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Spin ordering between sub-lattices in nasicon $Li_3Fe_2(PO_4)_3$ measured by Mössbauer spectroscopy

Hee Seung Kim and Chul Sung Kim[a)]
Department of Physics, Kookmin University, Seoul 136-702, South Korea

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The chemical stability and conductivity of nasicon-structured α-$Li_3Fe_2(PO_4)_3$ make it a possible candidate for a cathode material in Li-battery. The x-ray diffraction pattern of $Li_3Fe_2(PO_4)_3$ showed the monoclinic structure with space group of $P2_1/n$. In the zero-field-cooled (ZFC) curve, the magnetization remained constant while the temperature was increased up to the splitting temperature ($T_S = 11$ K) of two sub-lattices, indicating the antiferromagnetic behavior below T_S. Magnetization curves of both ZFC and FC from 4.2 to 295 K showed ferrimagnetic behavior below the Néel temperature ($T_N = 29.5$ K). We observed the change in the slope of the temperature-dependent H_{hf} curve at T_S. These results suggest that the change in the spin ordering in $Li_3Fe_2(PO_4)_3$ is originated from the difference in hyperfine interactions between the localized Fe^{3+} magnetic ions at each of two sub-lattices. The spectra of $Li_3Fe_2(PO_4)_3$ under applied magnetic field of 5 T exhibit the magnetic phase transition around T_S, indicating antiferromagnetic behavior below T_S and ferrimagnetic behavior between T_S and T_N. [http://dx.doi.org/10.1063/1.4794188]