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Determination of the Magnetic Structure and Properties of the FeS Compound by using Mössbauer Spectroscopy

Jae Yeon Seo, Hyunkyung Choi and Chul Sung Kim*
Department of Physics, Kookmin University, Seoul 02707, Korea

Young Rang Uhm and Gwang Min Sun
HANARO Operation and Utilization, Korea Atomic Energy Research Institute, Daejeon 34057, Korea

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This study investigates the magnetic hyperfine structure and the magnetic properties of FeS by using an X-ray diffractometer (XRD), a vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The XRD FeS pattern showed NiAs hexagonal structure with space groups P-62c, $P63/mmc$, and $P63/mc$. The hysteresis loop with the maximum applied field of 15 kOe was measured at room temperature by using VSM, and the saturation magnetization (M_s) and the coercivity (H_c) values were observed to saturate. The temperature dependence of the zero-field-cooled (ZFC) and the field-cooled (FC) curves were examined at temperatures from 4.2 to 295 K at 100 Oe. Below 280 K, the ZFC curve displayed antiferromagnetic behavior; it was shown that the α-transition temperature (T_α) was shown to begins at a temperature high than 280 K in the FeS compound. The Mössbauer spectra of FeS were taken at various temperatures ranging from 4.2 to 295 K, and at each of them, the spectrum was analyzed using two sets of sextets containing A-sites, B-sites, and C-sites. The charge state was determined to be Fe^{2+} and Fe^{3+} based on the isomer shift, and the Curie temperature (T_C) was found to be 630 K.

Keywords: Iron sulfide, Mössbauer spectroscopy, Antiferromagnetic, Ferrimagnetic
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