J Supercond Nov Magn (2011) 24: 635–639
DOI 10.1007/s10948-010-0959-6

ORIGINAL PAPER

The Magnetic Properties for Europium-Doped $BiFeO_3$

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Received: 12 September 2010 / Accepted: 14 September 2010 / Published online: 8 October 2010

Abstract The crystallographic and magnetic properties of europium-doped $Bi_{1-x}Eu_xFeO_3$ prepared by a sol-gel method have been studied by X-ray diffraction, superconducting quantum interference device (SQUID) magnetometer, vibrating sample magnetometer (VSM) and Mössbauer spectroscopy. The X-ray diffraction pattern for $Bi_{0.9}Eu_{0.1}FeO_3$ was analyzed by the Rietveld refinement using FULLPROF computer program. The crystals were determined to be a rhombohedrally distorted perovskite-like structure with a space group of $R3c$. SQUID and VSM measurements showed the antiferromagnetic behavior with Néel temperature (T_N) of 638 and 633 K for $x = 0.1$ and 0.2, respectively. A least-squares fitting program was used to determine the Mössbauer parameters by assuming Lorentzian line shapes. The valence state of Fe ion is Fe^{3+} relative to the Fe metal, according to the isomer shift (δ) value = 0.39 mm/s at 4.2 K. In determining the inter-atomic binding force in $Bi_{0.9}Eu_{0.1}FeO_3$, the Debye temperature was 486 and 477 K, respectively.

Keywords Mössbauer spectroscopy · Multiferroic · Perovskite · $BiFeO_3$