

## Effects of Prolonged Milling and Carbon Contamination on the Characteristics of MgNi Alloy Used as Negative Electrode in Ni-MH Batteries

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It was recently found that some amorphous Mg-Ni alloys prepared by mechanical alloying can absorb and desorb electrochemically a much larger amount of hydrogen at room temperature than their polycrystalline counterparts. For example, the amorphous MgNi alloy has a maximum discharging capacity around 500 mAh/g (at a current density of 20 mA/g), which is ten times higher than that of the crystalline alloy.

Although many studies have been done about MgNi-based alloys prepared by ball milling, little information is available for the optimization of the ball-milling parameters in order to obtain the best alloy in the shorter milling time.

The purpose of this paper is to optimize the ball milling parameters in order to synthesize an amorphous MgNi alloy having the best first discharging capacity with the shortest ball milling duration. The syntheses were accomplished by varying the type of milling machine (vibrator, attritor and planetary mill), the ball to powder weight ratio and the milling duration. In addition, the influence of the carbon added to the elemental powders was studied. The variation of these parameters allows the structure, the particle morphology and the charge/discharge capacity of the material to be modified.

The optimization of the ball milling parameters resulted in the synthesis with a milling duration equal to 10 hours of amorphous MgNi having an initial discharge capacity over 520 mAh/g. Further milling results in a partial crystallization of amorphous MgNi into nanocrystalline MgNi<sub>2</sub> and Mg<sub>2</sub>Ni, (Fig. 1) which decreases significantly the electrode performance (Fig. 2). In addition, it was demonstrated that the carbon added at the beginning of the milling to avoid powder welding, in spite of its small proportion, has a notable influence on the electrode performance (Fig. 3).

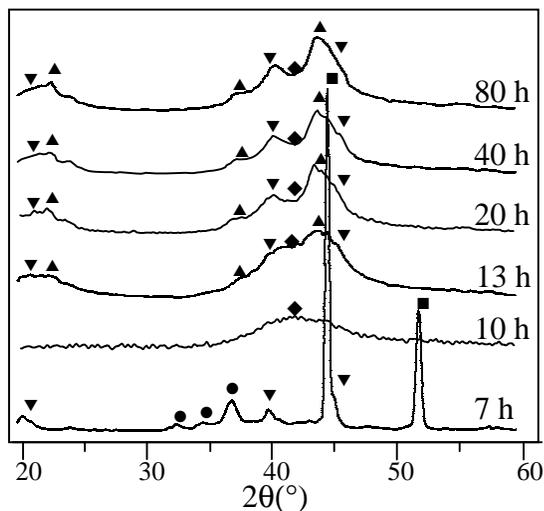


Fig.1. XRD patterns evolution of MgNi (1:1) with milling duration

(Mg: ●, Ni: ■, Mg<sub>2</sub>Ni: ▼, MgNi<sub>2</sub>:▲, a-MgNi: ◆)

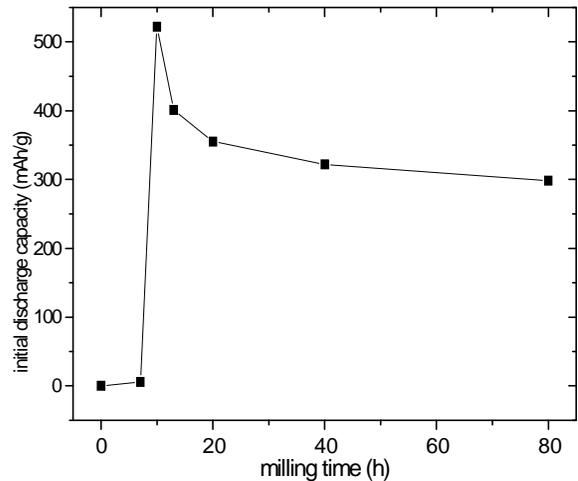


Fig. 2. Initial discharge capacity of MgNi electrode as a function of milling time

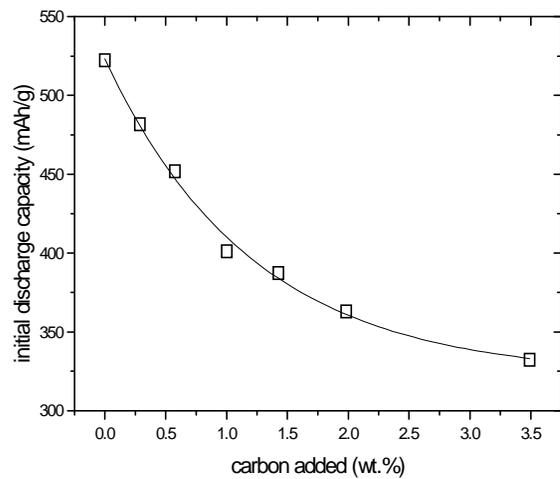


Fig. 3. Initial discharge capacity of MgNi electrode as a function of the carbon added (wt.%) at the beginning of the milling. The milling duration is 10 h.