Evolution of hyperfine parameters in Co-doped FINEMET

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Two-phase Fe-Cu-Nb-Si-B alloys, known as FINEMET [1] exhibit excellent soft magnetic properties attributed to the presence of Fe-Si nanocrystalites, magnetically coupled via the amorphous matrix [2]. The addition of other metals (*e.g.* Cr, Al, Co) modifies magnetic properties of these materials [3-6]. The aim of this work is to analyse the influence of Co admixture on FINEMET microstructure and hyperfine parameters investigated with transmission Mössbauer spectrometry. The systematic alterations of the composition are particularly important considering the complex evolution of magnetic characteristics. The samples of thin amorphous ribbons with composition $(Fe_{1-x}Co_x)_{73.5}Cu_1Nb_3Si_{13.5}B_9$ (x = 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.7, 0.9) were prepared by melt-spinning technique. The nanocrystalline specimens were obtained after heat treatment in a vacuum furnace at temperature 570°C for 1 hour. Mössbauer spectra of the as-quenched alloys were fitted using histogram-like hyperfine field (HF) distribution which was linearly correlated to the isomer shift (IS) one. As a general tendency, in the range $x \leq 0.5$ the increase of HF and IS mean values with Co concentration is observed. For higher Co content the average HF slowly decreases. The complex spectra collected for nanocrystalline samples were fitted with a set of several (up to six) sharp Zeeman sextets, attributed to the nanocrystalline (Fe,Co)-Si phase, and with a broad HF distribution, attributed to the amorphous matrix. For $x < 0.5$ we observed the significant contribution of A4 sextet (with the lowest HF value) characteristic of DO_3 structure. When $x > 0.5$, A4 sextet disappears what could be a sign of bcc (Fe,Co)Si substitutional solid solution. Mean hyperfine field - in general - increases with Co concentration, except for the highest Co content. The derived volumetric fraction of crystalline phase indicates that the admixture of cobalt influences the process of crystallization: for $0.1 \leq x \leq 0.5$ it proceeds slower compare to pure FINEMET, whereas for $x > 0.5$ the crystallization is accelerated.

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