

Effect of Si additions in the glass-forming ability of a $\text{Ni}_{57}\text{Nb}_{33}\text{Zr}_5\text{Co}_5$ alloy

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As the global warming is leading to a huge pressure to reduce CO_2 emissions and as the reserves of fossil fuels are running to the exhaustion, the fuel cells seem to offer a solution to this energy problem. They are more efficient and cleaner, hydrogen can be produced by renewable energy and the technology does not require big changes in our way of life. Focusing on the automotive sector, the most promising fuel cells for these applications are the proton exchange membrane fuel cells (PEMFC). The bipolar plates correspond to 60 % of the weight and about 30 % of the cost of a PEMFC and they provide conduits for the gas and fluid flows of reactants and products. Metallic glasses are promising candidates to be used as bipolar plates. They have a high strength and low Young's Modulus, which allows to prepare thin plates with adequate strength. Their processing is also facilitated by their thermoplastic formability, which makes easier the formation of grooves in the plates and their corrosion resistance is also much better than the conventional materials. One metallic glass promising for this application is the $\text{Ni}_{57}\text{Nb}_{33}\text{Zr}_5\text{Co}_5$. In previous work [1], it was observed that this alloy has a limited glass-forming ability (GFA). A strategy to improve the GFA of metallic glasses is the minor addition of some elements, as for example Si to Ni-based metallic glasses [2]. Considering this, the present work aims to investigate the influence of Si additions in the GFA of the $\text{Ni}_{57}\text{Nb}_{33}\text{Zr}_5\text{Co}_5$. Ingots with composition $(\text{Ni}_{0.57}\text{Nb}_{0.33}\text{Zr}_{0.05}\text{Co}_{0.05})_{100-x}\text{Si}_x$ with $x = 0.5, 1, 2$ e 3 % at. were prepared using arc melter and they used to produce edge shape samples and ribbons by suction casting and melt spinning, respectively. Their characterization was carried out using X-ray diffraction (XRD), differential scanning calorimetry (DSC), optical microscopy (MO) and scanning electron microscopy (SEM). The effect of Si additions in the microstructure, phase formation and thermal stability of the $\text{Ni}_{57}\text{Nb}_{33}\text{Zr}_5\text{Co}_5$ will be discussed.

[1] S. Dulnee, C. S. Kiminami, P. Gargarella, M. J. Kaufman, submitted to Materials Research (2016).

[2] W. H. Wang, Progress in Materials Science 52 (2007) 540-596.