ISOTOPIC HYPERFINE STRUCTURE OF THE EPR SPECTRUM OF Cu^{2+} IN ZnWO_4

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In a single crystal of $ZnWO_4$ doped with copper (0.1 wt.%), a sharply resolved hyperfine structure of the EPR spectrum ([1]) was observed, caused by the interaction of the electron spin of the Cu^{2+} ion ($S = 1/2$) with the nuclear spins of two copper isotopes, Cu^{63} ($I = 3/2$) and Cu^{65} ($I = 3/2$), only at helium temperature. The spectrum consists of two groups of quartet lines, whose intensities (I^{65}/I^{63}) are in the ratio $3 : 5$.

Two Cu ions substituting for Zn in the unit cell are magnetically equivalent. A study of the angular dependence of the spectrum showed that the Cu^{2+} ions are acted upon by an intracrystalline field whose symmetry is no higher than rhombic. The corresponding spin Hamiltonian ([2]) in the principal z orientation has the form:

$$\mathcal{H} = g_z \beta H_z S_z + A S_z I_z.$$

Measurements of the spectrum at frequencies of ~ 10 and 40 GHz at a temperature of 4.2°K showed that:

$$\left.\begin{aligned} g_z &= 2.0023 \pm 0.005, \\ A_z^{63} &= 228.7 \pm 0.2 \text{ MHz}, \\ A_z^{65} &= 243.0 \pm 0.2 \text{ MHz} \end{aligned}\right\} \text{ at a frequency of 40 GHz}$$

$$\mu^{65}/\mu^{63} = A_z^{65}/A_z^{63} = 1.063$$

$$\left.\begin{aligned} g_z &= 2.0019 \pm 0.002, \\ A^{63} &= 227.6 \pm 0.2 \text{ MHz}, \\ A^{65} &= 247.4 \pm 0.2 \text{ MHz} \end{aligned}\right\} \text{ at a frequency of 10 GHz}$$

The isotopic hyperfine structure at a temperature of 77°K disappears because of line broadening, while the constants measured at a frequency of 10 GHz at 77°K change to the values:

$$g_z = 2.014 \pm 0.005; \qquad A_z = 218.2 \pm 0.2 \text{ MHz}.$$

Such a change apparently indicates that the intracrystalline field varies owing to a change in the volume of the crystal at different temperatures.

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