

THE EFFECT OF Ti ADDITION ON MICROSTRUCTURE AND MAGNETIC PROPERTIES OF NANOCRYSTALLINE FeAl₄₀ ALLOY POWDERS PREPARED BY MECHANICAL ALLOYING

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Abstract: Recent research on nanocrystalline FeAl alloys has shown that these alloys are of high importance due to their promising structural and mechanical properties, particularly magnetic behavior. This work aims at studying the synthesis, structural and magnetic characterization of nanocrystalline FeAl alloy powders, prepared by a mechanical alloying process (MA), as well as the effect of Ti addition on the magnetic properties of a compound. The powder morphology, phase transformation, crystallite size, micro-stress evolution, and magnetic properties were investigated by X-ray diffraction (XRD), scanning electronic microscopy (SEM), and vibrating samples magnetometer (VSM). It has been found that at the final stage of mechanical alloying the bcc-disordered FeAl phase and nanocrystalline Fe(Al, Ti) solid solution occurred for the FeAl₄₀ and FeAl₄₀Ti₃ alloys, respectively. The milling time and the addition of titanium affect the powder morphology and decrease the size of the particles. The average crystallite size of 17.2 and 11.2 nm was reached at the end of 30 h of milling, and the lattice strain increased up to 0.3 and 0.21% for the FeAl₄₀ and FeAl₄₀Ti₃ alloys, respectively. Also, the magnetic properties attributed to microstructural changes were investigated. It has been established that the change in magnetic behavior occurs mainly due to the formation of a supersaturated Fe(Al, Ti) solid solution. Magnetic properties of the samples are highly influenced by the addition of the Ti element into FeAl₄₀ alloy, as well. The magnetism of the FeAl₄₀Ti₃ compound is reported to be higher than that of FeAl₄₀.

Keywords : Mechanical Alloying, nanocrystalline materials, lattice strain, crystallite size, magnetic behavior.