

The Effect of Si Content on the Physical Properties of Nanostructured (Ni₇₅Fe₂₅)_{100-x}Si_x Alloy Elaborated by Mechanical Alloying

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Abstract : The present work deals with the effect of Si content on the physical properties of nanostructured (Ni₇₅Fe₂₅)_{100-x}Si_x (x=0, 3.5, 6.5, 9, 12, and 15 at %) powders elaborated by mechanical alloying for a milling time of 96 h. The microstructure, hyperfine, and magnetic properties of the powders were investigated as a function of Si content by means of X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Mössbauer Spectroscopy, and Vibrating Sample magnetometry (VSM). From XRD spectra, the formation of FCC disordered Ni (Fe,Si) solid solution was evidenced after 96 h. As Si content increases, the lattice parameter and the grain size decrease (from ~28 to 15 nm), while the microstrain level decreases from 0.98% to 0.65%. From SEM micrographs, we showed that powder particles become round in shape and decrease in size with increasing Si content. For all Si content, the adjustment of Mössbauer spectra confirmed the formation of a disordered ferromagnetic NiFeSi phase. From hysteresis curves, we have extracted the values of saturation magnetization and coercive field for all powders. The evolution of Ms and Hc as a function of Si content will be discussed.

Keywords : nanostructured powders, (Ni₇₅Fe₂₅)_{100-x}Si_x alloy, microstructure, magnetic properties

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