SEMICONDUCTORS AND METALS

FYS3410: PROBLEM SET 4

CANDIDATE 33

3. Gallium Arsenide Semiconductor

Gallium arsenide (GaAs) is a semiconductor with a direct band gap of $1.42eV$ at room temperature. The experimental values for effective masses (in unit of free electron mass) are: 0.067, 0.082 and 0.45 for electrons in the conduction band as well as light and heavy holes at the of the valence bands, respectively.

The band structure of some semiconductors, including GaAs, around the point Γ can be approximated by

$$E(\mathbf{k}) = E_0 + \frac{\hbar^2}{2m*}(\mathbf{k}^2 - \Gamma) = C + Ak^2, \tag{1}$$

where m^* is the effective mass, and the factor A is the curvature of the band. Setting $C = E_0 = 0$ one gets

$$A = \frac{\hbar^2}{2m^*}. \tag{2}$$

Inserting for the different effective masser of the electrons and holes yields

$$\begin{aligned} A_1(m^* = \quad 0.067m_0) &= \quad 0.569eVnm^2 \\ A_2(m^* = -0.082m_0) &= -0.465eVnm^2 \\ A_1(m^* = -0.450m_0) &= -0.085eVnm^2. \end{aligned}$$

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