Electronic transport and crystallization kinetics of melt-spun Ni33.3Zr66.7 ribbon studied by electrical resistivity measurements

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Abstract

In this paper, rapidly quenched Ni33.3Zr66.7 ribbons were successfully prepared by melt spinning technique. The electrical and thermal transport properties of as-spun Ni33.3Zr66.7 alloys were studied in detail by a combination of electrical resistivity and absolute thermoelectric power measurements over a temperature range from 25 ∘C up to 400 ∘C. The non-crystalline structure of the samples was fully confirmed by X-ray diffraction (XRD) and scanning electron microscope (SEM). Moreover, the crystallization kinetics of Ni33.3Zr66.7 glassy alloy has been investigated during isochronal and isothermal annealing treatments based on the electrical resistivity measurements. The crystallization activation energy, Ex, for a series of electrical resistivity measurements at various heating rates, was calculated in the order of 371.4 kJ/mol and 382.2 kJ/mol by means of Kissinger and Ozawa methods, respectively. The Johnson-Mehl-Avrami (JMA) analysis was applied to the isothermal crystallization kinetics, and the local Avrami exponent has been determined in the range from 2.97 to 3.23 with an average value of n = 3.1, revealing that isothermal crystallization mechanism is diffusion-controlled three-dimensional growth crystallization mechanism, as well as an increasing nucleation rate. In addition, the local activation energy for crystallization, Eα, calculated from the Arrhenius equation decreases at the crystallized volume fraction $0.2 \leq \alpha \leq 0.8$ and giving an average value of 376.2 kJ/mol.

Keywords: Metallic glasses, Electronic transport properties, Thermal stability, Crystallization kinetics, Activation energy

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