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# Effect of Si addition on the glass forming ability and thermal stability of $Al_{83}Ni_{10}Ce_7$ alloy

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## 1. Introduction

Al-based amorphous alloys including Al-RE(La, Y, Ce)-TM(Fe, Co, Ni) systems have attracted much attention during the past two decades because of their extraordinary high strength combined with a good ductility (He *et al*., 1988; He *et al*., 1988; Inoue *et al*., 1988; Kawamura *et al*., 1993; Cahn, 1989). It was reported that most Al-based amorphous alloys possess a high tensile strength, as much as 1000 MPa, which is about twice as high as that of conventional high-strength aluminum alloys. The glass-forming ability and the thermal stability of amorphous alloy have attracted greater interest than ever. Inoue has proposed three empirical rulers for the achievement of high glass-forming-ability in metallic glasses: (1) multicomponent alloy systems consisting of more than three elements; (2) significant difference in atomic size ratios above 12% among main three constituent elements; and (3) negative heats of mixing among their elements (Inoue, 1997). The thermal stability of many Al-based glass former has been clearly correlated with chemical composition, for example, generally, by increasing rare earth content or transition metal content from low value.

In the current paper, the effect of Si addition on the glass-forming ability and thermal stability of $Al_{83}Ni_{10}Ce_7$ alloy is closely examined by means of different scanning calorimetry (DSC) and the X-ray diffraction (XRD). The microhardness of $Al_{83}Ni_8Ce_7Si_2$ and $Al_{83}Ni_{10}Ce_7$ has been studied using a Vickers microhardness testing.

## 2. Experimental

Ingots of $Al_{83}Ni_8Ce_7Si_2$ and $Al_{83}Ni_{10}Ce_7$ were prepared from the pure elements in an argon atmosphere. Ribbons were produced by a melt-spinning device using a quartz crucible and a copper wheel of 350mm diameter under an argon atmosphere. The amorphous ribbons were~2 mm in width and 30 um in thickness. The amorphous state of the as-quenched ribbons was assessed by XRD (D/max-rB) using Cu Kα radiation. The thermal properties were characterised by using a differential scanning calorimetry (Netzsch DSC404).

## 3. Result and discussion

### *3. 1. Results*

To achieve amorphous structure for $Al_{83}Ni_8Ce_7Si_2$ and $Al_{83}Ni_{10}Ce_7$ alloys, ribbon samples were prepared by melt-spinning. Figure 1 displays the XRD patterns for the melt-spun $Al_{83}Ni_8Ce_7Si_2$ and $Al_{83}Ni_{10}Ce_7$ ribbons at a cooling rate of 36 m/s, revealing the characteristic broad diffraction maxima corresponding to an amorphous phase. Figure 2 shows the XRD patterns for melt spun $Al_{83}Ni_8Ce_7Si_2$ and $Al_{83}Ni_{10}Ce_7$ ribbons at a cooling rate of 27 m/s. For the $Al_{83}Ni_{10}Ce_7$ ribbon, it is a fully amorphous structure; while for the $Al_{83}Ni_8Ce_5Si_2$ ribbon, it

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