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Structure and Magnetic Properties of Ho and Ni Co-doped $BiFeO_3$ Ceramics

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Recently, multiferroic materials gain much attention due to their fascinating fundamental physical properties. These materials offer wide range of potential applications such as data storage, spintronic devices and sensors, where both electronic and magnetic polarizations can be coupled. Among single-phase multiferroic materials, $BiFeO_3$ is typical because of the room-temperature magnetoelectric coupling in view of long-range magnetic- and ferroelectric-ordering temperatures. However, $BiFeO_3$ is well known to have large leakage current and small spontaneous polarization due to the existence of oxygen vacancies and other defects. Furthermore the magnetic moment of pure $BiFeO_3$ is very weak owing to its antiferromagnetic nature. Recently, various attempts have been performed to improve the multiferroic properties of $BiFeO_3$ through the co-doping at the A and the B sites, by making use of the fact that the intrinsic polarization and magnetization are associated with the lone pair of Bi^{3+} ions at the A sites and the partially-filled 3d orbitals of Fe^{3+} ions at the B sites, respectively. In this study, $BiFeO_3$, $Bi_{0.9}Ho_{0.1}FeO_3$, $BiFe_{0.97}Ni_{0.03}O_3$ and $Bi_{0.9}Ho_{0.1}Fe_{0.97}Ni_{0.03}O_3$ bulk compounds were prepared by solid-state reaction and rapid sintering. High-purity Bi_2O_3, Ho_2O_3, Fe_2O_3 and NiO_2 powders with the stoichiometric proportions were mixed, and calcined at 500°C for 24 h to produce the samples. The samples were immediately put into an oven, which was heated up to 800°C and sintered in air for 1 h. The crystalline structure of samples was investigated at room temperature by using a Rigaku Miniflex powder diffractometer. The field-dependent and temperature-dependent magnetization measurements were performed with a vibrating-sample magnetometer and superconducting quantum-interference device.

Keywords: Multiferroic, Doped $BiFeO_3$, Magnetic properties, Ferroelectric properties