PHASE TRANSFORMATION OF THE MECHANICALLY ALLOYED Fe-Nb-B POWDER MIXTURE

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Abstract : Iron based amorphous and nanocrystalline alloys exhibiting good soft magnetic properties have attracted researchers due to their applications. Techniques for processing these materials are melt spin and mechanical alloying of pure components both techniques can realize production on industrial scale. The mechanical alloying is a high energy ball milling process it leads to mixing elements at the atomic level. Its application results in metastable structure formation. The aim of this work was to follow the alloying process progresses and, therefore, the induced milling amorphisation of the Fe-8Nb-30B ternary alloy. Elemental Fe, Nb and B powders (99.9% purity) with a composition of Fe-8Nb-30B (wt.%) were mechanically alloyed in a planetary ball mill type Retsch PM400, under argon atmosphere, for several milling times up to 125 h. The thermal stability, structural and microstructural changes during the milling process were followed by differential scanning calorimetry (DSC) and X-ray diffraction (XRD) using the MAUD program based on the Rietveld method combined with a Fourier analysis in order to describe broadened diffraction Bragg peaks. The broad exothermic reaction which is observed in the DSC scans of the nanocrystalline Fe-Nb-B powders mixtures, consists of several exothermic peaks, occurs for all samples and spreads over the entire temperature range of the scan. This behaviour originates from strain and structural relaxations, recovery, grain growth and crystallization of the amorphous phase. XRD patterns of the Fe-8Nb-30B powders mixtures as a function of milling time show a progressive broadening of the as-received powders diffraction peaks due to the refinement of grain size and accumulation of internal strain. The disappearence of the elemental Nb powder peaks, within the first 10 h of milling, leads to the formation of a metastable Nb(B) solid solution. As the milling time increases, the intensity of the Bragg peaks for the obtained solid solution decreases and the diffracted peaks show considerable broadening within the range 2? ? (35°-45°) indicating the formation of the amorphous phase. On further milling time, a diffused haloes appear indicating the formation of an amorphous like phase above 50 h of milling.

Keywords : DRX; Fe-Nb-B alloys; Mechanical Alloying