MAGNETIC PROPERTIES OF BULK AMORPHOUS $Nd_{50}Fe_{40}Si_{10-x}Al_x$ ALLOYS

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9.7 cm

Some bulk amorphous alloys of compositions $Nd_{50}Fe_{40}Si_{10-x}Al_x$ (x between 0 and 10 at. %) were investigated with the view to enlarge the supercooled liquid region and to improve their hard magnetic properties. The increase of the Al content leads to the increase of the glass-forming ability and allows to obtain amorphous bars up to 3 mm in diameter by mould casting method. Coercivities up to 315 kA/m and saturation magnetization up to 0.33 T were measured for the $Nd_{50}Fe_{40}Si_{10}$ thick amorphous ribbons prepared by melt-spinning. For amorphous ribbons, independent of their thickness, the substitution of Si by Al does not change the saturation magnetization, but causes a decrease of the coercive force. The saturation magnetization and coercive force have small values for amorphous bars containing less than 5 at % Al and increase for those containing more than 5 at % Al. The diminishing of the hard magnetic properties for the ribbons and bars having more than 150 μm and 3 mm in thickness, respectively, can be explained by the appearance of the crystalline phases. The hard magnetic behavior of all amorphous samples can be improved by applying thermal treatments at temperatures below the crystallization temperature (between 475 K for alloys without Al and 625 K for $Nd_{50}Fe_{40}Al_{10}$). The hard magnetic properties of the $Nd_{50}Fe_{40}Si_{10-x}Al_x$ alloys are related to the existence of the amorphous phase, which contains ferromagnetic nanoclusters coupled by magnetic exchange interactions.

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