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Abstract

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ON THE VALUE OF THE NUCLEAR SPIN OF Fe^{57}

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Measurements were made of paramagnetic resonance in a frozen glassy melt of borax containing iron. Cylindrical samples were obtained by fusing 5 mg of $FeCl_3 \cdot 6H_2O$ with 4 g of borax. Sample I contained iron enriched to 71.91% in the isotope Fe^{57}, while the analogous sample II contained the ordinary, unenriched mixture of isotopes. The measurements were carried out at a temperature of 77°K at frequencies of 115, 240, and 430 MHz by the grid-current method, using modulation of the constant magnetic field H.

The magnitude of the effective g-factor, the asymmetric shape of the curves $\chi''(H)$, and the broadening of these curves with increasing frequency, observed in the unenriched sample II, make it possible to assume that the Fe^{+++} ion in glassy borax is under conditions analogous to those occurring in hemoglobin derivatives. Apparently in our case as well, owing to the partly covalent character of the bond of Fe^{+++} with its environment, the lower Kramers doublet ($M_s = \pm^1/2$) is at a considerable distance from the other sublevels (^{1}). Then, at the low frequencies used by us, it should be expected that the absorption maximum will correspond to an effective g-factor of ~ 4, which is indeed observed experimentally in sample II.

The curves $\chi''(H)$ for the enriched sample I at all three frequencies proved to be noticeably broader than the corresponding curves for sample II; moreover, in sample I, in addition to the main absorption maximum, a poorly resolved additional maximum is observed, situated in weaker fields H than the main one. The maximum found in sample II lies between them.

Analysis of the data obtained shows that they can be explained if the nuclear spin of the isotope Fe^{57} is assigned the value $I = {}^1/2$. The hyperfine-structure constant has a magnitude of the order of 10 gauss and is somewhat anisotropic. The value found for the hyperfine-structure constant turns out to be several times larger than that which may be expected from the data of work (^{2}), obtained on $K(Al, Fe)(SeO_4)_2 \cdot 12D_2O$, where the Fe^{+++} bonds have a purely ionic character. Such an increase of the hyperfine-structure constant appears possible, since the presence of a large initial splitting must be due to an admixture of excited states, in particular the state $3d^34s$ (^{3}).

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Note: Figure translations are in progress. See original paper for figures.