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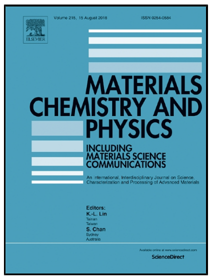

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Adil Murtaza, Sen Yang, Muhammad Tahir Khan, Awais Ghani, Chao Zhou, Xiaoping Song

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Temperature dependent magnetization and coercivity in morphotropic phase boundary involved ferromagnetic $Tb_{1-x}Gd_xFe_2$ system

Adil Murtaza, Sen Yang*, Muhammad Tahir Khan, Awais Ghani, Chao Zhou, and Xiaoping Song

School of Science, MOE Key Laboratory for Nonequilibrium Synthesis and Modulation of Condensed Matter, State Key Laboratory for Mechanical Behaviour of Materials, Xi'an Jiaotong University, Xi'an 710049, China

Abstract

Morphotropic phase boundary (MPB) refers to a transition region separating two ferromagnetic phases having different crystallographic symmetries in a ferromagnetic system. In the present study, magnetization and coercivity of the MPB involved ferromagnetic $Tb_{1-x}Gd_xFe_2$ system have been measured at selected temperatures between 5 and 300 K. The saturation magnetization $\boldsymbol{M_S}$ of the $Tb_{1-x}Gd_xFe_2$ system varies with Gd concentration exhibiting minimum value at MPB composition x=0.9 at all temperatures. Calculated magnetic moments of rare earth (RE) elements are lower than those of their corresponding free ions, which can be attributed to the crystal field effect (CFE). The magnetic anisotropy $\boldsymbol{K}$ decreases with increasing Gd concentration and anisotropy compensation has been observed at an MPB composition with x= 0.9. The coercivity $\boldsymbol{H_C}$ of the $Tb_{1-x}Gd_xFe_2$ system was found to decrease with increasing the Gd concentration. Furthermore, $\boldsymbol{H_C}$ exhibits a large value at low temperature and decays exponentially with increasing temperature. The observed temperature dependence of the $\boldsymbol{H_C}$ can be explained by domain wall pinning, as a high $\boldsymbol{K}$ of rare earth elements (RE) at low temperatures causes a prominent pinning effect at 5 K. Our results shed light on magnetization, magnetic anisotropy and coercivity mechanisms in MPB involved ferromagnetic systems and provides an effective way to design novel functional materials.

Keywords: Morphotropic phase boundary; Crystal field effect; Magnetic anisotropy; Intrinsic coercivity; Domain wall pinning

*Electronic-mail: yang.sen@mail.xjtu.edu.cn