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Mössbauer spectroscopic study of synthetic leucophosphite, $KFe_2(PO_4)_2(OH)\cdot 2H_2O$

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Abstract

A Mössbauer study of synthetic leucophosphite, $KFe_2(PO_4)_2(OH)\cdot 2H_2O$ is reported. The sample was prepared by the reaction of synthetic goethite (α-FeOOH) with a K-phosphate solution of pH 2 at 373 K for 20 days. The obtained cell parameters are $a = 9.771(1)$, $b = 9.675(2)$, $c = 9.747(2)$ Å, $\beta = 102.45(1)°$. The Mössbauer spectra from 295 K down to 40 K show the existence of two Fe^{3+} doublets with $\Delta E_{Q1} \approx 0.62$ mm/s and $\Delta E_{Q2} \approx 0.91$ mm/s (at 80 K), respectively, whereas for lower temperatures the spectra are composed of two sextets with $H_{hf1} \approx 48.3$ T and $H_{hf2} \approx 48.8$ T at 4.2 K. The magnetic transition temperature was determined to be 36 K from a Mössbauer thermoscan experiment. The magnetic ordering is presumed to be antiferromagnetic. The temperature variations of the hyperfine fields cannot be explained by the simple molecular field approximation. Using a model that takes into account the exchange magnetostriction associated to a non-second-order transition, an excellent reproduction of the $H_{hf}(T)$ curves was obtained.

Keywords: Leucophosphite, Mössbauer spectroscopy, magnetic ordering