Composition and semiconductor properties of non-stoichiometric deep-sea chalcopyrite from the Mid-Atlantic Ridge

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Compound semiconductors with a crystal structure of chalcopyrite have attracted particular attention due to a unique set of physical properties. In recent years, increased interest has been shown to the thermoelectric properties of $CuFeS_2$ that has long been known as a semiconductor magnetic mineral [1,2]. This paper presents the results of major element analyses and NMR ^{63}Cu measurements in the local field of natural chalcopyrite ($CuFeS_2$) from the massive sulfides on the Mid-Atlantic Ridge.

Major element analyses were done on a scanning electron microscope (laboratory of VSEGEI, St.Petersburg, Russia). The measurements were made on a multipulse NQR Tecmag-Redstone spectrometer at room temperature (laboratory of KSPEU, Kazan, Russia)

The element analyses of the studied samples has showed a significant deviation of composition (3-10%) from the stoichiometric chalcopyrite[3].

The main features of the observed NMR ^{63}Cu spectra are as follows: the received resonant frequencies are almost equal to the frequencies of the NMR ^{63}Cu spectrum of continental chalcopyrite mineral, though the intensities of the resonance lines in deep-sea hydrothermal vent samples are noticeably lower. Moreover, these lines are comparatively wider, and have a "complex" form.

The considerable width of the found resonance lines in the spectrum is a direct evidence of wide distribution of the local magnetic and electric fields in the studied samples of chalcopyrite, which may be the result of non-stoichiometry in chalcopyrites from the Mid-Atlantic Ridge.

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