Magnetic behavior and microstructure of Finemet-type ribbons in both, surface and bulk

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Different kinds of magnetic anisotropies were induced during the nanocrystallization process of amorphous ferromagnetic *Finemet*-type ribbons ($Fe_{73.5}Nb_3Si_{13.5}B_9Cu$) using diverse procedures like the application of a constant stress (500 MPa) or an axial magnetic field (750 A/m) during the annealing process. Two different types of samples have been obtained from a change of the chemical composition by partial substitution of Fe atoms respectively by: a) Co ones ($(Co_{77}Si_{13.5}B_{9.5})_{90}Fe_7Nb_3$) and b) Ni ones ($Ni_xFe_{73.5-x}$ $Nb_3Si_{13.5}B_9Cu$) with x = 5, 10, 20. Magnetization measurements of the samples by a fluxmetric method in quasistatic conditions evidence the anisotropy of the treated finemet samples. The main goal of this work has been the structural and microstructural analysis of the treated ribbons by using X-ray Diffraction (XRD) and Atomic Force Microscopy (AFM), detecting substantial differences in the crystallization state and grain size of the samples depending on the treatment that was carried out. Moreover, AFM measurements revealed in all the treated samples a strong nanocrystallisation of the surface without evidences of amorphous matrix, which contrast with Transmission Electron Microscopy measurements that have shown a high content of amorphous material in the bulk of the ribbons in accordance with XRD results. In order to go deeper in this different behavior in the surface and in the bulk, magneto-optical Kerr effect measurements have been performed with the aim to elucidate the complex magnetic behavior that is expected for the surface of the ribbons, measuring surface hysteresis loops that show much higher coercive field values than in the bulk.