Crystallisation progress in Si-rich ultra-soft nanocomposite alloy fabricated by melt spinning

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Abstract: The crystallisation process and the ultras-soft magnetic properties of amorphous/nanocomposite alloy $Fe_{73.5}$ $Si_{17.5}$ B_5 Nb_3 Cu_1 fabricated by conventional melt-spinning technique are systematically investigated in terms of thermal analysis and in-situ measurement of magnetisation dynamics. The thermal analysis using differential scanning calorimetry showed that crystallisation from Fe-based amorphous state to ?-Fe(Si) started at 535 {ring operator} C. Further heating the sample leads to a transformation from the ?-Fe(Si) to Fe-B phases at 670 {ring operator} C. Crystallisation activation energies were determined using two models: Kissinger and John-Mehl-Avrami (JMA), which were consistent to each other with a value of 2.81 ? 0.03 eV. High resolution transmission electron microscopy investigation revealed an ultrafine structure of ?-Fe(Si) nanocrystallite with mean size of 12.5 nm embedded in an amorphous matrix. At a volume fraction of 86% of ?-Fe(Si) phase, optimum soft magnetic properties were obtained with very high permeability of 110,000 and a very low coercivity of 0.015 Oe by annealing the amorphous alloy at 530 {ring operator} C in 40 min. Crown Copyright ?? 2009.

Author Keywords: Amorphous alloys; Finemet; Nanocrystalline materials; Permeability

Index Keywords: Amorphous matrices; Amorphous state; Coercivities; Crystallisation; Finemet; High permeability; In-situ measurement; Kissinger; Magnetisation; Mean size; Melt-spinning techniques; Permeability; Soft magnetic properties; Soft nanocomposites; Thermal analysis; Ultrafine structure; Activation energy; Amorphous silicon; Capillarity; Crystallization; Differential scanning calorimetry; High resolution transmission electron microscopy; Iron alloys; Magnetic properties; Melt spinning; Nanocrystalline alloys; Nanocrystalline materials; Niobium; Silicon; Silicon alloys; Thermoanalysis; Amorphous alloys

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