

APPENDIX: METHOD OF OBTAINING CARRIER DENSITIES AND MOBILITIES

Assuming a value of unity for the Hall scattering factor, the low-field Hall coefficient can be expressed as²⁶

$$R(0) = -\frac{1}{e} \frac{nb^2 - p}{(nb + p)^2}, \quad (\text{A1})$$

where n and p are the electron and hole concentrations, respectively, and b is the electron-to-hole mobility ratio. Since b is greater than 100, $nb^2 \gg p$ for very low values of n/p and

$$R(0) \approx -\frac{1}{e} \frac{nb^2}{(nb + p)^2}. \quad (\text{A2})$$

Expressing $R(0)$ in terms of the electron and hole contributions to the conductivity and rearranging gives

$$n = -\frac{1}{R(0)e} \left(1 + \frac{\sigma_p(0)}{\sigma_n(0)}\right)^{-2}. \quad (\text{A3})$$

The electron mobility can be expressed as

$$\mu_n = R(0) \sigma(0) \left(1 + \frac{\sigma_p(0)}{\sigma_n(0)}\right). \quad (\text{A4})$$

The conductivity, in a magnetic field, can be expressed as

$$\sigma(B) = \frac{\sigma_n(B) \sigma_p(B) [R_n(B) + R_p(B)]^2}{\sigma_n(B) R_n(B)^2 + \sigma_p(B) R_p(B)^2}, \quad (\text{A5})$$

where $R_n(B)$ and $R_p(B)$ are the Hall coefficients which would be obtained if only the electrons or only the holes were present, and similarly $\sigma_n(B)$ and $\sigma_p(B)$ are the hole and electron transverse

magnetoconductivities.

Because of the high values of b in $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$, a range of fields exists for which $\mu B \gg 1$ and $\mu_p B \ll 1$. In this range, we can replace the coefficients for electrons in Eq. (A-5) by their saturation values and the coefficients for holes by their low-field values. Then

$$\sigma(B) = \frac{\sigma_n(\infty) \sigma_p(0) [R_n(\infty) + R_p(0)]^2}{\sigma_n(\infty) R_n(\infty)^2 + \sigma_p(0) R_p(0)^2} \approx \sigma_p(0). \quad (\text{A6})$$

The approximation is valid for our samples where $n \ll p$ and $b \gg 1$. Thus, $\sigma_p(0)$ can be obtained from the "saturation" value of $\sigma(B)$ (see Fig. 4). $\sigma_n(0)$ can be obtained from the conductivity in zero field, since

$$\sigma_n(0) = \sigma(0) - \sigma_p(0). \quad (\text{A7})$$

Having determined $\sigma_p(0)$ and $\sigma_n(0)$, n may be obtained from Eq. (A3) and μ_n from Eq. (A4). When $\sigma_n(0) \gg \sigma_p(0)$, the method reduces to obtaining n directly as $1/R(0)e$ and μ_n as $R(0)\sigma(0)$. When $\sigma_n(0) \ll \sigma_p(0)$, the determination of n and μ_n becomes inaccurate.

p is obtained from the high-field Hall coefficient, since

$$p = 1/R(\infty)e + n. \quad (\text{A8})$$

For $n \ll p$

$$p \approx 1/R(\infty)e. \quad (\text{A9})$$

The hole mobility μ_p is determined from

$$\mu_p = \sigma_p(0)/pe. \quad (\text{A10})$$

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