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# The Site Dependence on Exchange Interaction of the Fe Spinel

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The Fe spinel $FeCr_2S_4$ and $FeIn_2S_4$ were studied on the site dependence microscopic interaction. $FeCr_2S_4$ exhibits cubic spinel structure of $Fd3m$, with Fe atoms occupying $A$ site and Cr atoms occupying octahedral ($B$) site, whereas $FeIn_2S_4$ shows an inverse spinel, with In atoms occupying both tetrahedral ($A$) and octahedral ($B$) sites. The determined lattice constants, for $FeCr_2S_4$ and $FeIn_2S_4$, were $a_0$ = 9.976, 10.618 Å, respectively. The Néel temperatures ($T_N$) were found to be 175 and 15 K for the $FeCr_2S_4$ and $FeIn_2S_4$, respectively, by Mössbauer spectroscopy and magnetization measurement. It can be understood that the strength of inter-sublattice exchange interaction $Fe^{2+}(A)$-$S^{2-}$-$Cr^{3+}(B)$ is stronger than that of the intra-sublattice exchange interaction $Fe^{2+}(B)$-$S^{2-}$-$Fe^{2+}(B)$. The $FeCr_2S_4$ shows a single line resonance spectrum with an isomer shift of 0.56 mm/s at room temperature, while $FeIn_2S_4$ has an isomer shift of 0.74 mm/s and an electric quadrupole splitting ($\Delta E_Q$) of 3.22 mm/s. The charge state of Fe ions is in ferrous ($Fe^{2+}$) for the both samples. We interpret that the presence of the large $\Delta E_Q$ is attributed to the trigonal field at the octahedral site, due to $Fe^{2+}$ ions occupying to octahedral $B$ site.

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