

Investigation of site preference of Zn doped $\text{Ba}_3\text{Co}_{2-x}\text{Zn}_x\text{Fe}_{24}\text{O}_{41}$ by Mössbauer spectroscopy

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The polycrystalline $\text{Ba}_3\text{Co}_{2-x}\text{Zn}_x\text{Fe}_{24}\text{O}_{41}$ ($x=0.0, 0.5, 1.0$) samples were prepared by using solid-state-reaction method. The crystal structures and magnetic properties of samples were investigated with x-ray diffractometer, vibrating sample magnetometer, and Mössbauer spectroscopy. The crystal structure of $\text{Ba}_3\text{Co}_{2-x}\text{Zn}_x\text{Fe}_{24}\text{O}_{41}$ ($x=0.0, 0.5, 1.0$) samples was determined to be a hexagonal structure with $P6_3/mmc$ space group at 295 K, and the saturation magnetization (M_s) of $\text{Ba}_3\text{Co}_{2-x}\text{Zn}_x\text{Fe}_{24}\text{O}_{41}$ ($x=0.0, 0.5, 1.0$) samples were found to be $M_s = 50.9, 53.1, 55.0$ emu/g, respectively. From the temperature dependence of magnetization curves under 100 Oe between 4.2 and 740 K, we were able to observe the spin transition, and both spin transition temperature (T_s) and Curie temperature (T_C) decrease with increasing Zn concentration. Mössbauer spectra of all samples were obtained and analyzed at various temperatures ranging from 4.2 to 295 K. With ten-sextets for Fe sites corresponding to the Z-type hexagonal crystallographic sites, all spectra below T_C were fitted by least-square method. In addition, from the site occupation numbers of Fe, calculated from the relative areas fitted to the Mössbauer spectra, we find that Zn ions preferentially occupy the tetrahedral sublattices of down sites. © 2014 AIP Publishing LLC. [<http://dx.doi.org/10.1063/1.4861676>]