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Crystallographic and Magnetic Properties of α–$LiFeO_2$

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Lithium iron oxides such as $LiFeO_2$ and $LiFe_5O_8$ are increasing scientific interest and are also promising candidates for cathode materials in rechargeable lithium batteries as well as low-cost substitutes to garnet materials ($Y_3Fe_5O_{12}$) in microwave frequency applications[1, 2]. α–$LiFeO_2$ powders were prepared by the sol‐gel method and studied using Mössbauer spectroscopy, X-ray diffraction, differential thermal analysis (DTA) and vibrating sample magnetometry(VSM). α–$LiFeO_2$ powders that were annealed at and above 600 ^oC have a single-phase. The crystal structure of the α–$LiFeO_2$ at room temperature, was determined to be cubic of *Fm3m* space group with its lattice constant a = 4.1610 ± 0.0005. Å. The Bragg factor R_B and R_F were 5.56 % and 3.79 %, respectively. Mössbauer spectra of the α–$LiFeO_2$ were taken at various absorber temperatures from 4.2 to 295 K. The Néel temperature of α–$LiFeO_2$ is found to T_N = 90 ± 2 K. The spectra for the samples at 4.2 K exhibit a general sextet shape indicating ferromagnetic behaviors. The spectrum was fitted using the two magnetic components of hyperfine fields H_{hf} = 506 and 478 kOe, isomer shifts δ = 0.37 and 0.36 mm/s corresponding to Fe^{3+} ions, with nearly null quadrupole splitting in accord with the cubic crystal structure of α–$LiFeO_2$. Room temperature Mössbauer spectra of ^{57}Fe for α–$LiFeO_2$ powders are shown paramagnetic behavior as demonstrated by the single quadrupole doublet with zero hyperfine fields. The hyperfine parameters for the sample are isomer shift δ = 0.24 mm/s and quadrupole splitting E_Q = 0.61 mm/s, respectively. The average magnetic hyperfine field, $[H_{hf}(T) - H_{hf}(0)] / H_{hf}(0)$, as a function of temperature. The average magnetic hyperfine field decreases with increasing temperature according to $[H_{hf}(T) - H_{hf}(0)] / H_{hf}(0) = -0.36(T/T_C)^{3/2} - 0.27(T/T_C)^{5/2}$ for $T/T_C < 0.7$, indicative of spin-wave excitation. The Debye temperatures of α–$LiFeO_2$ is Θ=253 ±5 K. The calculated Curie-Weiss temperature (θ_P) value was 160±5 K for α–$LiFeO_2$. Their negative θ_P value is consistent with the antiferromagnetic behavior below room temperature.

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Magnetization Processes of $(La_{0.7}Pb_{0.3}MnO_3)_{1-x}(SiO_2)_x$ Composites

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The diluted magnetic properties and magnetoresistance have been observed through the composites of $La_{1-x}Sr_xMnO_3/CeO_2$, $La_{1-x}Ca_xMnO_3/SrTiO_3$, La1-xPbxMnO3/$Fe_2O_3$, and $La_{1-x}Pb_xMnO_3$/Ag [1-3]. Magnetic and transport properties of $(La_{0.7}Pb_{0.3}MnO_3)_{1-x}(SiO_2)_x$ composites are explored in this study. Ferromagnetism is gradually attenuated due to the magnetic dilution induced by the increase of SiO_2 content. Clearly irreversible behavior is observed in the zero-field cooling and field cooling curves at a low field of 100 Oe. Saturation magnetization decreases as x increases, while ferromagnetic transition temperature remains around 346K for all composites. All of the composites exhibited ferromagnetic hysteresis behavior which can be modeled by the law of approach to saturation in the form M = MS(1−α/Hn) where $0 \leqq n \leqq 1$ [3]. The term α/H^n expresses the deviation of magnetization from saturation. The larger factor n and smaller factor a for $La_{0.7}Pb_{0.3}MnO_3$-rich samples resulting in sharper square curves which should be associated with the long-range spin order of ferromagnetic coupling.

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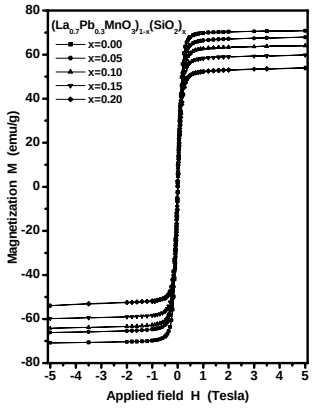

Fig. 1. Magnetic hysteresis curves of all composites.

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