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Synthesis and magnetic properties of $LiFePO_4$ substitution magnesium

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ABSTRACT

$LiFe_{0.9}Mg_{0.1}PO_4$ sample was prepared by using a solid–state reaction method, and the temperature-dependent magnetic properties of the sample were studied. The X-ray diffraction (XRD) pattern showed an olivine-type orthorhombic structure with space group *Pnma* based on Rietveld refinement method. The effect of Mg substitution in antiferromagnetic $LiFe_{0.9}Mg_{0.1}PO_4$ was investigated using a vibrating sample magnetometer (VSM) and Mössbauer spectroscopy. The temperature-dependence of the magnetization curves of $LiFe_{0.9}Mg_{0.1}PO_4$ shows abnormal antiferromagnetic behavior with ordering temperature. Sudden changes in both the magnetic hyperfine field (H_{hf}) and its slope below 15 K suggest that magnetic phase transition associated to the abrupt occurrence of spin-reorientation. The Néel temperature (T_N) and spin-reorientation temperature (T_S) of $LiFe_{0.9}Mg_{0.1}PO_4$ are lower than those of pure $LiFePO_4$ (T_N = 51 K, T_S = 23 K). This is due to the Fe–O–Fe superexchange interaction being larger than that of the Fe–O–Mg link. Also, we have confirmed a change in the electric quadrupole splitting (ΔE_Q) by the spin-orbit coupling effect and the shape of Mössbauer spectrum has provided the evidence for T_S and a strong crystalline field. We have found that Mg ions in $LiFe_{0.9}Mg_{0.1}PO_4$ induce an asymmetric charge density due to the presence of Mg^{2+} ions at the FeO_6 octahedral sites.