Neutron Diffraction and Mössbauer Studies of the $La_{0.67}Ba_{0.33}Mn_{0.99}{}^{57}Fe_{0.01}O_3$

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***Abstract*—The perovskite $La_{0.67}Ba_{0.33}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ compound was prepared by wet chemical solution process at 1200 °C for 3 h. Magnetic properties of $La_{0.67}Ba_{0.33}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ were studied using X-ray diffraction, Rutherford backscattering spectroscopy (RBS), neutron diffraction, Mössbauer spectroscopy, vibrating sample magnetometry, and magnetoresistance measurements. The polycrystalline $La_{0.67}Ba_{0.33}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ had a space group *Pnma* of orthorhombic perovskite structure with lattice constants $a_0 = 5.526$ Å, $b_0 = 7.830$ Å, and $c_0 = 5.540$ Å, respectively. A chemical composition was confirmed to be stoichiometric by RBS. The maximum magnetoresistance ratio $(\Delta\rho/\rho(0))$ was observed at 281 K, with a magnitude of 9.5% in 1 Tesla. The Curie temperature (T_C) was determined to be 345 K. Mössbauer spectra of $La_{0.67}Ba_{0.33}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ were taken at various temperatures ranging from 15 to 400 K. Below 77 K, two magnetic phases were increased and showed two sharp sextets of spectra. The magnetic hyperfine fields of outer (51%) and inner (49%) subspectrum were $H_{hf} = 530$ and 480 kOe, respectively. These unusual phenomena provide direct evidence of the two-magnetic phase character of the metallic state in the mixed valence of $La_{0.67}Ba_{0.33}Mn_{0.99}{}^{57}Fe_{0.01}O_3$ powder. The outer sextet of Mössbauer spectra rapidly collapsed to paramagnetic phase with increasing temperature.**

***Index Terms*—Colossal magnetoresistance, Mössbauer spectroscopy, neutron diffraction.**