INFLUENCE OF EXTERNAL ELECTRIC FIELD ON THE HYPERFINE STRUCTURE OF THE EPR SPECTRUM OF Mn^{2+} IN $CdWO_4$

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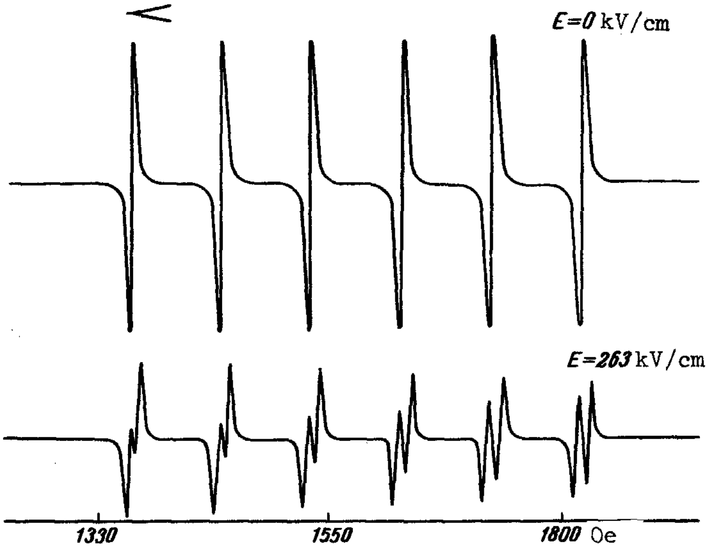
Bloembergen predicted [1] that an external electric field can produce linear changes in the spin-Hamiltonian constants describing the hyperfine interaction in the EPR spectra of complexes without inversion symmetry. Attempts to measure this effect directly [2,3] yielded no positive results.



Splitting of hyperfine structure lines of Mn^{2+} in $CdWO_4$. Field E parallel to x, field H oriented 65° to the x axis in the (011) plane

In an investigation of the electric-field effect in $CdWO_4$ with Mn^{2+} [4] we observed a change, linear in the electric field, of the hyperfine-interaction constant A. In this case the splitting of each of the hyperfine-structure lines was different. It can be described by an additional term of the spin Hamiltonian

$$\hat{H}^A_E = \sum_{i,j,k} V_{ijk} E_i \hat{S}_j \hat{I}_k ,$$

where the third-rank tensor $\hat{V}$ should be chosen in accordance with the point group C_2 of the Mn^{2+} ion in the cadmium tungstate.

Analysis of the experimental results must take into account the fact that the difference in the line splittings can be due also to interaction between the nuclear sublevels of different electron levels. Detailed calculations have shown, however, that in this case the allowance for the term $\hat{H}^A_E$ is essential for an explanation of the observed angular dependences. The following components V_{ijk} were found in this case (in MHz/kV/cm):

$$V_{111} = 0{,}006; \quad V_{122} = 0{,}007; \quad V_{133} = -0{,}015.$$

From a comparison of these values with the components R_{ijk} characterizing the change of the constant D it follows that V_{ijk}/R_{ijk} has the same order of magnitude as the ratio A/D.

A detailed experimental and theoretical investigation of this effect can yield added information on the main mechanisms causing the hyperfine interaction in paramagnetic complexes.

Detailed results will be published later.

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SPECIFIC HEAT OF ANHYDROUS $CrCl_3$ BELOW 4°K

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In connection with our investigations of the specific heat of layered halides of the iron group [1 - 3], we measured in the present investigation the specific heat of $CrCl_3$ in the temperature range from 2 to 4°K.

The specific heat of $CrCl_3$ was measured earlier above 12°K [4, 5]. The temperature of the antiferromagnetic transformation in $CrCl_3$, according to calorimetric data, is T_c = 16.8°K. $CrCl_3$ has a layered crystal lattice of type D_3. The layers of the metallic ions are separated by two layers of Cl ions, and the principal symmetry axis C_3 is directed perpendicular to the plane of the layer.

Neutron diffraction investigations [6] confirmed the magnetic-ordering picture first predicted by Landau [7]. The spins within each layer are ferromagnetically ordered, and a weak antiferromagnetic interaction takes place between layers. The spins in neighboring layers are antiparallel. The spins in antiferromagnetic $CrCl_3$ are oriented in the basal plane.

Magnetic susceptibility data [8] have shown that the anisotropy in $CrCl_3$ is small, since the difference in the fields at which saturation takes place when H is parallel and perpendicular to C_3 does not exceed 2 kOe. Measurements of the susceptibility [9] yielded an estimate of the antiferromagnetic interaction between layers: the exchange integral is $I_{af}/K = -0.018$°K.

Recently, Narath and Davis investigated the temperature dependence of the magnetization of the sublattices by a nuclear magnetic resonance method [9, 10]. A near-linear temperature dependence of the magnetization is observed at helium temperatures and is attributed to the singularity of the energy spectrum of a two-dimensional ferromagnetic system with small anisotropy.

Besides the investigations of Narath and Davis [9, 10], theoretical studies of the energy spectrum of layered antiferromagnets were made by Yoshimori [11] and Shore [12]. The latter have shown that if the ferromagnetic interaction inside the layer greatly exceeds the antiferromagnetic interaction between layers, then the spin-wave dispersion law is strongly anisotropic and spin waves with wave vector parallel to the C_3 axis reach the band