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Magnetic Characterizations and Structural, Microstructural of Mechanically Alloyed Fe65Si20Cr15 Powders Mixture

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Nanostructured $Fe_{65}Si_{20}Cr_{15}$ (at.%) powders were prepared by mechanical alloying in a planetary ball mill. Morphological, structural and magnetic characterizations of the powders milled several times were investigated by scanning electron microscopy, X-ray diffraction, Mössbauer spectroscopy and vibrating sample magnetometer.

Morphological observations have shown the existence of a broad distribution of size and shape of the powder particle. A decrease in the average particle size is observed during milling process.

A mixture of substitutional bcc Fe(Si) (~ 29 nm) and bcc Cr(Si) (~ 45 nm) is obtained after 3 h of milling. On prolonged milling, all the as-milled powders exhibit non-equilibrium α-Fe(Si,Cr) solid solution with crystallite size of 19-23 nm. The variations of microstructural parameters such as crystallite size, r.m.s. microstrain, static Debye –Waller parameter and dislocation density as a function of milling time show good correlations among them.

Mössbauer spectra of the milled powders, recorded at room temperature, reveal the decrease of the average hyperfine field suggesting a random distribution of atoms during milling and point out the formation of the disordered bcc Fe (Si,Cr) solid solution. Magnetic measurements show the ferromagnetic behavior of the milled powders.

Keywords: Nanostructures; X-ray diffraction; Mössbauer spectroscopy; Magnetic Properties