The effect of nonmagnetic ion substitution for the $FeCr_{2-x}M_xS_4$ (M=Ga,In) by Mössbauer spectroscopy

Bae Soon Son and Sam Jin Kim
Department of Physics, Kookmin University, Seoul 136-702, Korea

Koan Sik Joo
Department of Physics, Myongji University, Yongin, Kyungki 449-728, Korea

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

(Presented on 1 November 2005; published online 3 May 2006)

The Mössbauer spectroscopy has been studied for the sulphur spinel $FeCr_{2-x}M_xS_4$ (M=Ga,In) at various temperatures, from 4.2 K to room temperature. The spectra consist of two doublets at room temperature, which show that the Ga and In ions are partially occupied to the tetrahedral (A) site. It is found that the Ga and In ions stimulate the asymmetric charge distribution of Fe ions in the A site. The electric quadrupole splittings (ΔE_Q) of the A and B sites in the Mössbauer spectra of $FeCr_{2-x}Ga_xS_4$ (x=0.3) are 0.83 and 2.94 mm/s, respectively, while those for the $FeCr_{2-x}In_xS_4$ (x=0.3) are 0.54 and 1.54 mm/s, respectively. The ΔE_Q for the Ga doped samples are larger than that for the In doped samples, in spite of the larger ionic radius for In ions. We suggest that stronger covalence associated with the smaller bond length includes a large asymmetric charge distribution.
 [DOI: 10.1063/1.2177425]