modynamic equilibrium, we shall show that the isothermal jump vanishes in a sufficiently hot gas.

We determine the equation of state

$$p_a + p_\gamma = \rho RT + a_0 T^4 / 3 = p; \quad \rho \equiv 1/V \tag{2}$$

and the enthalpy

$$H = c_p T + \frac{4}{3} a_0 T^4 V = \left(\frac{i+2}{2} p_a + 4p_\gamma\right) V \tag{3}$$

with allowance for the radiation density. By virtue of the fact that in such a gas the isothermal velocity of sound increases relatively slowly,

$$a_T^2 \equiv (\partial p / \partial \rho)_T = (\partial / \partial \rho)_T (\rho RT + {}^1/_3 a_0 T^4) = RT = p_a V, \tag{4}$$

the following relation is satisfied behind the shock wave at certain amplitudes

$$-V_{+\infty}^2 (p_{+\infty} - p_{-\infty}) / (V_{+\infty} - V_{-\infty}) = u_{+\infty}^2 > a_T^2 = -V_{+\infty}^2 (\partial p / \partial V)_{T,+\infty} \tag{5a}$$

or

$$-(\partial p / \partial V)_{T,+\infty} = (p_{+\infty} - p_{\gamma,+\infty}) / V_{+\infty} \leqslant -(p_{+\infty} - p_{-\infty}) / (V_{+\infty} - V_{-\infty}),$$

which leads to the condition

$$(p_\gamma / p)_{+\infty} (V_{-\infty} / V_{+\infty} - 1) \geqslant (V_{-\infty} / V_{+\infty} - 2) + p_{-\infty} / p_{+\infty}. \tag{5b}$$

It is easy to see, for example from the p-V diagram, that condition (5a) is equivalent to stating that the temperature is monotonic along the line of evolution of the heat-conducting gas within the shock wave:

$$-\frac{p_{+\infty} - p_{-\infty}}{V_{+\infty} - V_{-\infty}} = -\frac{dp}{dV} = j^2 \equiv (\rho u)^2 = \text{const.}$$

This is correct also for a non-radiating gas [in the latter case we obtain Eq. (1)]. For strong waves, from the conservation conditions for the flow of energy and momentum

$$j^2 (V_{-\infty}^2 - V_{+\infty}^2) = V_{+\infty} [(6 - i) p_{\gamma,+\infty} + (i + 2) p_{+\infty}],$$
$$j^2 (V_{-\infty} - V_{+\infty}) = p_{+\infty},$$

we get the total compression on the wave in the radiating gas:

$$V_{-\infty} / V_{+\infty} = i + 1 + (6 - i) p_{\gamma,+\infty} / p_{+\infty} \to 7 \quad \text{for } p_{\gamma,+\infty} / p_{+\infty} \to 1. \tag{6}$$

Expressing $(p_\gamma/p)_{+\infty}$ in terms of $V_{-\infty}/V_{+\infty}$ in (5b) we obtain the inequality

$$(V_{-\infty} / V_{+\infty})^2 - 8 V_{-\infty} / V_{+\infty} + 13 - i \geqslant 0, \tag{7}$$

which means that waves on which

$$V_{-\infty} / V_{+\infty} \geqslant 4 + \sqrt{3 + i} = 6.45 \ (\text{for } i = 3) \tag{8}$$

(we disregard the second root, for we specified large amplitudes) have a monotonic temperature profile in the heat-conduction approximation. The equality corresponds to the transformation of the isothermal jump into isothermal sound.

In conclusion, I consider it my pleasant duty to express my indebtedness to my associates at the Institute of Chemical Physics, K. E. Gubkin, O. S. Ryzhov, and A. A. Milyutin, for valuable discussions.

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60

THE CONDUCTIVITY OF SEMI-CONDUCTORS IN AN ULTRASONIC FIELD

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In the literature there are several references to the effect of ultrasonics on the luminescence[1-4] and photoconductivity of semiconductors.[5]

We have examined the influence of ultrasonics on the conductivity of a number of semiconductors, and have studied specimens of selenium, cadmium sulphide, lead sulphide, cuprous oxide, stannic oxide and germanium, irradiated with 10 w/cm^2 of ultrasound at 600 Kcs. In all cases a change of conductivity was found on irradiation, but analysis of these changes shows that the ultrasound does not have a specific action on the conductivity, but that the effects follow from the heating of the specimen. The conductivity did not change immediately on switching on the ultrasound, but increased or decreased (depending on the sign of the temperature coefficient for the specimen) during the heating of the sample on irradiation. Simultaneous measurement of the temperature and conductivity shows that the latter varies as $\sigma = \sigma_0 \exp\{-E/kT\}$, i.e.,

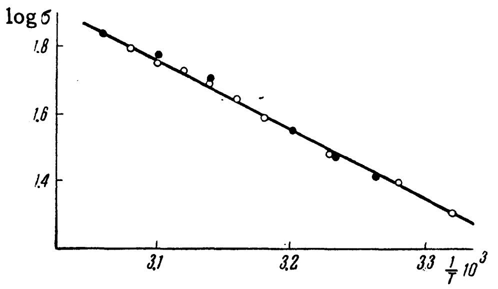
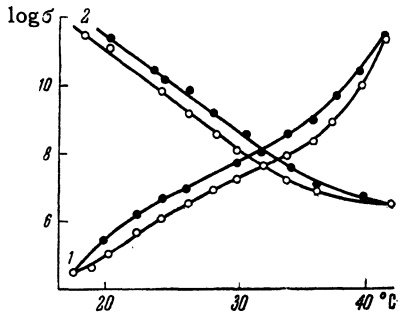


FIG. 1

FIG. 2



there is no variation in conductivity over and above the temperature effect. On switching off the ultrasound, the specimen cools down and one finds that any temperature corresponds to the same value of conductivity, whether it is reached during irradiation or during cooling. This shows clearly the purely temperature action of the ultrasound. These results are illustrated in Fig. 1, which shows the dependence of conductivity on temperature for lead sulfide, on a log σ vs. $1/T$ plot, during irradiation (full circles) and on cooling at the end of the irradiation (open circles).

Similar results were obtained with copper oxide, stannic oxide, cadmium sulfide, and germanium, but there were some differences in the case of selenium. We examined two groups of selenium specimens, one with positive and the other with negative temperature coefficients. On increasing the temperature by irradiation the conductivity of the former increased while for the latter it decreased. The conductivity of selenium showed some hysteresis on heating and cooling (this is shown in Fig. 2, in which curve 1 applies to a specimen with positive temperature coefficient and curve 2 to a negative coefficient). The cause of this instability in conductivity was examined in studies of the temperature dependence of the conductivity of selenium.[6] Investigation of the influence of ultrasound on the photoconductivity of cadmium sulfide and of selenium also shows that this effect corresponds to a thermal action.

In view of the foregoing, it is essential to have some confirmation of a specific action of ultrasound on luminescence,[4] as Leistner did not measure the temperature of the irradiated specimen. Some differences between the variation of the intensity of luminescence with irradiation and with external heating could be explained by the different heating conditions in these two cases.

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61