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Investigation of spin-orientation in antiferromagnetic ordering for $LiFe_{1-x}Zn_xPO_4$ with Mössbauer spectroscopy

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We have investigated the spin orientation in antiferromagnetic polycrystalline $LiFe_{1-x}Zn_xPO_4$ using Mössbauer spectroscopy. The temperature-dependent magnetic susceptibility curves show antiferromagnetic behavior with ordering temperature. The experimentally determined effective moment of $LiFe_{1-x}Zn_xPO_4$ is larger than the theoretical value, which can be explained as incomplete absence of orbital contribution by the crystalline field around distorted octahedra. The value of the Néel temperature (T_N) and the spin reorientation temperature (T_S) of $LiFe_{1-x}Zn_xPO_4$ decreased with the increasing Zn concentrations from 48 and 14 K for x = 0.1 to 36 and 8 K for x = 0.5, resulting in weak antiferromagnetic interaction. Below T_N, Mössbauer spectra of $LiFe_{1-x}Zn_xPO_4$ showed asymmetric eight-line shape due to the strong crystalline field in the distorted octahedral structure. A change in both the magnetic hyperfine field and electric quadrupole splitting below T_S suggests that magnetic phase transition is related to the spin rotation and the superexchange interaction.
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