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Structural, Magnetic, and Magneto-Caloric Properties of Cu-Substituted $\text{Nd}_{0.67}\text{Ba}_{0.33}\text{MnO}_3$ Manganites

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The crystal structure and magnetic properties of polycrystalline $\text{Nd}_{0.67}\text{Ba}_{0.33}\text{Mn}_{1-x}\text{Cu}_x\text{O}_3$ ($x = 0.00, 0.02, 0.04, 0.06, 0.08, \text{ and } 0.10$) manganites are discussed. All the samples are crystallized into an orthorhombic crystal structure with Imma symmetry space group and the obtained lattice parameters confirm the presence of a co-operative Jahn-Teller effect for all the studied compounds. X-ray photoelectron spectra suggest the ratio of $\text{Mn}^{3+}/\text{Mn}^{4+}$ ions are observed to be decreasing systematically with the increase of Cu-content substitution and affects the Cu-ions oxidations states. The ferromagnetic (FM) to paramagnetic (PM) transition and magnetic moment is found to decrease systematically with the increase of Cu-content substitution leading to the suppression of double-exchange interactions. The theoretical and experimentally observed values of effective PM moment and saturation magnetic moment confirm the presence of inhomogeneous magnetic states containing FM and antiferromagnetic phases in all the samples. A magnetic phase change, i. e., from second-order transition to first-order transition is witnessed in between the 4 to 6 at.% of the Cu substitution in $\text{Nd}_{0.67}\text{Ba}_{0.33}\text{MnO}_3$ mixed-valence manganite.

Keywords: mixed-valence manganites, magnetic properties, X-ray photoelectron spectroscopy, magneto-caloric effect, Nd-based manganites, Jahn-Teller effect.