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PROGRAM AND ABSTRACTS

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MAGNETIC AND ELECTRON TRANSPORT PROPERTIES IN SULPHUR SPINEL

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The magnetic properties and magnetoresistance of $\text{Fe}_{1-x}\text{Cr}_2\text{S}_4$ ($x=0.0, 0.04, 0.08$) and $\text{Fe}_{1-x}\text{M}_x\text{Cr}_2\text{S}_4$ ($\text{M}=\text{Cu}, \text{Co}$) have been studied by x-ray diffraction, Mössbauer spectroscopy, x-ray photoelectron spectroscopy (XPS), Rutherford back scattering (RBS), SQUID magnetometer, and magnetoresistance (MR). The samples were synthesized by the usual ceramic method and the crystal structure was examined by powder x-ray diffraction. According to the magnetoresistance measurements of the $\text{Fe}_{1-x}\text{Cr}_2\text{S}_4$ ($x=0.0, 0.04, 0.08$), these systems exhibit semiconducting behavior in region below the 140 K and metal insulator transitions occur around the Curie temperature. As increasing Fe deficiency the Curie temperature decreased slightly but the maximum magnetoresistance temperature increased gradually. The separations of the temperatures between the maximum MR (metal-insulator transition) and the Curie temperature are increased gradually. When the Fe ions are replaced with the Co as much 10 % relative to the iron metal, the Curie temperature was 178 K and the maximum MR ratio was 8 % at 192 K. Mössbauer spectra were recorded from 4.2 K to room temperature. Below the Curie temperature the asymmetric line broadening is observed and considered to be dynamic Jahn-Teller distortion. Isomer shift value of the sample $x=0.04$ at room temperature was 0.56 mm/s, which means that charge state of Fe ions is ferrous in character. Ferrous character of irons was also manifested by XPS spectrum. In the XPS spectrum of $x=0.04$ the sharp peak of Fe $2p_{3/2}$ and Cr $2p_{3/2}$ core level are located at the position of 707.3 and 574.8 eV, respectively. There were no mixed iron charge valence states other than Fe^{2+} . The evidence that iron ions are ferrous in character led to the conclusion that conduction mechanism in this sample is different from the double exchange mechanism as in Mn Perovskite colossal magnetic compound [1].

On the other hand when the Cu ion is replaced as much 50 % its electronic properties are changed drastically. For the sample Cu replaced $x=0.5$ the iron ions show ferric character.

[1] A. P. Ramirez, R. J. Cava, and J. Krajewski, Nature 386, 156 (1997).

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