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Letters to the Editor

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Effect of Hydrostatic Pressure on the Superconducting Transition of Tin*

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THE pressure-induced displacement of the critical field curve for superconductivity has been measured for tin using liquid helium as the pressure fluid. The procedure followed has been to observe the critical field curve over a small temperature range near T_c for several constant pressures. The critical field measurements were made using a sensitive ballistic induction technique. The use of liquid helium as the pressure fluid makes it possible to apply and remove the pressure while the specimen remains at helium temperatures, and also assures that the pressure experienced by the specimen is really hydrostatic. The specimen used was a single crystal cast in the shape of an ellipsoid of revolution.

The data obtained so far are presented in Fig. 1 which shows the displacement of the critical field values as a function of the applied pressure. Results for two runs are plotted, and each point on the curves represents an average of about 10 separate determinations. The vertical lines through the points indicate the spread in the experimental values of ΔH_c over the range of temperature studied (which was from about 3.45°K to 3.70°K). This spread is too great to permit experimental observation of the temperature variation of $\partial H_c/\partial p$ in such a small temperature interval. The value of dT_c/dp given below includes a small calculated adjustment to correct the experimental $\Delta H_c/\Delta p$ to its value at T_c.

The significance of the intercepts in Fig. 1 is that they represent displacements of the critical field curve which result from the application of pressure at helium temperatures. The displacement is permanent in the sense that the specimen must be warmed above helium temperatures in order to restore the zero-pressure critical field curve to its initial position. (Warming the specimen to liquid nitrogen temperature appeared to be sufficient.) A systematic study of the factors affecting the magnitude of the permanent shift has not yet been made but it appears that most of the displacement is present after the initial application of pressure. Presumably this effect results from cold-working the specimen but it is surprising that a hydrostatic pressure of such relatively small magnitude can do this. In the present measurements the specimen was cycled several times to the maximum pressure (about 100 atmospheres) in order to produce a stable zero-pressure transition curve. This procedure resulted in fairly good reproducibility in the pressure coefficient $\Delta H_c/\Delta p$ as can be seen in Fig. 1. The difference in permanent displacement between the two runs is unexplained at present.

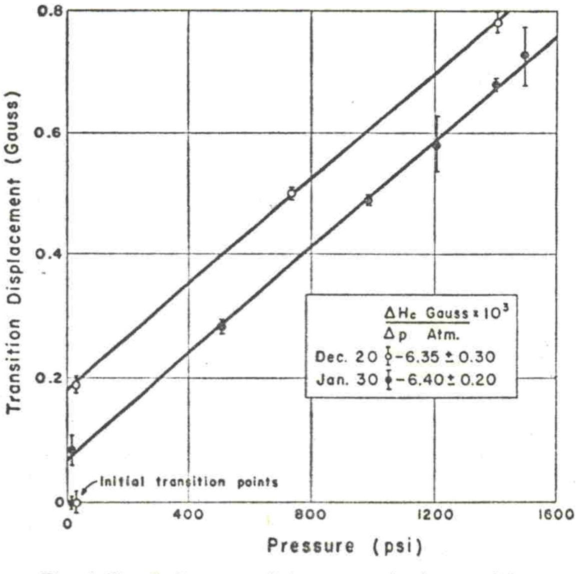

Fig. 1. The displacement of the superconducting transition curve for tin produced by hydrostatic pressure.

The measuring methods used in this work make it possible to determine the critical temperature and the slope of the critical field curve. The values obtained are $T_c = 3.728 \pm 0.0015$°K and $(\partial H_c/\partial T)_{T_c} = 149 \pm 1$ gauss deg^{-1} which are in very close agreement with the values reported by Lock, Pippard, and Schoenberg.[1] The displacement of the critical temperature with respect to pressure calculated from our values of $(\partial H_c/\partial T)_{T_c}$ and an average of the slopes of Fig. 1 yields the value

$$(dT_c/dp) = 4.40 \pm 0.20 \times 10^{-5} \text{ deg atmos}^{-1}.$$

This value is lower than most previously reported values for dT_c/dp in tin.[2] We believe that this may be due to the fact that earlier workers have not taken into account the possibility of the permanent pressure displacement observed in the present experiments. The data of Kan, Lasarev, and Sudovstov[3] for tin have been reported in sufficient detail to permit an approximate check on this point. Unfortunately only two pressures were used, but their data plotted as in Fig. 1 indicate a substantial intercept on the ΔH_c axis as we have found. The magnitude of their "permanent" displacement if their data are interpreted in this way is in reasonable agreement with our results if one assumes that the magnitude of the permanent displacement is proportional to the maximum pressure applied to the specimen. This interpretation of their data also yields a value of dT_c/dp which is in agreement with our value to within the accuracy of the extrapolations involved.

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[1] Lock, Pippard, and Schoenberg, Proc. Cambridge Phil. Soc. **47**, 811 (1951).

[2] The values reported earlier have been tabulated in a letter by M. D. Fiske, Phys. Rev. **94**, 495 (1954), together with his own recent data.

[3] Kan, Lasarev, and Sudovstov, J. Exptl. Theoret. Phys. (U.S.S.R.) **18**, 825 (1948).

Hall Coefficient in Germanium*

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A NUMBER of recent measurements by various investigators on germanium indicate that the use of simplified Hall-effect equations give values for carrier concentrations which, although generally satisfactory for n-type specimens, fail on p-type specimens to give results consistent with those obtained from other electrical data. A major discrepancy is that between the room-temperature value for hole mobility of 2600 to 2900 cm²/volt-sec,[1] as determined from Hall and resistivity measurements ($\mu = 0.85 R\sigma$), and the value of 1700 to 1900 cm²/volt-sec[2] as determined from drift-mobility experiments. Also, the value of electron-