The contribution of interband scattering, between the Γ_{1c} minimum and the X_{1c} minima, has been neglected. This seems justified (Nathan et al., 1961) for the range of carrier concentration and pressures studied here.

The calculation of $\rho(10)/\rho(0)$ for $n \geqslant 8 \times 10^{17}$ cm^{-3} ($E_F \geqslant 2kT$) is shown in Figure 1. The pressure variation of ϵ, taken from DeMeis (1965) for an energy 1·3 eV above the Γ_{15v} valence band, is

$$\frac{\epsilon(10)}{\epsilon(0)} = \frac{n(10)^2 - k(10)^2}{n(0)^2 - k(0)^2} = \frac{n(10)^2}{n(0)^2} = 0{\cdot}97$$

since below 2·5 eV, the absorption constant k is negligible in comparison with the refractive index n. The dotted line represents the transition from polar scattering through Brooks–Herring scattering to degenerate scattering.

The close agreement with experiment is somewhat fortuitous, since $\rho(10)/\rho(0)$ varies rapidly near the energy gap. In addition, the mobility in the degenerate region was calculated by assuming that each scattering event is random and independent of all others. Certainly the charged centres are sufficiently screened that they behave as independent scattering centres. On the other hand, the de Broglie wavelength of the electrons covers several impurity spacings, so that the carriers do not fully resolve the impurity structure. This leads to correlation in the scattering events. However, the result may not be greatly different from the scattering by the same number of widely separated ions, because the impurities are randomly distributed and should therefore produce mostly incoherent scattering. The preceding arguments then cannot be quantitatively applied, but the qualitative description should still hold. The quantum transport theory of Moore (1967) attempts to overcome this problem but the results are not easily re-evaluated at high pressures.

Conclusion

It was found that the variation with pressure in effective mass of the electrons in the Γ_{1c} conduction band could be described by $\mathbf{k} \cdot \mathbf{p}$ perturbation theory, provided

$$\frac{\partial E_g}{\partial p} = (10{\cdot}7 \pm 0{\cdot}5) \times 10^{-6} \text{ eV bar}^{-1}.$$

We then find that

$$\frac{\partial m_0^*}{\partial p} = (6{\cdot}0 \pm 0{\cdot}2) \times 10^{-6}\, m_0^* \text{ bar}^{-1}.$$

In the heavily doped samples the initial deviation from the polar scattering curve is caused by the onset of screened impurity scattering, but we note that when $n > 3 \times 10^{18}$ cm^{-3}, electron transfer rapidly dominates the value of $\rho(10)/\rho(0)$. This may be seen at greater pressures in the experiments of Pitt and Lees (to be published) on Te-doped GaAs, in which the carrier concentration was $1{\cdot}5 \times 10^{18}$ cm^{-3}. The reduction in mobility to 10 kbar is accompanied by a constant carrier concentration but at about 20 kbar, when transfer becomes important, the mobility rapidly falls towards its value in the X_{1c} minima.

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