the autoionization states of Ar is small [5], the contribution of the processes of autoionization and of ionization with excitation can be found directly from the total area of the fourth peak. Finally, the contribution of the double ionization can be estimated from the form of the loss spectrum in the region $Q \gtrsim 42$ eV adjacent to the threshold for this process (not shown in the figure).

The analysis of the loss spectra has shown that the cross section of any of the inelastic process remains small with increasing scattering angle, up to a certain threshold value (different for each transition). After these thresholds are attained, the cross sections increase rapidly and experience more or less clearly pronounced oscillations at large angles. The existence of threshold scattering angles has made it possible to integrate the differential cross sections corresponding to the ionization processes with respect to the angle, and to obtain data on the relative contributions of these processes to the total ionization cross section.

It was found that the contribution of the direct ionization (2) for the K^+-Ar case, in the investigated incoming-ion energy interval does not exceed 5%. The contribution of the double ionization (4) likewise does not exceed several per cent. The ratio of the cross sections of the ionization processes remains approximately the same also for collisions of K^+ ions with Xe atoms.

It can thus be concluded that in the investigated collision-energy region the ionization of the Ar and Xe atoms by K^+ ions is determined practically completely by the autoionization process (1) and by the process of ionization with excitation (3).

In the investigation of the scattering of K^+ ions by Ne atoms, no inelastic energy losses connected with the processes of excitation of autoionization states and ionization with excitation were observed.

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CURRENT INSTABILITY IN $CdSnP_2$

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The semiconducting compound $CdSnP_2$ is one of the most interesting representatives of the class of ternary semiconductors of the type $A^2B^4C^5_2$. Comprehensive studies of the properties of $CdSnP_2$ have shown that this material is a straight-band semiconductor ($\Delta E = 1.16$ eV, T = 300°K) with high carrier mobility and with a many-valley conduction band [1, 2]. $CdSnP_2$ is the first ternary superconducting compound in which the laser effect and high-frequency current oscillations have been observed [3, 4].

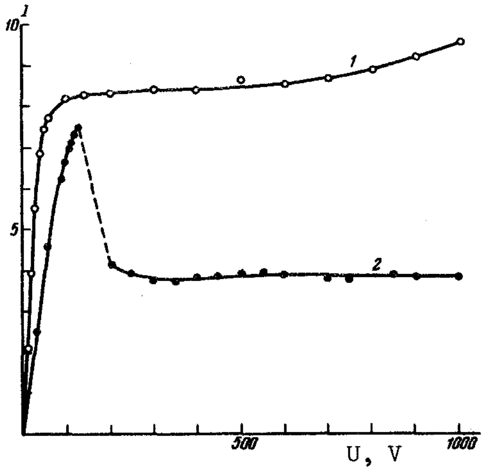

Fig. 1. Current-voltage characteristics of a CdSnP$_2$ sample at low (1) and high (2) illumination levels. In the region after the break in curve 2 there occur current oscillations, and measured values of the current are time-averaged. The maximum current I_{max} is equal to the current at the point of the break. The ordinate scales are 10^{-7} A/div for curve 1 and 10^{-5} A/div for curve 2. The sample length is L = 1 mm.

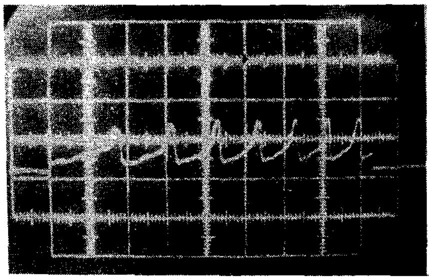

Fig. 2. Waveform of the current oscillation in a CdSnP$_2$ sample (L = 1 mm) following application of a voltage pulse with amplitude 500 V. The abscissa and ordinate scales are 10 m-sec/cm and 5 μA/cm, respectively.

We report here observations of low-frequency current oscillations in high-resistivity ($\rho \geq 10^4$ ohm-cm) samples of CdSnP$_2$ doped with Cu in strong electric fields. The investigations were carried out at T = 77°K on samples of various lengths with two ohmic contacts, illuminated with white scattered light. Figure 1 shows the current-voltage characteristics (CVC) of a CdSnP$_2$ sample 1 mm long at different illumination intensities. As seen from Fig. 1, the CVC under weak illumination (curve 1), in fields exceeding 0.5 kV/cm, has a sublinear character with a current-saturation section that persists up to 7.0 kV/cm. At an illumination intensity in excess of a certain threshold value, the CVC changes significantly. Low frequency large-amplitude current oscillations set in in fields stronger than $\sim$1 kV/cm.

Curve 2 of Fig. 1 shows the mean values of the current at different voltages applied to the sample.

The amplitude of the oscillations and the mean value of the current remain constant when the voltage increases to fields of $\sim$10 kV/cm. The current ratio I_{max}/I_{min} depends on the illumination intensity and reaches 8 - 10. The current oscillations have a relaxation character (Fig. 2), and their period increases in the field interval 2 - 6 kV/cm from 56 to 16 msec, without changing in stronger fields, and also increases with increasing illumination intensity. The threshold field corresponding to the start of the oscillations does not depend on the illumination level. Probe investigations and the study of the kinetics of the formation of the "current jump" in the CVC have shown that a section of negative volume differential conductivity (NVDC) appears in the investigated CdSnP$_2$ samples in fields exceeding 1.0 kV/cm, and a strong-field domain moving through the sample is produced.

Special investigations of doped and undoped CdSnP$_2$ samples have made it possible to establish that they contain multiply-charged impurity centers of two types. The levels of these centers, which have the same charges as the majority carriers (electrons), E_V + 0.92 eV and E_c - 0.03 eV in the filled state, belong to the Cu atom having a double negative charge (in the CdSnP$_2$

doped with Cu) and to the lattice defect (in samples doped with different impurities and in the specially undoped samples), respectively. The observed low-frequency instabilities in $CdSnP_2(Cu)$ may be due to the capture of hot electrons by the repulsion centers $E_v + 0.92$ eV or $E_c - 0.03$ eV in samples with different amounts of the compensating acceptor impurity Cu. It is possible that an important role in the formation of the NVDC is played also by the conduction subbands lying above the absolute minimum of the band and having a higher density of states.

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GASDYNAMIC CW LASER USING A MIXTURE OF CARBON DIOXIDE, NITROGEN, AND WATER

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We report in this article that amplification of infrared radiation was observed when a heated mixture of carbon dioxide and nitrogen, with a small amount of moisture, was blown through a supersonic wind tunnel, and that lasing was produced when an optical resonator was installed in the working part of the tunnel.

Gasdynamic infrared lasers (GL), using molecular gases and in particular the CO_2-N_2 mixture, were proposed in [1, 2]. The general ideas of devices of this kind were discussed in [3, 4], and the theory of a CO_2-N_2 GL was developed in [1, 5 - 7]. The first attempt to observe population inversion of the electronic levels of xenon in a supersonic jet was described in [8]. In [9] it was demonstrated experimentally that the physical premises on which the action of a CO_2-N_2 GL is based are correct. The addition of helium to the mixture, in order to accelerate the relaxation of the molecules from the lower laser level, led to inversion of the population of the vibrational levels of the CO_2 molecule and resulted in pulsed lasing [10, 11]. A gas mixture of the required composition and temperature for a GL can be obtained by burning a mixture of carbon monoxide and air [12], or by mixing the gas in a supersonic jet [13].

Investigations of the gain of a supersonic stream ($M = 4 - 5$) were made with a previously described aerodynamic setup [9], modified so that the gas was expanded in a wedgelike jet with an aperture angle 13° and with a supersonic section 5 cm long. The stagnation temperature was 1000°K, the stagnation pressure 5 atm, and the dimensions of the critical section 0.5 × 100 mm. The beam of a single-mode single-frequency CO_2 laser was directed parallel to the larger dimension of the critical section and crossed the gas stream at the point of its emergence from the nozzle.

Figure 1 shows a time scan of the gain or absorption coefficient of a CO_2 laser operating on the transition $(00^01\ I = 15) \to (02^00\ I = 14)$ (R branch,