STUDY OF TROILITE EXTRACTED FROM SIKHOTE-ALIN IRON METEORITE USING X-RAY DIFFRACTION, FERROMAGNETIC RESONANCE AND MÖSSBAUER SPECTROSCOPY.

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Introduction: Troilite (FeS) is the main sulfur mineral in the extraterrestrial matter. It was found in iron meteorites in the form of macro inclusions in kamacite matrix. ^{57}Fe Mössbauer spectroscopy is widely used to study meteorites, yielding information about the phase composition and the ^{57}Fe hyperfine parameters of iron-bearing phases [1, 2]. However, Mössbauer spectra of troilite in the form of magnetic sextet cannot be fitted satisfactorily when the quadrupole interaction is treated as a perturbation to the first order on the nuclear Zeeman levels. Therefore, diagonalization of the full Hamiltonian is required to fit the FeS spectrum correctly. In this work we studied troilite extracted from Sikhote-Alin iron meteorite using X-ray diffraction, ferromagnetic resonance and Mössbauer spectroscopy.

Experimental: Sample of FeS mechanically extracted from a kamacite matrix of Sikhote-Alin IIAB iron meteorite was prepared as powder. X-ray diffraction (XRD) study was done using PANalytical X'pert PRO diffractometer. Ferromagnetic resonance (FMR) was measured by the means of a Bruker ElexSys E500 X-band spectrometer. Mössbauer spectra were measured at 295 K using automated precision Mössbauer spectrometric system with a high velocity resolution [3] with spectrum registration in 4096 channels.

Results and Discussion: XRD and FMR studies demonstrated the presence of small amount of dobreelit ($FeCr_2S_4$) in the sample extracted from Sikhote-Alin iron meteorite. Using the Rietveld full profile refinements the structural parameters of FeS unit cell were determined and deviation from stoichiometry was evaluated. The Mössbauer spectrum of the extracted sample at 295 K displays a main six-peak pattern along with a minor single peak. Correct fit of the spectrum was achieved by using the full Hamiltonian approach for the main magnetic sextet, a distribution of the hyperfine field for a minor residual magnetic component, both related to troilite, and one minor peak related to dobreelit. The observed hyperfine parameters are considered to be related to the features of FeS structure and possible non-stoichiometry. We compare our data with corresponding results obtained for FeS from Agpalilik iron meteorite [4].

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