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Mössbauer Study of a Polycrystalline Multiferroic Ba-doped $BiFeO_3$ Compound

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We prepared a $Bi_{0.7}Ba_{0.3}FeO_3$ sample by a using rapid two-stage solid state reaction method. The X-ray diffraction measurement showed that the sample had a rhombohedrally-distorted perovskite structure with lattice constants $a_0 = b_0 = 5.579$ Å and $c_0 = 13.749$ Å. The Mössbauer spectra of $Bi_{0.7}Ba_{0.3}FeO_3$ were measured at various absorber temperatures from 4.2 K to the Néel temperature. The Mössbauer spectrum at 4.2 K was fitted with two magnetic components of the magnetic hyperfine fields: $H_{hf} = 549$ kOe for octahedral sites and $H_{hf} = 521$ kOe for oxygen-deficient octahedral sites. The isomer shift values at room temperature were found to be 0.27 and 0.23 mm/s relative to the Fe metal, which are consistent with high-spin Fe^{3+} charge states. The reduced magnetic hyperfine field $H_{hf}(\mathrm{T})/H_{hf}(0)$ as a function of the reduced temperature T/T_N for the octahedral sites of $Bi_{0.7}Ba_{0.3}FeO_3$ followed a Brillouin curve B(S) with S = 5/2. The Fe^{4+} ion was not observed in the Mössbauer spectroscopy measurement. The Néel temperature (T_N) and the Debye temperature were found to be 755 K and 321 K, respectively. The magnetization measurement indicated a ferromagnetic behavior with hysteresis loops at room temperature. The coercivity value (H_c) was 2,612 Oe. The strong coercivity force might result from the magnetic anisotropy.