area can be expected in the elastic and inelastic scatterings, as $v = 4.36 \times 10^7$ cm/sec for 5 MeV proton and ^{70}Ge. The details of this work will be published elsewhere.

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THE ELECTRONIC SPECIFIC HEAT OF THE HIGH PRESSURE PHASE OF GALLIUM

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We have measured the critical magnetic field curve of the high pressure phase of superconducting Ga. For a pressure of about 20 katm, the critical field at $T = 0$, H_0, is found to be 620 Oe and the critical temperature T_c is 6.24°K.

It is well known from experiments by Bridgman [1] that gallium undergoes a phase transition at pressures between 15 katm and 30 katm according to temperature. Buckel and Gey [2] found that the high pressure modification of gallium, which is generally referred to as GaII, is a superconductor with a transition temperature, T_c, of 6.3°K. We have measured the critical field, H_c, as a function of temperature in this high pressure phase. The results are shown in fig. 1. The experimental method employed and the cryostat will be described elsewhere [3].

From a knowledge of T_c and H_0, the critical field at $T = 0$, the electronic specific heat constant γ can be calculated from the well known relation:

$$\gamma = \tfrac{1}{4}\pi V f''(0) H_0^2 / T_c^2 \qquad (1)$$

where V is the molar volume and $f''(0)$ is the second derivative of the reduced critical field function $f(t) = H_c/H_0$ at $T = 0$. For GaII we find γ to be 1.63 m joule/°K^{2}mol. This value is larger by a factor 2.3 than the abnormally low value for GaI. This result can be understood, at least qualitatively, since the orthorhombic GaI, with a c/a ratio of 1.7 transforms into the tetragonal structure which is practically the same as that of indium [4]. Thus one expects a simpler Fermi surface because the total number of conduction bands is reduced. In fact, the measured value of γ lies close to the values of In and Al. On the basis of the free electron model one would expect a value for γ for 0.92 mJ/K^{2}mol. This indicates that GaII has a nearly free electron Fermi surface similar to those of its neighbours aluminium and indium. The values for γ given in table

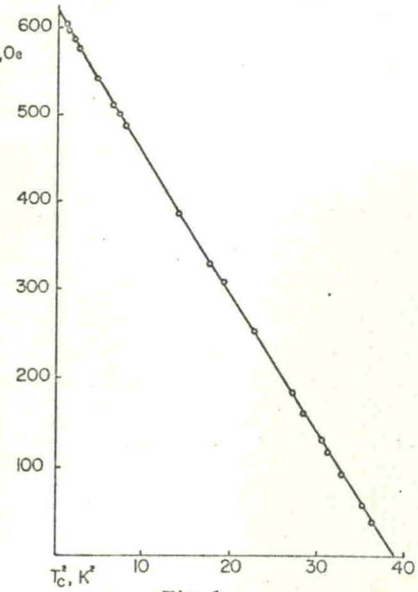

Fig. 1.

Table 1

Element	H_o (Oe)	T_c (^oK)	θ_D (^oK)	γ exp (mJ/K^{2}mol)	γ calc (mJ/K^{2}mol)
GaI	59.3	1.08	317	0.598 [10]	1.02
GaII	620	6.24	200 [2]	1.63	0.92
Al	103	1.17	423	1.36 [10]	0.90
In	293	3.39	108	1.70 [10]	1.23

1 illustrate the relationship between Al, GaII and In.

In addition the question whether the change of the electron-phonon coupling constant or the increase in the density of states is responsible for both the high T_c and the high γ of GaII, compared with GaI, can be answered. We may do this by using an expression for T_c given by Jensen and Maita [5] and by McMillan [6]. Moreover we use an expression for γ due to Migdal [7].

$$T_c = 0.69\ \theta_D \exp\{-(1+\lambda)/(\lambda - \mu^*)\} \tag{2}$$

$$\gamma \propto N(E_F)(1+\lambda)\ . \tag{3}$$

Here λ denotes the electron-phonon coupling constant, μ^* is the effective Coulomb interaction and θ_D is the Debye temperature. $N(E_F)$ is the band structure density of states at the Fermi surface. μ^* is taken to be 0.10, a value which has recently been confirmed by isotope effect measurements [8]. Assuming $\lambda = N(E_F)\cdot V_{ph}$ it turns out that V_{ph}, the electron-phonon interaction coefficient, is decreased by going from GaI to GaII, while the density of states at the Fermi surface is increased by a factor of 2.3.

According to Ziman [9] we may also write

$$\lambda \approx C^2/M\,\theta_D^2 \tag{4}$$

where M is the atomic mass and C is a measure for the rigid-ion potential in the electron-phonon interaction. The change from GaI to GaII decrease C^2 by a factor of about 1.4. It may be, however, that the uncertainty in θ_D in the high pressure phase [2] is too large to make any reliable conclusions.

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