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Magneto-impedance effect in nanocrystalline FeSiBCu(Nb,Ti) alloys

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Because of the increasing requirement of sensitive and quick response micro magnetic sensors, Co-based amorphous alloys showing high magneto-impedance (MI) effect have been studied by many researchers. Fe-based nanocrystalline alloys are also a good candidate because of their excellent soft magnetic properties, which originate the nanometric grain size of Fe(Si) phase. The highest permeability and the lowest coercivity can be acquired by a suitable annealing process which leads the growth of grains smaller than the exchange correlation length and the crystallization fraction for a reduced magnetostriction coefficient due to the opposite contribution to this parameter from the Fe(Si) nanocrystals and the amorphous matrix. In Co-based amorphous alloys, the magneto-impedance effect mainly depends on their magnetostriction and anisotropy while that of nanocrystalline alloy varies with both the grain size and the crystallized fraction. In this study, the influence of annealing conditions on the nanocrystalline FeSiBCu(Nb,Ti) alloy has been investigated. Amorphous alloy ribbons with varying contents of titanium in which the sum of the concentrations of Nb and Ti was 3 at% were fabricated by planar flow casting method They were annealed at 500~600°C for 0~1 hour under argon atmosphere with and without magnetic field. The permeability and impedance were measured by using a HP4192A impedance analyzer. The cyclic magnetic field was applied by a Helmholtz coil using a computer attachment. The microstructures were analyzed using X-ray diffractometry (XRD) and transmission electron microscopy (TEM).