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Magnetic properties of Ni substituted Y-type barium ferrite

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Y-type barium hexaferrite is attractive material for various applications, such as high frequency antennas and RF devices, because of its interesting magnetic properties. Especially, Ni substituted Y- type hexaferrites have higher magnetic ordering temperature than other Y-type. We have investigated macroscopic and microscopic properties of Y-type barium hexaferrite. $Ba_2Co_{2-x}Ni_xFe_{12}O_{22}$ ($x = 0$, 0.5, 1.0, 1.5, and 2.0) samples are prepared by solid-state reaction method and studied by X-ray diffraction (XRD), vibrating sample magnetometer, and Mössbauer spectroscopy, as well as a network analyzer for high frequency characteristics. The XRD pattern is analyzed by Rietveld refinement method and confirms the hexagonal structure with *R-3m*. The hysteresis curve shows ferrimagnetic behavior. Saturation magnetization (M_s) decreases with Ni contents. Ni^{2+}, which preferentially occupies the octahedral site with up-spin sub-lattice, has smaller spin value S of 1 than Co^{2+} having $S = 3/2$. The zero-field-cooled (ZFC) measurement of $Ba_2Co_{1.5}Ni_{0.5}Fe_{12}O_{22}$ shows that Curie and spin transition temperatures are found to be 718 K and 209 K, respectively. The Curie temperature T_C is increased with Ni contents, while T_S is decreased with Ni. The Mössbauer spectra were measured at various temperatures and fitted by using a least-squares method with six sextet of six Lorentzian lines for Fe sites, corresponding to the $3b_{VI}$, $6c_{IV}$*, $6c_{VI}$, $18h_{VI}$, $6c_{IV}$, and $3a_{IV}$ sites at below T_C. From Mössbauer measurements, we confirmed the spin state of Fe ion to be Fe^{3+} and obtained the isomer shift (δ), magnetic hyperfine field (H_{hf}), and the occupancy ratio of Fe ions at six sub-lattices. The complex permeability and permittivity are measured between 100 MHz and 4 GHz, suggesting that Y-type barium hexaferrite is promising for antenna applications in UHF band. © *2014 AIP Publishing LLC*.
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