Thus, investigations of the frequency dependence of the RRS line intensity, performed at T = 77°K and T = 4.2°K, offer unambiguous evidence that the resonant character of the RS is due to excitation of free excitons in mixed $Zn_xCd_{1-x}Te$.

In conclusion, the authors thank Ya.V. Morozenko for help with the experiment.

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PHOTOTHERMAL MAGNETIC EFFECT IN $CdCr_2Se_4$

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We have observed that the high-frequency magnetic permeability of the ferromagnetic semiconductor $CdCr_2Se_4$ is altered by illumination. This phenomenon, following [1], can be called the photoferromagnetic effect (PFE). The experiments were performed with rings made of the polycrystal, with outside diameter 7 mm, inside diameter 4 mm, and thickness 2 mm. The polycrystalline rings were obtained by grinding small $CdCr_2Se_4$ into powder and pressing it with a small amount of organic binder. The initial single crystals were prepared by the liquid-transport method. A coil of 40 - 50 turns was wound on the ring and connected to a self-oscillator circuit. The value of μ of the core could be determined from the oscillator frequency, which decreased rapidly when the ring with the coil was cooled below the Curie temperature of $CdCr_2Se_4$ ($\sim$129°K). If the maximum frequency above the Curie point is denoted by ω_C and the frequency below the Curie point by $\omega(T)$, and if it is assumed that the magnetic permeability above the Curie point is equal to unity, then

$$\mu(T) = (\omega_C/\omega(T))^2. \tag{1}$$

A plot of $\mu(T)$ is shown in Fig. 1. In our experiments, ω_C was close to 2.6 MHz. We note that the value of μ obtained by us is much lower than the values given in [2, 3], although our $\mu(T)$ curve has the same shape as that in [3]. In addition to cores of pure $CdCr_2Se_4$, we investigated cores of $CdCr_2Se_4$ doped with up to 1 at.% Ga. The $\mu(T)$ curves retained in this case the same general form, but

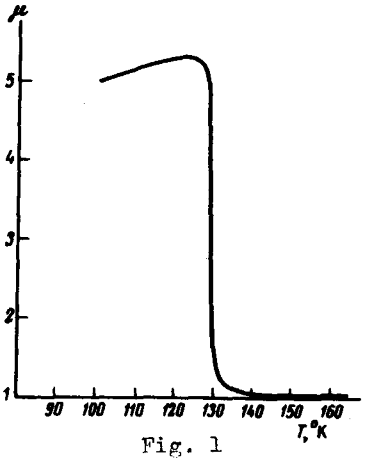

Fig. 1

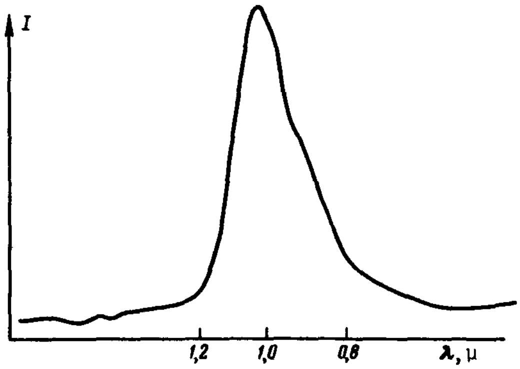

Fig. 2

Fig. 1. Temperature dependence of relative high-frequency magnetic permeability. μ remains practically unchanged in the interval from 100°K to room temperature.

Fig. 2. Spectral characteristic of photoferromagnetic effect in $CdCrSe_4$. DMR-4 monochromator, slit widths 1.5 mm, illuminator OI-24, temperature 77°K.

the maximum value of μ was decreased by the doping. The Curie temperature is not noticeably altered by the doping.

When the core was illuminated with a DMR-4 monochromator, a decrease of μ was observed. The magnitude of this effect is smaller than in [1] and depends on the degree of doping. $\Delta\mu/\mu \approx 10^{-4}$ for the material with 1% Ga, and smaller by approximately one order of magnitude for the pure material. The light source in this case was a 100 W lamp, and the slits of the DMR-4 were fully opened.

The PFE spectral characteristic is shown in Fig. 2. Its shape is not altered by doping.

To determine the temporal characteristics of the PFE, we measured the shift in the frequency of the resonant circuit following illumination of doped $CdCr_2Se_4$ by a flash lamp with approximate flash duration 20 msec. It turned out that the frequency shift follows the illumination, indicating by the same token that the effect observed by us does not have large inertia as in the case in [2].

The most probable cause of the PFE effect in $CdCr_2Se_4$ may be the formation of a Cr_2^{2+} ion from the Cr^{3+} ion by ionization of the Ga atoms. The Cr^{2+} ions form a sublattice with a magnetic moment having a direction opposite that of the moment of the Cr^{3+}-ion lattice, thus decreasing the total moment [4].

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SINGLE-PARTICLE TUNNELING IN SUPERCONDUCTING LEAD SINGLE CRYSTALS IN A MAGNETIC FIELD

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We investigated tunnel junctions made of single-crystal lead, lead oxide, and a tin film (or a lead film). The samples were obtained by a method close to that used in [1].

Just as in [1], two singularities, corresponding to two values of the energy gap in the lead single crystal, were observed for all samples in the single-particle tunneling region ($eV = \Delta_{Pb} + \Delta_{Sn}$). With increasing magnetic field parallel to the junction plane, a gradual coalescence of the singularities into one is observed.

The figure shows the experimental data obtained at 0.8°K with the Pb single crystal + Sn film junction. The magnetic field in Oersteds is indicated near each curve.

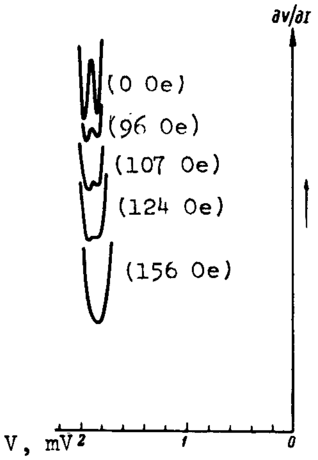
We note the following characteristic features of the observed effect:

1. The tests were performed on six samples with random orientation of the junction plane relative to the single-crystal axis. In none of the samples was there a noticeable dependence on the junction orientation.

2. The magnetic field in the plane of the junction is independent of the orientation.

3. The effect does not depend on the polarity of the electrodes.

4. When the magnetic field was perpendicular (accurate to 5%) to the junction plane, the coalescence occurs at larger intensities than in the case of a field parallel to the junction. Thus, a curve similar to that for 107 Oe in the figure was obtained in a perpendicular field of 215 Oe.



The formation of a single singularity can be ascribed to the following factors: 1) singularity broadening connected with the Sn film (a field of 150 Oe constitutes an appreciable fraction of the critical field of tin); 2) broadening of the contribution from each band of Pb in a magnetic field; 3) entanglement of states belonging to different bands of Pb. To verify the first assumption, the tin film was replaced with a lead film. This did not change the results.

The second and third assumptions call for further study.

The facts described above are interesting in connection with measurements in the voltage range $V \approx \Delta_{Pb}/e$ [2]. In the case of samples consisting of a lead single crystals and tin films, a splitting of the singularities is observed, due to the fact that the lead is mono-