ELECTRODE CHARACTERISTICS OF SOME KINDS OF METAL HYDRIDES AND MH-NI BATTERY AT RELATIVELY LOW TEMPERATURE

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INTRODUCTION

The negative electrode material has been much attractive as the most critical material in MH-Ni battery at low temperature. Up to date characteristics of the commercial MH-Ni battery, in which AB_5 ($LaNi_5$) type alloy is used as negative electrode material, is very bad at low temperature. For example, the electrochemical discharge capacity is very low and almost to be zero at -40□, and the middle voltage is reduced to be not determined. It is urgent to find a valuable negative electrode material for MH-Ni battery at relatively low temperature.

RESULTS AND DISCUSION

The investigation on structure and electrode characteristics of metal hydride (Non-$LaNi_5$ type alloy system) and MH-Ni battery has been presented at relatively low temperature. The various kinds of alloy (AB_5 type $MmNi_{3.9}Al_{0.4}Co_{0.3}Mn_{0.15}$, AB_2 type $Zr_{0.9}Ti_{0.1}Ni_{0.1}Mn_{0.7}V_{0.3}B(Mn)_{0.1}$ and $LaNi_{3.8}Al_{0.2}$) have been synthesized by arc melting and the structure as shown in Fig1 and the electrochemical performances have been characterized. The electrochemical capacity of the metal hydride electrode is 285-300 mAh/g at room temperature and more than 200mAh/g at -40□ as shown in table 1 in detail. Using the alloy, $AB_{5□x□3}$ type, as metal hydride electrode, the AA type and D type MH-Ni batteries have been fabricated and the electrochemical properties have been measured. The electrochemical capacities of the AA type and D type MH-Ni battery are 1.3 Ah and 7 Ah at room temperature and more than 0.65Ah and 3.6 Ah at -40 □, respectively.

Table 1 Electrochemical performances of metal hydride electrodes, Id=60 mA/g and cut off at 0.8V

Alloy	$MmNi_{3.9}Al_{0.4}Co_{0.3}Mn_{0.15}$	$Zr_{0.9}Ti_{0.1}Ni_{0.1}Mn_{0.7}V_{0.3}B(Mn)_{0.1}$	$LaNi_{3.8}Al_{0.2}$
Capacity/mAh/g at -30□	270	210(206)	
Capacity/mAh/g at -40□	80		206
Middle voltage/V	1.16(at -30□) 1.09 (at -40□)		1.33(at -40□)

CONCLUSIONS

The performances of Non-stoichiometric alloy and $LaNi_{x□5}$ are better than stoichiometric alloy at low temperature, and The addition of B or Mn element is beneficial to improve the properties of AB_2 type alloy at low temperature.

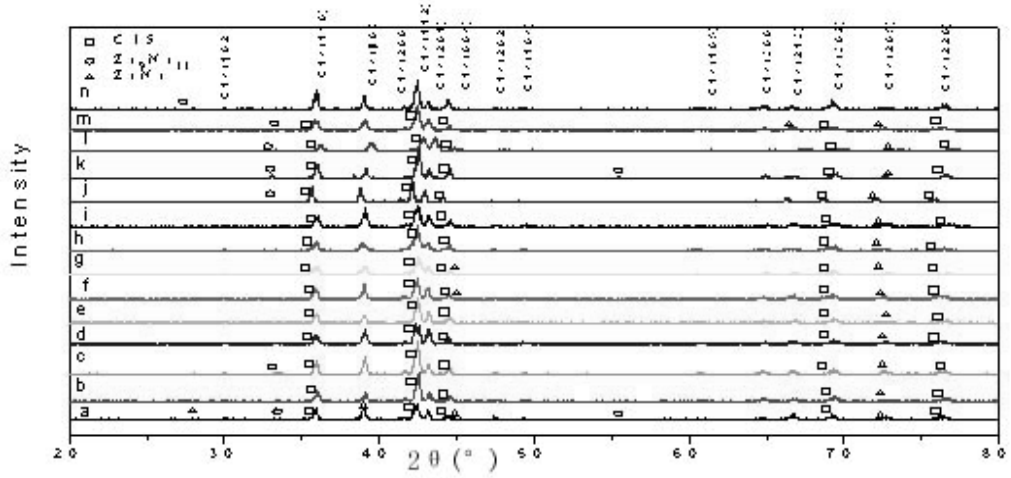

Fig.1 XRD patterns of the $Zr_{0.9}Ti_{0.1}Ni_{1.1}Mn_{0.7}V_{0.3}M_{0.1}$ alloys
(a: M = None; b: M = Ni; c: M = Mn; d: M = V; e: M = Co; f: M = Cr; g: M = Al;
h: M = Fe; i: M = Mo; j: M = Si; k: M = C; l: M = Zn; m: M = Cu; n: M = B

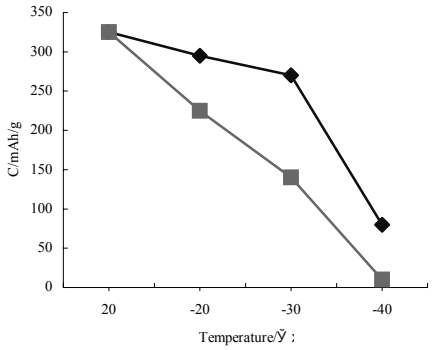

Fig.2 Effect of temperature on discharge capacity
Id = 66.7mA/ g
□---- $MmNi_{3.9}Al_{0.4}Co_{0.3}Mn_{0.15}$ alloy
□---- Commercial AB_5–type alloy

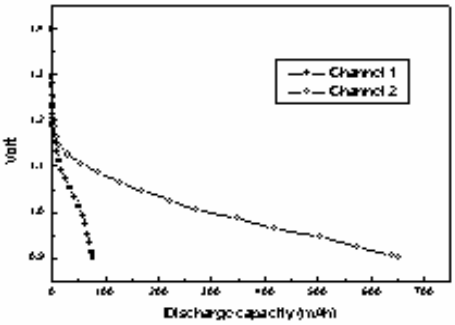

Fig. 4 Discharge characteristic of AA-size cell at -40^{0}C
Channel---1 Negative electrode with AB_5 alloy
Channel--- 2 Negative electrode with sample alloy

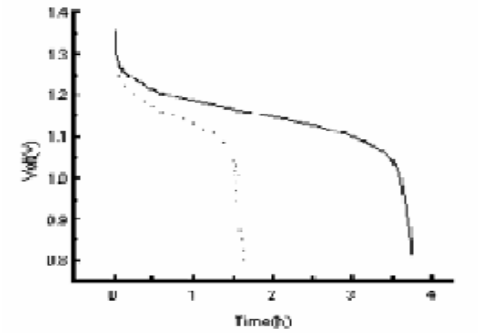

Fig.3 Discharge profile at –30□
Solid line ---- $MmNi_{3.9}Al_{0.4}Co_{0.3}Mn0.15$ alloy
Dotted line ---Commercial AB_5-type alloy