PHOTOMAGNETIC EFFECT ON HOT PHOTOELECTRONS IN QUANTIZING MAGNETIC FIELDS

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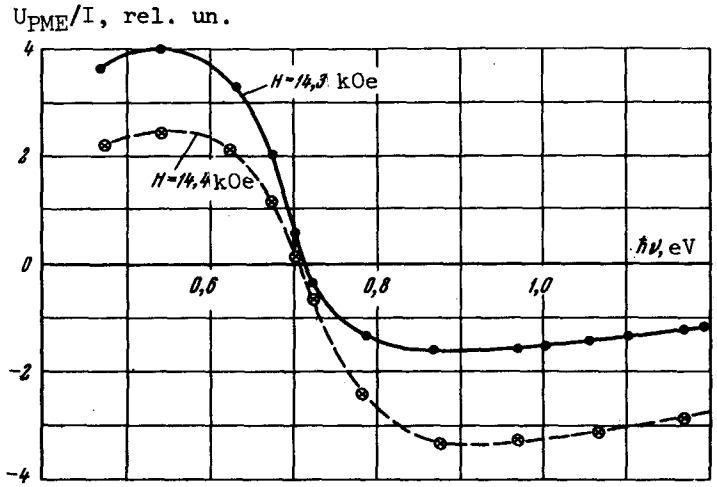
It was shown in [1] that hot photoelectrons, with energy exceeding the energy of the optical phonon $\hbar\omega_0$, can play a dominating role in the diffusion current, causing spectral singularities in photoelectric effects. In particular, a new phenomenon was predicted, namely the reversal of the sign of the Kikoin-Noskov photomagnetic effect (PME) with increasing frequency of the light.

At the same time, allowance for the hot photoelectrons has made it possible to explain [1] the reversal of the sign of the oscillations of the Shubnikov-type PME, which was observed experimentally in [2,3], and also explain the mechanism of the oscillating PME of the Gurevich-Firsov type [4] observed in [3].

To verify the role of the hot photoelectrons, we undertook an experimental study of the spectral characteristics of PME at low temperatures and strong magnetic fields. We investigated n-InSb samples with concentrations 5.2×10^{15}, 9.4×10^{15}, and 1.6×10^{16}. The sample dimensions were 15 x 0.4 x 3 mm. The samples were etched in CP-4 and placed directly in the liquid helium. The PME was measured both under pulsating and constant illumination. In the former case, the no-load PME voltage was measured with a narrow-band amplifier with a synchronous detector and was registered by an automatic recorder, while in the second case it was measured by a null method with the aid of an F116 galvanometer. The samples were illuminated with monochromatic light ("globar" source and IKS-21 or IKS-12 monochromator). Special measures were taken to decrease the photovoltaic effects.

Illumination with white light (0.5 - 2.8 μ) resulted in oscillations of the PME with the magnetic field, which duplicated the results of [2,3]. The spectral characteristics of



Variation of the sign of the photomagnetic effect with variation of the frequency of the incident light for an InSb sample with $n = 5.2 \times 10^{15}$ cm^{-3} (I - intensity).

the odd PME in the interval 0.5 - 1.2 eV are shown in the figure for one of the samples and for different values of the magnetic field. Similar curves were obtained for the other samples. It is seen from the figure that at a specified value of the magnetic field the PME voltage reverses sign with increase in frequency and becomes negative, starting with $\hbar\nu = 0.7$ eV. This quantity agrees with the theoretical value obtained in [1]:

$$\hbar\nu \approx \left(\frac{kT\hbar\omega_0 \tau_e}{\tau_{im}}\right)^{1/2} + E_g \approx 0{,}9 \text{ eV},$$

where $T = 4.2°K$, $\hbar\omega_0 = 0.024$ eV, $\tau_e = 10^{-7}$ is the lifetime of the electron, $\tau_{im} = 3 \times 10^{-12}$ is the momentum relaxation time, and $E_g = 0.24$ eV is the width of the forbidden band. From this we can conclude that the observed effect of reversal of the PME sign is actually due to the hot electrons. Results of detailed investigations of the spectral characteristics of InSb and InAs will be published later.

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PULSED SUPERRADIANCE AT THE GREEN LINE OF THALLIUM IN TlI VAPOR

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In a recent note [1] we reported observation of superradiance at the green line of thallium in thallium vapor. This superradiance is of great interest, since the structure of the thallium levels is highly favorable for obtaining a high efficiency. However, to work with thallium it is necessary to heat it to a temperature of approximately 800°C. One of the methods of lowering the working temperature may be, in principle, the use of a discharge in thallium-salt vapor, similar to that used in gas-filled lamps with addition of metal salts, mostly iodides [2]. This is not the only reason for the interest in investigations of discharges in metal-salt vapor.

It was shown earlier that an excitation satisfying the Franck-Condon principle leads, under definite conditions, to the formation of inversion between the electronic states of molecules [3,4]. A natural extension of this reasoning to the case of excitation that leads to the dissociation of the molecule shows that when the potential curves are suitably disposed, the excitation of the molecule by electrons leads to predominant dissociation in one