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CHANGE IN THE TEMPERATURE OF ANTIFERROMAGNETIC TRANSFORMATION OF MANGANESE TELLURIDE UNDER PRESSURE

N. P. GRAZHDANKINA

Institute of Metal Physics, Ural' Branch, Academy of Sciences, U.S.S.R.

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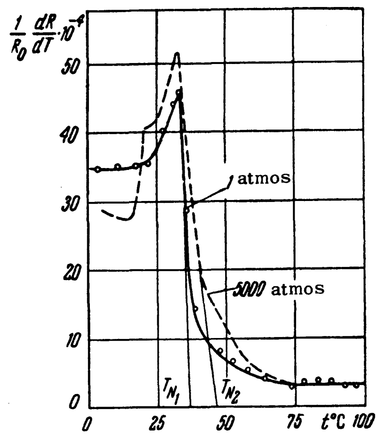
THE effect of the shift of the Curie point of ferromagnetic substances under the influence of hydrostatic compression has been investigated repeatedly. However, up to the present time there has not been a single paper devoted to the experimental investigation of the influence of hydrostatic pressure on the Néel temperature (T_N) of antiferromagnetic substances. By measuring the temperature and pressure coefficients of electrical resistance of manganese telluride we have investigated the influence of hydrostatic compression on the temperature of the antiferromagnetic transformation ($T_N = +37°C$)[1,2] of this compound.

Uniform hydrostatic pressure was applied to the sample in a high pressure chamber into the upper part of which four special electric leads were introduced. Transformer oil served as the medium for transmitting the pressure. In order to eliminate the effect of junction resistances at the boundaries of the sample and the metal electrodes supplying the current, a compensation method of measuring electrical resistance by means of probes was employed. Thin constanan wire served for the potential probes, while copper wire was used for the current leads. This enabled us to measure the temperature of the sample by means of a copper-constantan thermocouple without introducing additional electrodes. The cold junction of the thermocouple was at atmospheric pressure and at 0°C. Measurements were carried out over the temperature range of 279 — 363°K and the pressure range of 1 — 5200 kg/cm^2.



It has been established that hydrostatic compression results in a decrease of electrical resistance of manganese telluride. The value of the pressure coefficient $R_T^{-1}\,dR/dP$ varies as a function of temperature within the range -3.5 to -0.73. At temperatures far removed from the Néel temperature the electrical resistance varies linearly with the pressure. However, close to the temperature of the magnetic transformation the nature of the R(P) curves alters appreciably: a curvature becomes apparent with the R(P) curves being convex downward below T_N and upward above T_N. The figure shows the curve of the dependence on the temperature of the temperature coefficient of electrical resistance measured at atmospheric pressure and of the quantity $R_0^{-1}\,dR/dT$ calculated for a pressure of 5000 atmos. The calculations were carried out in a manner similar to that used for the determination of the shift of the Curie temperature of ferromagnetic substances.[3]

As can be seen from the figure, hydrostatic compression results in an increase of the temperature of antiferromagnetic transformation of manganese telluride. The magnitude of this effect is equal to $dT_N/dP = (2.0 \pm 0.4) \times 10^{-3}$ deg/kg/cm². This result was confirmed by direct measurements at a pressure of 4400 kg/cm². The Néel temperature determined from a break in the R(T) curve is in this case equal to +46°C.

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CONCERNING THE STABILITY OF SHOCK WAVES

V. M. KONTOROVICH

Institute of Radio Physics and Electronics, Academy of Sciences, Ukrainian S.S.R.

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THE stability of normal discontinuities in an arbitrary medium with respect to perturbations of a wave type was studied by D'iakov.[1] He found a region of absolute instability when the perturbation from the shock grew with time, a region of stability when this perturbation is damped and, finally, a peculiar region of "spontaneous sound emission by the discontinuity," in which the perturbation has the form of an undamped travelling wave. However, the last region was not completely determined by D'iakov. In order to separate off the wave emitted by the discontinuity from the incident one, it was required in Ref. 1 that the wave vector $\mathbf{q}(q \sin \vartheta,\ q \cos \vartheta,\ 0)$ of the wave be directed away from the discontinuity.* Together with the requirement of the reality of $\mathbf{q}$ and ω this gives the condition

$$0 < \cos\theta < 1, \tag{1}$$

according to which the region of spontaneous emission was defined. But here the "transport" of the perturbation of the moving fluid was not taken into account.

We write the conditions of spontaneous emission

$$\operatorname{Im}\omega = 0, \quad \operatorname{Im} q_y = 0, \quad V_y > 0, \tag{2}$$

where $\mathbf{V}$ is the velocity of the perturbation in the system in which the discontinuity is at rest. Since, in this system, the fluid behind the shock moves with a velocity $\mathbf{v}(0, v, 0)$ and the velocity of the perturbation in the moving medium is[2]

$$\mathbf{V} = \mathbf{v} + \mathbf{q}\, c/q, \tag{3}$$

the Eqs. (2) lead to the inequality

$$-M < \cos\theta < 1, \tag{4}$$

where $M = v/c$ is the Mach number.

Thus, to region (1) (in which the emitted wave moves relative to the stationary fluid in a direction opposite to the moving shock wave) is joined the region

$$-M < \cos\theta < 0, \tag{5}$$

in which the emitted sound waves move in the same direction as the shock wave, gradually falling behind it.

Application of Sturm's theorem to the equation for $\cos\vartheta$ (see Ref. 1) gives us for the region (5)