Crystalline evolution and large coercivity in Dy-doped $(Nd,Dy)_2Fe_{14}B$/α-Fe nanocomposite magnets

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Abstract: Nanocomposite hard magnetic materials $(Nd,Dy)_{4.5}Fe_{77.5}B_{18}$ (No. 1) and $(Nd,Dy)_{4.5}Fe_{76}B_{18}Nb_{1.2}Cu_{0.3}$ (No. 2) have been prepared by crystallizing amorphous ribbons, fabricated by single roll melt-spinning. The evolution of a multiphase structure was monitored by an x-ray diffractometer and by thermomagnetic measurement. We observed that, at annealing temperatures below 670 °C, there is crystallization of soft phase Fe_3B and a small amount of hard phase $Nd_2Fe_{14}B$. At annealing temperatures above 670 °C, crystallization of α-Fe and probably $Dy_2Fe_{14}B$ phases with large magnetocrystalline anisotropy led to a drastic enhancement in the hard magnetic properties of the materials. The maximum value of H_C is found to be 4.2 kOe for sample No. 1. For sample No. 2, with co-doping of Nb and Cu, nanostructure refinement yields a strong enhancement in exchange coupling between the component phases. Thereby, we obtained high reduced-remanence of 0.78, high remanence of 1.15 and a high $(BH)_{max}$ value up to 16.2 MGOe. © 2007 IOP Publishing Ltd.

Index Keywords: Annealing; Coercive force; Doping (additives); Dysprosium; Magnetocrystalline anisotropy; Nanocrystallization; Remanence; X ray diffraction analysis; Multiphase structure; Nanocomposite magnets; Thermomagnetic measurement; Magnets

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