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Influence of Cation Substitution on Magnetic Transitions and Ordering in La2NixCo1-xMnO6 Compounds (x = 0.2 - 0.8)

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Abstract : This study explores the structural and magnetic characteristics of newly synthesized double perovskite oxides, $La_2Ni_xCo1\text{-}xMnO_6$, with x ranging from 0.2 to 0.8. Utilizing X-ray powder diffraction and SQUID magnetometry, we analyzed the compounds that consistently exhibit a monoclinic structure with the P21/n space group at ambient temperature. it findings reveal that as Ni2+ is progressively substituted by Co2+, there is a corresponding decrease in cell parameters, attributable to the smaller ionic radius of Ni2+ (0.69 Å) compared to Co2+ (0.74 Å). The crystal structure features octahedrally coordinated (Co/Ni)2+ and Mn4+ cations with oxygen, forming (Co/Ni)O6 and MnO6 octahedra linked via oxygen atoms along different crystallographic axes. Magnetic characterization conducted over a temperature range of 2 to 300 K in both DC and AC magnetic fields, showed a predominant paramagnetic to ferromagnetic transition between 232 K and 260 K, with the Curie temperature notably increasing with higher x values. Samples with x=0.2, 0.25, and 0.5 exhibited a secondary PM-FM transition between 200 K and 208 K. Cation ordering was quantitatively assessed, indicating a higher ordering in Ni2+-rich samples (x=0.75 and 0.8) at over 96%, whereas the sample with x=0.25 showed minimal ordering. Furthermore, the out-of-phase component of the AC susceptibility displayed frequency-dependent transitions between 65 K and 110 K, suggesting the presence of superparamagnetic domains across all samples.

Keywords : double perovskite oxides, magnetic transitions, cation ordering, squid magnetometry
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