* We are grateful to M. I. Klinger for calling our attention to this circumstance (see also [14]).

POLARIZATION OF SILICON AND GERMANIUM UNDER IMPACT LOADING

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We present in this communication the results of an investigation of the polarization of p-type single-crystal silicon (KDB 4.5/0.4). The impact loading was by means of a plane shock wave perpendicular to the (111) plane using the scheme shown in Fig. 1a.

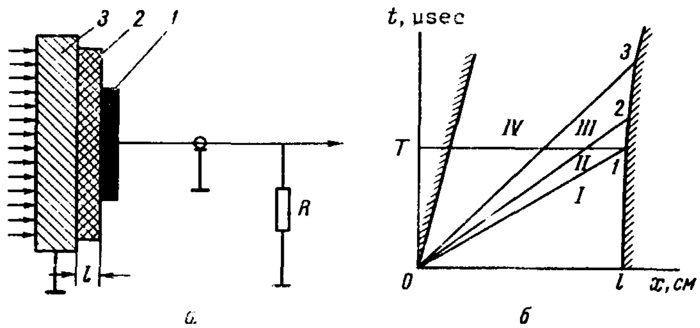

Fig. 1. a) Experimental setup. 1 - Measuring electrode (copper disc covering an aluminum coating of area S), 2 - silicon or germanium single crystal, 3 - aluminum screen. The arrows show the direction of the elastic-wave front. b) x-t compression diagram of the single crystal. 1 - Elastic wave propagating with velocity $D = 8.5 \times 10^5$ cm/sec; 2,3 - first and second plastic waves. I - Region of uncompressed matter; II, III, and IV - regions of material compressed by the elastic and first and second plastic waves, respectively.

The end surfaces of the samples were coated with an aluminum layer 2 - 3 μ thick. A pressure of 200 kbar was realized in the experiments. It is known that in this case a configuration of three compression waves (Fig. 1b) propagates through the crystal [1].

The results of the experiments have shown the following:

1. The polarization current I is positive (this means that the shock-wave front carries a positive electric charge) and appears simultaneously with the emergence of the shock wave to the sample (Fig. 2).

2. The polarization current I(t) is practically constant in time ($0 < t < T$), except for the start of the oscilloscope trace.

3. The voltage drop across the load resistance R is practically independent of R as the latter varies from 93 to 1053 ohms.

4. The current also remains approximately constant when the thickness l of the single crystal is varied from 0.1 to 0.6 cm.

These facts can be explained by assuming that a double electric layer propagates with constant velocity D together with the front of the elastic wave. In this case, recognizing

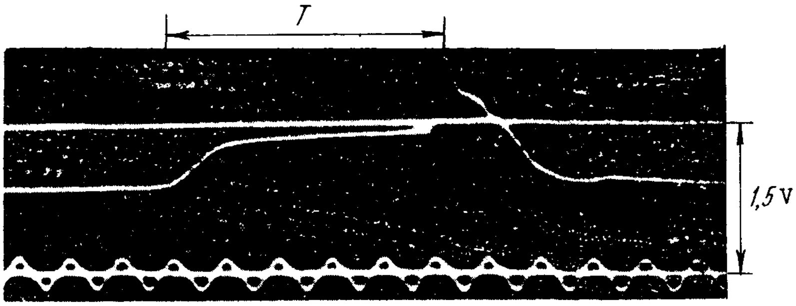

Fig. 2. Typical oscillogram from compressed KDB sample; l = 0.49 cm, S = 1.25 cm^2, R = 93 ohms. Time markers - 0.1 μsec.

that the single crystal has good conductivity (ρ = 4.5 ohm-cm), practically the entire potential difference across the double layer will be applied to R, and the dependence of the current on S will be weak. The thickness of the double layer is determined by the conductivity of the material and is [2,3] $\delta = \rho\epsilon D/4\pi\sigma$, where ϵ is the dielectric constant of the material behind the shock-wave front, and σ is the compression of the material behind the shock-wave front. Since δ is proportional to ρ, and according to [4] ρ decreases rapidly with the pressure, it follows that if we assume, say by analogy with organic glass [5], that the polarization depends weakly on the pressure, then it is apparently possible to neglect the influence exerted on I(t) by the double layers in plastic waves 1 and 2.

Putting ϵ = 11.7, ρ = 4.5 ohm-cm, D = 8.5 x 10^5 cm/sec, and $\sigma \approx 1$ we get δ = 4 x 10^{-6} cm. Assuming that the potential difference V across the double layer is equal to that observed in the experiments (0.4 V), let us estimate the polarization P (the surface-charge density on the double layer) and the field intensity E in the double layer: $P = V\sigma/D\rho \approx 10^{-7}$ Coul/cm^2 and $E = V/\delta \approx 10^5$ V/cm.

The obtained value of P corresponds to 1.6 x 10^{17} cm^{-3} charged particles per unit volume of the double layer. We note that the number of impurity atoms in KDB is ~10^{17} cm^{-3}. For the investigated valence crystal, which consists of electrically neutral atoms of one sort, it is difficult to visualize a polarization mechanism other than that connected with the impurities.

We note the appearance of sharp current peaks at the instant T. The peaks were present also when the electrode material was replaced with teflon.* It is possible that this phenomenon is connected with the decrease of the transient resistance at the aluminum-silicon boundary when the shock wave emerges from it.

Individual experiments made with single crystals of silicon (KEF 4.5/0.4) and germanium (GES 15-24/0.9) having n-type conductivity have shown that the polarization current in these crystals has the same sign and an amplitude of approximately the same order as in p-type silicon.

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* With electric contact maintained.

MEASUREMENTS OF THE ULTRAVIOLET RADIATION OF THE METAGALACTIC GAS, MADE OUTSIDE THE ATMOSPHERE

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A radiation receiver mounted on the automatic interplanetary station (AIS) "Venera-3" [Venus-3] was used to observe the upper limit of the uv flux in the wavelength interval 1225 - 1340 Å. The main source of such radiation is the line L_α (λ = 1216 Å) of intergalactic hydrogen, shifted in the red direction by the cosmological expansion. The experimentally obtained upper limit of the flux yields information on the density and temperature of the intergalactic medium, where present-day notions presume the bulk of the matter of the Universe to be located.

The AIS Venera-3, which was launched on 16 November 1965, was equipped with an instrument to measure the radiation in two spectral intervals, 1050 - 1340 and 1225 - 1340 Å. The uv reciver was a photon Geiger counter with a window of lithium fluoride, filled with NO. An additional filter of calcium fluoride, approximately 1 mm thick, was used for the measurements in the second band. The fields of view for the indicated spectral intervals were 7 and 20° respectively, and the corresponding geometric factors were 3×10^{-4} and 3×10^{-3} cm^{2}sr. The counter efficiencies at the investigated wavelengths were approximately 10 - 20%, as determined by laboratory measurements. The field of view of the photometer subtended a cone with apex angle 140° around the antisolar point in a time of approximately 10 minutes. Both counters, with the exception of the window (7 mm diameter) were shielded with 3.5 mm of lead, which cut off completely the soft component of the cosmic radiation.

The flux measured far from the earth in the first spectral interval was 5.5×10^{-5} erg/cm^{2}sec-sr. It can be naturally attributed to the solar L_α emission resonantly scattered by the interplanetary neutral hydrogen [1]. In the 1225 - 1340 Å band outside the L_α line the rate was 31.6 ± 4 counts/sec. Comparison with measurements made on the same AIS with an STS-5 Geiger counter with approximately the same shielding has made it possible to estimate the counting rate due to cosmic rays in our instrument. This counter read 31.4 ± 1.4 counts/sec.* (These measurement data were graciously furnished by G. P. Lyubimov.) Figure 1 shows the counter readings in both spectral intervals during one of the transmissions. At a rate of about 31 counts/sec, it can be stated that the radiation in the 1225 - 1340 Å band