into bulk metal, should decrease; when the polarity of the voltage is reversed, the indicated distance should increase. Further, at a voltage corresponding to a shift of the Fermi level of the bulk electrode below the bottom of the first sub-band in the thin film, the nonmonotonic dependence should give way to a monotonic growth of the current. We can estimate from this the position of the Fermi level in the bismuth film.

All the foregoing regularities are actually observed in the experiments. The experimentally obtained values of the Fermi energy lie in the range between 0.02 and 0.027 eV, i.e., they are close to the known values of the Fermi energy in bulk bismuth (see the table in [5]).

The distance between the singularities on the voltage-current characteristic allows us to estimate the component of the effective mass of the electrons in Bi, corresponding to the direction of the trigonal axis. This turned out to be equal to $\sim 0.012m_0$, which is in good agreement with the known values obtained from measurements of the de Haas - van Alphen effect [6].

In conclusion we note that Kirk [7] observed nonmonotonic voltage-current characteristics in the Al-Al_2O_3-Al system. However, in view of the fact that in Al the conditions were unfavorable for the realization of size-effect quantization, the observed nonmonotonicity is probably connected, in our opinion, with phenomena in the Al_2O_3 layer.

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CONTRIBUTION TO THE THEORY OF SHOCK WAVES IN NONCONDUCTING MEDIA IN THE PRESENCE OF AN ELECTRIC FIELD

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The theory of shock waves usually does not deal with the case when an external electric field is present. We show in this article that in the presence of an external electric field a low-intensity shock wave can be a rarefaction wave.

If we denote by braces the difference between the values of a quantity on both sides of the discontinuity, and by ρ, V, v, T, s, w, u, ϵ, E, and D the density, volume per unit mass, velocity, temperature, entropy, heat function, internal energy, dielectric constant, the electric field intensity, and the induction vector, then the system of boundary conditions takes the following form (the symbols $\|$ and $\perp$ denote the components parallel and transverse to the direction of the shock-wave front):

$$\begin{aligned}
&\{\rho v_{\|}\} = 0, \\
&\{P + \rho v_{\|}^2 + \epsilon(E_{\perp}^2 - E_{\|}^2)/8\pi)\} = 0, \\
&\{P + f v_{\|} v_{\perp} + \epsilon E_{\|} E_{\perp}/8\pi\} = 0, \\
&\{\rho v_{\|}[w + v^2/2] + [v_{\|}(ED) - D_{\|}(vE)]/4\pi\} = 0, \\
&\{D_{\|}\} = 0, \\
&\{E_{\perp}\} = 0.
\end{aligned} \tag{1}$$

From this system we obtain the equation of the shock adiabat

$$(u_2 - u_1) + \frac{P_2 + P_1}{2}(V_2 - V_1) + \frac{D_{\|}^2}{16\pi}\,\frac{(\epsilon_1 - \epsilon_2)(V_2 - V_1)}{\epsilon_1\epsilon_2}\,\frac{E_1^2(\epsilon_1 + \epsilon_2)(V_2 - V_1)}{16\pi}. \tag{2}$$

We proceed to the case of low-intensity waves and consider the case $E_{\perp} = 0$. For gases [1] and polar liquids [4] we have with good accuracy $\epsilon - 1 \sim \rho$; the proportionality coefficient depends on the magnitude of the field. We neglect this dependence. We then have from (2)

$$T\,(s_2 - s_1) = \frac{1}{12}\left(\frac{\partial^2 V}{\partial P^2}\right)(P_2 - P_1)^3 + \frac{D_{\|}^2}{16\pi}\left|\frac{\partial E}{\partial V}\right|\left(\frac{\partial V}{\partial P}\right)^2\frac{(P_2 - P_1)^2}{\epsilon_1\epsilon_2}. \tag{3}$$

From (3) we see that when

$$E_{\|}^2 > \frac{4\pi}{3}|P_2 - P_1|\,\frac{\partial^2 V}{\partial P^2}\left(\frac{\partial V}{\partial P}\right)^{-2}\left|\frac{\partial\epsilon}{\partial V}\right|^{-1}$$

a rarefaction shock wave is possible. Such a shock wave can be formed, for example, from a sound wave. Indeed, an analysis similar to [2] shows that when

$$E_{\|}^2 > \frac{4\pi}{3}\,\rho^4\left(\frac{\partial P}{\partial\rho}\right)^3\left(\frac{\partial^2 V}{\partial P^2}\right)$$

the rate of displacement of the wave profile decreases with increasing density, and a rarefaction shock wave is produced. Using the experimental values for the compressibility [5] and the speed of sound [6], we find that the last inequality is satisfied, for example, for organic liquids in electric fields near 10 kV/cm, which is much less than the breakdown fields. The presence of $E_{\perp} \neq 0$ does not change the result if

$$\frac{\epsilon E_{\perp}^2}{8\pi} \ll \frac{1}{3}\,\frac{\partial^2 V}{\partial P^2}\left|\frac{\partial V}{\partial P}\right|^{-1}(P_2 - P_1)^2.$$

In the opposite case low-intensity rarefaction shock waves are possible if

$$\left(\frac{E_{\parallel}}{E_{\perp}}\right)^2 > \frac{V^2}{|P_2 - P_1|} (\epsilon_1 + \epsilon_2)\left|\frac{\partial \epsilon}{\partial \rho}\right|^{-1} \left|\frac{\partial V}{\partial P}\right|^{-1}.$$

We note that (1) and (3) show that the electric field becomes stronger in a rarefaction shock wave and weaker in a compression wave. The latter is simplest to understand by analyzing the case $E_{\perp} = 0$, in which we can see, from the condition for the continuity of $D_{\parallel}$, that the ratio of E on the two sides of the continuity is the inverse of the ratio of $\epsilon(\rho)$. With decreasing (increasing) ρ, ϵ also decreases (increases) in a rarefaction (compression) wave, and this leads to an increase (decrease) of the electric field.

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THE $\Sigma^+ \to p\gamma$ DECAY

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We calculate in this letter the imaginary amplitude of the $\Sigma^+ \to p\gamma$ decay, an amplitude connected with the existence of real intermediate states $\Sigma^+ \to n\pi^+(p\pi^0) \to p\gamma$ [1]. The result is discussed from three different points of view: the possibility of obtaining information on the mechanism of the $\Sigma^+ \to n\pi^+$ decay from the study of the $\Sigma^+ \to p\gamma$ decay, the degree of violation of unitary symmetry in the $\Sigma^+ \to p\gamma$ decay, and the possible magnitude of the difference in the probabilities of the decays $\Sigma^+ \to p\gamma$ and $\overline{\Sigma^+} \to \bar{p}\gamma$ in the case when CP invariance is strongly violated in strangeness-changing electromagnetic transitions.

1. The magnitude of the imaginary part depends strongly on whether the $\Sigma^+ \to n\pi^+$ decay proceeds via an s- or a p-wave. This is connected with the fact that the largest of all the amplitudes of pion photoproduction on a proton with total angular momentum I = 1/2 is the s-wave amplitude in the production of charged mesons $\gamma p \to n\pi^+$.

If the s-wave is large in the $\Sigma^+ \to n\pi^+$ decay, then

$$W^s_{min} = (1.95 \pm 0.25) \times 10^{-3}. \tag{1}$$