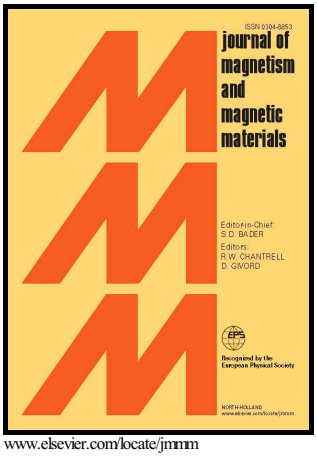

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Micromagnetic Study for Magnetic Properties of Exchange Coupled Nanocomposite Magnetic Systems with $Nd_2Fe_{14}B$ Grains Embedded in α-Fe Matrix

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Abstract: Developing high efficiency rare earth alloy magnets at low cost is an economically hopeful way to expand their application area. In this study, magnetic properties of nanocomposite isotropic exchange coupled systems with the structure of $Nd_2Fe_{14}B$ crystalline grains embedded in α-Fe matrices have been simulated by micromagnetic finite element method (FEM). The results have been analyzed by means of the effect of volume fraction of nanosized exchange coupling area between the magnetically hard $Nd_2Fe_{14}B$ and soft α-Fe phase on magnetic properties of the exchange coupled $Nd_2Fe_{14}B/\alpha$-Fe magnetic systems. The results show that the magnetic systems with the structure of $Nd_2Fe_{14}B$ grains embedded in α-Fe matrices can have comparatively advanced magnetic properties with small amount of $Nd_2Fe_{14}B$ components, because of efficient inter-phase exchange coupling between magnetically hard $Nd_2Fe_{14}B$ grains and soft α-Fe matrix.

Keywords: Permanent magnet, Nanocomposite magnet, Exchange coupling, Micromagnetic simulation, Microstructure, $Nd_2Fe_{14}B/\alpha$-Fe magnets

1. Introduction

Discovery of exchange coupled nanocomposite magnets [1, 2] opened an outlook to develop high efficiency permanent magnets which have good magnetic properties (e.g. high remanence and maximum energy product) with low cost by replacing iron to comparatively expensive $Nd_2Fe_{14}B$ composition. Many researchers have theoretically [3] and experimentally [4-8] studied the magnetic properties and behaviors of exchange coupled nanocomposite magnets including $Nd_2Fe_{14}B/\alpha$-Fe