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MAGNESIUM-BASED HYDROGEN ALLOY ANODES FOR A NICKEL-METAL HYDRIDES SECONDARY BATTERY

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Abstract

In the past decade, a novel secondary battery, nickel-metal hydride (Ni-MH) battery using a hydrogen storage alloy as the negative electrode material have received much attention because of their high energy density, superior charge-discharge characteristics and freedom from poisonous materials. Most recent research in this area is focused on the developing superior negative electrode materials, mainly on rare-earth (misch metal) system and Laves-phase multicomponent hydrogen storage alloys.

Magnesium-based alloys have been used as hydrogen storage alloys since 70s. This type alloys are superior to other hydrogen storage alloys in respect to their high hydrogen storage capacity, light weight and low cost. Nevertheless, magnesium-based hydrogen storage alloys have never been used as electrode materials in a secondary battery since their slow hydriding-dehydriding kinetics and poor corrosion resistance in alkaline aqueous solution.

Extensive work has been carried out in our group to try utilizing magnesium-based hydrogen storage alloys as a low cost and high performance anode materials for Ni-MH battery. It was found that the modified Mg_2Ni alloy anodes were able to be charged-discharged effectively in a KOH aqueous solution at ambient temperature. The discharge capacity and cycle have been substantially improved in four ways: (1) by partial substitution of La, Ti, V, Zr, Ca for Mg and Fe, Co, Cu, Al, Si, Y, Mn for Ni in Mg_2Ni; (2) by composite of Mg_2Ni with another hydrogen storage alloys; (3) by room-temperature surface microencapsulation and, (4) by ultrasound treatment of alloy powders. A discharge capacity of 170 mAh/g has been obtained from the modified Mg_2Ni-type alloy electrode, and the cycle life has exceeded 350 cycles. The high-rate dischargeablity was also significantly improved by the modification. It was concluded that magnesium-based hydrogen storage alloys would become promising anode materials for Ni-MH secondary battery with further improvement of discharge capacity and cycling performance.