

Effect of heat treatment on the structural and magnetic properties of the system Fe_{56.25}Al_{43.75} prepared by mechanical alloying

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Resumo

The study of the Fe_{56.25}Al_{43.75} system prepared by Mechanical Alloying (MA), using elementary powders, at different times (12, 24, 48, 72 and 96 hours), named MA0 samples, showed that the alloy is consolidated at 48 hours. Taking the sample for this time it was compacted at 1 ton, encapsulated in an Ar filled quartz tube and a heat treatment at 700°C for 9 days was performed. Then the thermally treated samples, were mechanically alloyed (1, 4, 8, 12, 24 and 48 hours), named MA1 samples. For all samples, a magnetic and structural properties study was conducted by Mössbauer Spectrometry (MS) and X-Ray Diffraction (XRD). XRD results for MA0 samples allow us to consider the system as a nanostructured one who presents a single disordered BCC phase where the lattice parameter is approximately constant (2.900 Å) and a decrease of the crystallite size with increasing milling time was found. For the thermally treated sample XRD results show that they exhibit some degree of ordering. The XRD patterns allow us to identify the following phases, FeAl, Fe₃Al, FeO and α-Fe which tend to disappear with milling time. Additionally an Fe-Al metallurgical phase was proposed. MS results for the MA0 samples a ferromagnetic phase was found. An increase in the mean hyperfine field (MHF) was found resulting from the MA induced structural disorder. From MS of MA1 samples it was found that for times (0, 1, 4, 8 and 12 hours), there is a tendency to ordering and the presence of a doublet with $Q_S = 0.48 \text{ mm s}^{-1}$ and $\Gamma_{\text{exp}} = 0.50 \text{ mm s}^{-1}$, that we associate to the FeAl phase, needs to be included. Likewise for times (24 and 48 hours), we obtained a doublet with $Q_S = 0.95 \text{ mm s}^{-1}$ and $\Gamma_{\text{exp}} = 0.30 \text{ mm s}^{-1}$, associated with the FeO phase (wüstite), maybe due to an oxidation promoted by a leak in the seal of the jars.