The influence of processing, composition and temperature on the magnetic characteristics of nanophase RE-Fe-B alloys

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The effects of Pr:Nd and RE:Fe (RE=Rare Earth) ratios, Co substitution for Fe and of mean crystallite size dg on the spin reorientation temperature T_{sr} of the 2/14/1 phase have been systematically investigated. Increasing Pr:Nd and Co:Fe ratios and reduction in dg result in reduced T_{sr}, owing to inter-grain exchange coupling, while changes in the RE:Fe ratio (and, thus, in the volume fractions of the 2/14/1 and soft magnetic Fe phases), surprisingly, have no significant effect on T_{sr}. Similarly, for superstoichiometric alloys, introduction of the paramagnetic Nd-rich phase at the 2/14/1 crystallite boundaries, again surprisingly, does not significantly influence T_{sr}.

The elevated temperature magnetic properties of nanocrystalline REFeB alloys have also been studied as functions of Nd:Pr, RE:Fe and Fe:Co ratios and are compared with corresponding microcrystalline alloys. The influence of these factors and of dg on the temperature coefficients of both the remanence Jr and the coercivity iHc will be discussed in the context of optimising the thermal stability with respect to both reversible and irreversible losses. It is shown that nanocomposite alloys have lower coefficients of remanence than single phase and RE-rich counterparts, owing to exchange coupling effects, while Co substitution for Fe has the largest effect in decreasing the coeffiecients for both Jr and iHc. On the other hand increasing Pr:Nd has little effect on either coefficient.