators are typically wound together.

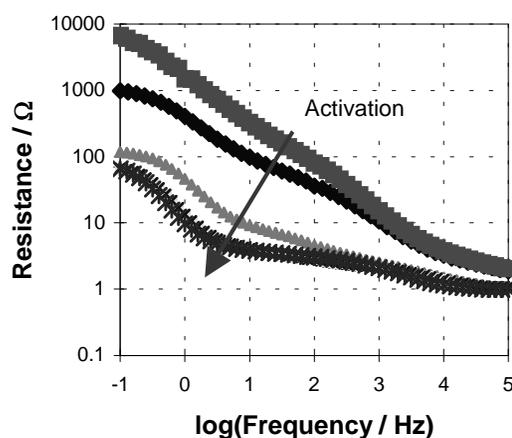


Fig. 1 - change in resistance as a function of lg(frequency) during activation of a metal alloy electrode

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