atomic) diamagnetic molecules capable of reacting chemically with the hydrogen atom.

We note that the value of K_1^{se} obtained by us exceeds by one order of magnitude the rate constant of the chemical act $H + NO_2 \rightarrow OH + NO$ (1) known for these partners [1]. It is not excluded, however, that in addition to (1) there occurs, with large rate constants, the formation of a shorter-lived compound particle that decays into H and NO_2 via the inverse channel. From this point of view, it would be quite interesting to experiment with observation, by any method, of the trimolecular process $H + NO_2 + M \rightarrow HNO_2 + M$.

Thus, on the basis of a comparison of the characteristics of the spin-exchange processes and the chemical reaction between the H atom and a paramagnetic molecule, we have raised in this paper a number of questions, an experimental answer to which by the given method and by the means of chemical kinetics will make it possible to choose the mechanism of the elementary processes of joining of a hydrogen atom to a free radical.

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INFLUENCE OF MAGNETIC FIELD ON LIGHT SCATTERING IN NEMATIC LIQUID CRYSTALS

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The scattering of light in nematic liquid crystals was investigated in a magnetic field up to 130 kOe and in an electric field up to 24 kV/cm.

We have investigated the joint action of magnetic and electric fields on the scattering of light in crystals with negative ($\varepsilon_{\parallel} < \varepsilon_{\perp}$) and positive ($\varepsilon_{\parallel} > \varepsilon_{\perp}$) anisotropies of the dielectric constant, where $\varepsilon_{\parallel}$ and $\varepsilon_{\perp}$ are the dielectric constants along the elongation direction of the molecule and perpendicular to it.

The experiment consisted of measuring the intensity I(H) of the light passing through the liquid crystal. In the case $\varepsilon_{\parallel} < \varepsilon_{\perp}$ we used the MBBA nematic liquid crystal, and in the case $\varepsilon_{\parallel} > \varepsilon_{\perp}$ we used a mixture (6% MBBA + 30%EBBA + 10% nitryl). The liquid crystal was placed between plates of fused quartz separated by liners 125 μ thick. To apply the electric field, the plates were coated with a transparent conducting SnO_2 layer. The light source was an He-Ne laser (LG-75) with 0.63 μ wavelength. The magnetic field was produced by the "Solenoid" setup [1]. The measurements were made at 19°C.

The action of the magnetic field on the liquid crystals is due to the diamagnetism of the molecules, owing to the presence of benzene rings. In a sufficiently strong magnetic field $\vec{H}$, the molecules become aligned along $\vec{H}$. The nematic liquid crystal, which has a polycrystalline structure characterized by a set of regions with inidvidual preferred molecule directions, then becomes monocrystalline. The formation of the single crystal is revealed by the saturation of the I(H) dependence in fields H > 50 kOe at E = 0 V/cm (Figs. 1 and 2). If the electric and magnetic fields are applied simultaneously, however, the I(H) dependence will be different for $\varepsilon_{\parallel} < \varepsilon_{\perp}$ and $\varepsilon_{\parallel} > \varepsilon_{\perp}$.

2. If $\varepsilon < \varepsilon$ and an electric field E is applied, a static perturbation picture is produced in MBBA by the presence of residual ions in the medium [2]. With increasing E, this

picture gives way to turbulent motion of the liquid-crystal regions, as a result of which dynamic scattering of light is observed [2-5]. On the other hand, application of a magnetic field can suppress the perturbations and the turbulence. This is illustrated by Fig. 1. In

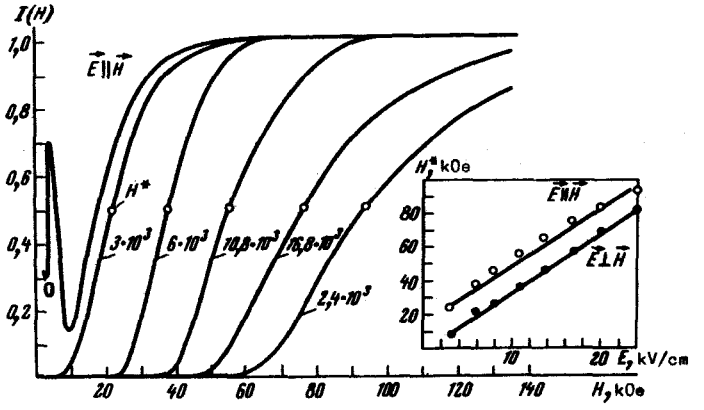

Fig. 1

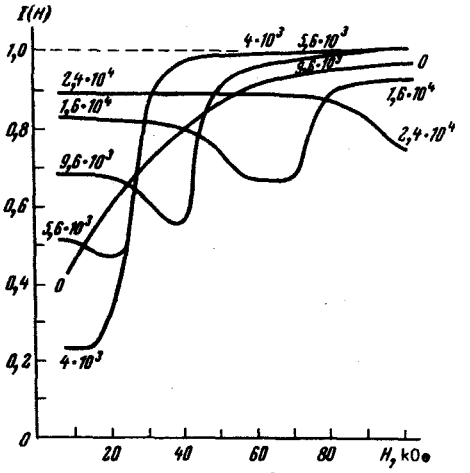

Fig. 2

Fig. 1. Intensity of transmitted light vs magnetic field at different values of the electric field E, $\varepsilon_{\parallel} < \varepsilon_{\perp}$, $\vec{E} \parallel \vec{H}$. The numbers at the curves indicate the value of the electric field in V/cm.

Fig. 2. Intensity of transmitted light I(H) for different values of the electric field E, $\varepsilon_{\parallel} < \varepsilon_{\perp}$, $\vec{E} \perp \vec{H}$. Light-wave polarization vector $\vec{E}_{\sim} \parallel \vec{H}$.

accord with the theoretical concepts [5], the curves are shifted approximately linearly towards larger H with increasing E. This can be deduced from the E-dependence of the magnetic fields H* at which I(H*) for each E. The differences in the values of H* in the cases $\vec{E} \perp \vec{H}$ and $\vec{E} \parallel \vec{H}$ may be due to the fact that when $\vec{E} \perp \vec{H}$ the action of the fields on the molecules is in one direction. When $\vec{E} \parallel \vec{H}$ the magnetic field suppresses the turbulence and the perturbations, and orients the molecules parallel to the ion current. The magnetic field must then overcome the action of the electric field. The irregular variation of I(H) at E = 0 and H < 10 kOe is due to interference between the ordinary and extraordinary waves (see [6]). The point is that prior rubbing together of the electrodes produced a direction on which the molecules have a preferred orientation. On the other hand, the polarization vector $\vec{E}_{\sim}$ of the light wave was inclined approximately 45° to this direction. The polarizer and analyzer axes were parallel.

2. If $\varepsilon_{\parallel} > \varepsilon_{\perp}$ both the electric and magnetic fields pass separately through the liquid crystal. In the presence of the electric field, however, the magnetic field ($\vec{E} \perp \vec{H}$) causes rotation of the molecules in a direction perpendicular to the stream of charges, and this can increase the light scattering when the crystal structure is altered. This is indeed observed in experiment (Fig. 2) in a certain region of H that can be determined for each value of E. I(H) is decreased by 15 - 20% when the actions of $\vec{E}$ and $\vec{H}$ on the molecules compete with each other, i.e., $4\pi(\chi_{\parallel} - \chi_{\perp})H^2 \geq (\varepsilon_{\parallel} - \varepsilon_{\perp})E^2$, where χ is the diamagnetic susceptibility.

We did not find a detailed explanation of the experimental curves. It can be assumed, however, that under our conditions there is no turbulent motion, since the decrease of I(H) is small. This phenomenon can apparently be described in the following manner:

If the electric field $\vec{E}$ is strong enough, the molecules ar arranged parallel to $\vec{E}$ and the scattering of the light is negligible. As soon as the torque exerted on the molecules by the magnetic field exceeds that of the electric field, the molecules become reoriented parallrl to $\vec{H}$ but perpendicular to $\vec{E}$. T the same time, a static perturbation picture similar to the case ($\varepsilon_{\parallel} < \varepsilon_{\perp}$) is produced [5]. When H is increased, the perturbations are suppressed and the crystal becomes transparent.

We note that a similar picture was obtained in a crystal with $\varepsilon_{\parallel} > \varepsilon_{\perp}$ by another method [7]. By rubbing the electrodes, the molecules were oriented parallel to the plance of the cell, and were then reoriented perpendicular to its plane by application of $\vec{E}$. This was done using an MBC liquid crystal. The decrease of the transmitted-light intensity occurred in the region $(1 - 2)\times10^3$ V/cm and amounted to 15%. It can therefore be concluded that the rubbing

action is equivalent to application of a field $\sim 10^3$ V/cm. Under our conditions, however, the electric fields were larger by one order of magnitude, and therefore the influence of the electrodes on the behavior of I(H) was negligble, and the observed changes were due to the applied electric and magnetic fields.

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EXPERIMENTAL OBSERVATION OF THE INFLUENCE OF AN ELECTRIC FIELD ON THE PLASTIC DEFORMATION OF ZnSe CRYSTALS

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Great strengthening (up to 100%) of ZnSe single crystals was observed in constant electric field. The dependence of the effect on the temperature and on the applied voltage was investigated. The effect is attributed to a change in the states of the electron subsystem of the crystal.

We have previously observed and investigated a reversible effect of light on the plastic deformation of semiconductors (the photoplastic effect) [1 - 5]. It turned out that the change of the state of the electron subsystem of the crystal under the influence of the light leads to a change of the conditions for the dislocation motion, and consequently to a great strengthening of the crystal. To confirm this model, it was of great interest to attempt to change the state of the electron system of the crystal by some other means, say with an electric field, and see whether this affects the plastic deformation. The present paper is devoted to a description of such experiments, which revealed the effect of an electric field on the plastic deformation of semiconducting crystals. n-ZnSe single crystals with sphalerite structure were grown from the melt and had a resistivity 10^7-10^{10} Ω-cm. The sample for deformation were cut in the form of thin plates 0.3 × 4 × 8 mm, with the wide face (110). Current-conducting contacts of In, Ag, or Cu_2Se were deposited on both sides of the sample at the center of the wide faces (Cu_2Se is a p-type semiconductor and forms a heterojunction with ZnSe [6]). The indium contacts were fused in a hydrogen atmosphere at 500 - 600°C. The silver contacts were either evaporated or secured with silver solder. The Cu_2Se layer was grown on the ZnSe surface by a procedure described in [6]. The approximate contact area was 5 sq. mm, and the total thickness of the contacts did not exceed several microns. The plastic deformation was produced by three-point bending at temperatures from 40 to 210°C. The distance between the lower supports was 5 mm. The deformation was produced by bringing the supports closer together at a constant speed of 5 μ/min. The actively deformed region was then located between the two contacts. The voltage reached 2.4 kV, corresponding to average fields on the order of 100 kV/cm. Figure 1 shows a diagram of the deformation of an In-ZnSe-Ag plate. In the plastic-flow section, a voltage 1.2 kV (+ on the Ag contact) was turned on at the instant (1), and was turned off at the instant (2). A voltage of opposite polarity was turned on and off at the instants (3) and (4). As seen from Fig. 1, the sample becomes much stronger when the electric field is applied, and plastic flow resumes only at loads exceeding the yield point by 100%. The strengthening disappears when the field is turned off . We observed a similar phenomenon in the deformation of plates having all possible combinations of In, Ag, and Cu_2Se contacts. The maximum effect was observed for the

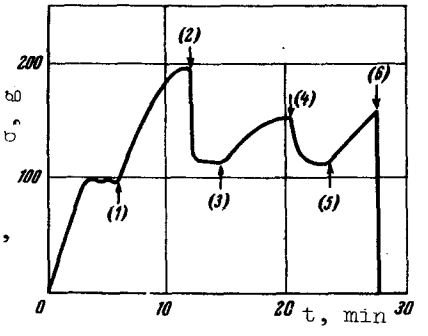

Fig. 1. Effect in Ag-ZnSe-In sample at T = 105°C.