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### The Study of Magnetic Properties in Lithium-iron Phosphate

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Since the magnetoelectric (ME) effect was observed in Lithium-orthophosphates  $\text{LiMPO}_4$  ( $M=\text{Fe}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ), have been extensively investigated for information storage and electronic, magnetic and optical switches [1]-[3]. The polycrystalline sample of  $\text{LiFePO}_4$  and  $\text{LiFe}_{0.8}\text{Co}_{0.2}\text{PO}_4$  was made by using a direct reaction. X-ray diffraction pattern for  $\text{LiFePO}_4$  and  $\text{LiFe}_{0.8}\text{Co}_{0.2}\text{PO}_4$  showed a pure olivine single phase. The crystal structure of  $\text{LiFePO}_4$  and  $\text{LiFe}_{0.8}\text{Co}_{0.2}\text{PO}_4$  was determined to be an orthorhombic with space group  $Pnma$ . The determined lattice constants  $a_0$ ,  $b_0$ , and  $c_0$  are 10.241 and 10.397 Å, 5.924 and 6.002 Å, and 4.698 and 4.700 Å, respectively. The Mössbauer spectrum shows a large asymmetric and distorted line broadening at 4.2 K. The magnetic hyperfine field ( $H_{\text{hf}}$ ) and the quadrupole splitting ( $\Delta E_Q$ ) were 135 and 129 kOe, 2.61 and 2.61 mm/s, respectively. The charge states of Fe ions are Ferrous ( $\text{Fe}^{2+}$ ) in character by isomer shift; 1.25 and 1.24 mm/s at 4.2 K.

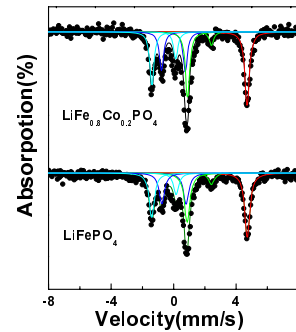


Fig. 1. Mössbauer spectra of  $\text{LiFePO}_4$  and  $\text{LiFe}_{0.8}\text{Co}_{0.2}\text{PO}_4$  at 4.2 K.

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### Magnetic Properties of Fe-doped $\text{La}_{0.5}\text{Sr}_{0.5}\text{TiO}_3$ Nanoparticles

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Dilute magnetic oxides have been intensively researched in recent years. It has been reported that the wide band gap materials  $\text{ZnO}$ ,  $\text{TiO}_2$  and  $\text{SnO}_2$  exhibit ferromagnetism with a Curie temperature above room temperature when the oxide doped only a few atomic percent of 3d transition metals [1-6]. In this paper, we report on the effects of percent dopant and calcination temperature in the nanoparticles of Fe-doped  $\text{La}_{0.5}\text{Sr}_{0.5}\text{TiO}_{3-\delta}$  ( $\text{La}_{0.5}\text{Sr}_{0.5}\text{Ti}_{1-x}\text{Fe}_x\text{O}_{3-\delta}$ ,  $0 \leq x \leq 0.02$ ) synthesized by a polymerized complex method [7-9]. The structure, elemental composition, morphology and particle size of the synthesized nanoparticles were investigated by XRD, EDS, FESEM and TEM. The magnetic properties of the nanoparticles were characterized by vibrating sample magnetometry (VSM) superconducting quantum interference magnetometer (SQUID). The undoped samples show a diamagnetic behavior, whereas all the Fe-doped samples are ferromagnetic at room temperature having the magnetic moment of  $-0.003$ - $0.101 \text{ Am}^2 \text{ kg}^{-1}$  ( $0.022$ - $0.252 \mu_B/\text{Fe}$ ) at 10 kOe.

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