INFLUENCE OF THE ELECTRIC FIELD ON THE PARAMAGNETIC RESONANCE IONS IN THE S STATE

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Submitted 21 October 1967
ZhETF Pis'ma 7, No. 1, 9-12 (15 January 1968)

Earlier investigations [1,2] of the influence of external electric fields on the EPR spectra of ions in the S state have shown that the effect is manifest in the form of a weak broadening of the resonance lines. Therefore a quantitative determination of the R-tensors characterizing the influence of the electric field turned out to be impossible. On the other hand, these data are of considerable interest, since they can yield additional information on the character of the interaction of the ions in the S state with the intracrystalline field.

We observed complete splitting of the EPR lines of the ions Mn^{2+} and Fe^{3+} in $CdWO_4$ single crystals. The spin-Hamiltonian constants of these ions were determined in [3-5]. Our measurements were made with a spectrometer with double magnetic modulation at 9.16 GHz and at room temperature. The paramagnetic-ion concentration in the batch was 0.05%. The line splitting by the external electric field was observed in the transition $|1 + 3/2\rangle \rightarrow |-3/2\rangle$ (the classification is relative to a weak magnetic field) in the (011) magnetic plane. The electric field was applied along the crystallographic b axis and reached 320 kV/cm. The maximum effect occurred when H ∥ E ∥ b. In this case the splitting was 14 and 19 Oe for the Mn^{2+} and Fe^{3+} ions, respectively (Figs. 1, 2).

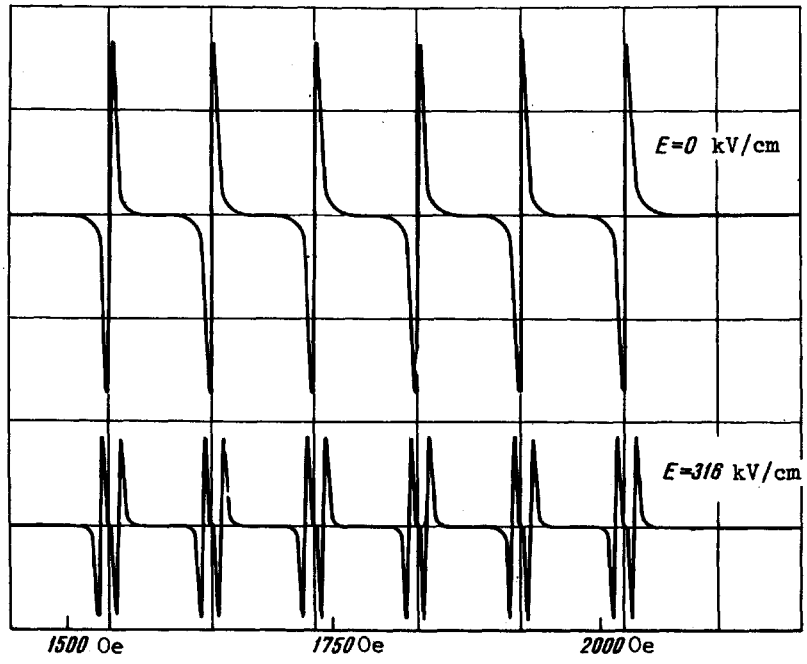

Fig. 1. EPR line splitting by an external constant electric field (Mn^{2+}).

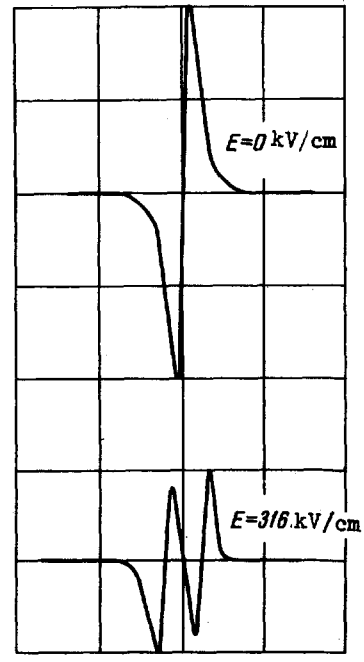

Fig. 2. EPR line splitting by an external constant electric field (Fe^{3+}).

The reduction of the measurement data was carried out for the Mn^{2+} ion. The effect can be described with the aid of the R-tensor, the structure of which is similar [6]. Unlike [6], the use of perturbation theory for the interpretation of the EPR spectrum is impossible, and the spin Hamiltonian is diagonalized exactly. The equation for the energy of the states was represented in the form of a sixth-degree polynomial, the roots of which can be readily obtained for the transition in question by an iteration method. The energy correction brought about by the electric field was calculated in first-order perturbation theory. Comparison with the experimental values of the splittings yielded the constants

$$R_{122} - R_{111} = 0{,}12 \frac{\text{MHz-cm}}{\text{kV}}; \quad R_{123} = -0{,}07 \frac{\text{MHz-cm}}{\text{kV}}.$$

The constant R_{133} was not determined, since its contribution to the line splitting in the investigated transition lies within the limits of the measurement error.

More detailed results of the influence of the electric field of these ions will be published later.

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CHANGE IN THE REFRACTIVE INDEX OF A LIQUID COMPRESSED BY A SHOCK WAVE. ANOMALOUS OPTICAL PROPERTIES OF CARBON TETRACHLORIDE

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Submitted 22 October 1967
ZhETF Pis'ma v. 7, No. 1, 12-16 (15 January 1968)

1. The dependence of the refractive index (n) of a liquid on the density (ρ) was determined in experiments on the diffraction of light by ultrasound [1] and also under adiabatic [2] and isothermal [3-5] compression to pressures of several kbar. All the results were obtained at a relatively small change in density and do not reveal the variation of n with ρ when the density is appreciably higher than normal, yielding only the slope

$$\frac{dn}{d\sigma} = \rho_0 \frac{dn}{d\rho}.$$

The results of these experiments indicate that they can be described by means of the Gladstone-Dale formula

$$n - 1 = (n_0 - 1)(\sigma - 1) \qquad (1)$$

and point to noticeable deviations from the theoretical relations of Lorentz-Lorenz (L-L) and Drude. The experimental data on the dependence of the refractive index on the compression $\sigma = \rho/\rho_0$ far from the edge of the absorption band ν_0 can be described also by the single-term