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Magnetic properties and Mössbauer studies of $Gd_{1-x}Sr_xFeO_{3-y}$ ($x = 0.25$, 0.75)

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Abstract

Perovskite $Gd_{1-x}Sr_xFeO_{3-y}$ ($x = 0.25$ and 0.75) powders have been studied by X-ray diffraction, Mohr's salt analysis, vibrating sample magnetometer, and Mössbauer spectroscopy. X-ray diffraction patterns show that their crystal structures are orthorhombic for $x = 0.25$ and cubic for $x = 0.75$. ^{57}Fe Mössbauer spectra of the $Gd_{1-x}Sr_xFeO_{3-y}$ have been taken at various temperatures ranging from 4.2 to 850 K. It is found that Néel temperatures for $x = 0.25$ and 0.75 are 685 and 270 K, respectively. Mössbauer spectra of $Gd_{0.75}Sr_{0.25}FeO_{3-y}$ powders have been taken at various temperatures ranging from 13 to 620 K. The Néel temperature decreases with the increase of the Sr concentration, which suggests that the superexchange interaction for Gd–Fe–O–Fe is stronger than that for Sr-Fe-O-Fe. Mössbauer spectrum at 13 K consists of magnetic sextet components arising from different charge states of iron ions. In the orthorhombic phases ($x = 0.25$), the charge states coexist Fe^{3+} and Fe^{4+}(high spin) and the charge states coexist Fe^{3+} and Fe^{4+}(low and high spin) in the cubic phases ($x = 0.75$). Magnetic susceptibility measurements by using a vibrating sample magnetometer show that $Gd_{1-x}Sr_xFeO_{3-y}$ behavior is weak-ferromagnetic due to canted spin for $x = 0.75$ and antiferromagnet for $x = 0.25$.

Keywords: Mössbauer spectroscopy; Mohr's salt; Superexchange interaction; Weak-ferromagnetic