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MÖSSBAUER STUDIES OF La-Ca-Mn-Fe-O COMPOUNDS

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ABSTRACT

Magnetic and structural properties of $La_{0.67}Ca_{0.33}Mn_{1-x}Fe_xO_3$ ($x = 0.0 \div 0.05$) powders have been studied with Mössbauer spectroscopy, vibrating sample magnetometer (VSM), and X-ray diffraction. A single phase of the polycrystalline perovskite powder has been prepared using the metal-salt routed sol-gel method. The results of X-ray measurements show that there was no appreciable change in the value of the lattice parameter when a small amount of iron was added. However, the results of Mössbauer and VSM measurements demonstrate that the Curie temperature of the perovskite powder ($x = 0.05$) has decreased from 282 K to 180 K and that the large decrease of the saturation magnetization from 84 emu/g to 40 emu/g at 77 K has been observed as $^{57}Fe(x = 0.05)$ was introduced into the compound. Mössbauer spectra of $La_{0.67}Ca_{0.33}Mn_{0.95}Fe_{0.05}O_3$ powders have been taken at various temperatures ranging from 4.2 K to room temperature. It is observed that the patterns of the spectra were changed from a doublet line to a 6-line as the temperature decreased. Four experimental magnetic hyperfine fields at 4.2 K are found to be 465, 514, 489, and 417 kOe and isomer shifts at 4.2 K are 0.37, 0.38, 0.35, and 0.29 mm/s. These isomer shifts indicate that the valence state of Fe ions is ferric (Fe^{+3}), which are relative to α-Fe at room temperature. It should be noted that superparamagnetic relaxation begins at 37 K.