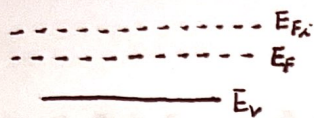


## 第二章

1.  $\underline{\hspace{2cm}} E_c$



光照前

$$n_0 = n_i \exp\left(\frac{E_f - E_{fn}}{kT}\right)$$

$$p_0 = n_i \exp\left(\frac{E_{fv} - E_f}{kT}\right)$$

所以  $E_{fn} > E_f > E_{fv}$ .

但在p型半导体中具有  $p_0 \gg n_0 \gg \delta p = \delta n$ , 所以  $E_f - E_{fp} \ll E_{fn} - E_f$

因此可认为  $E_{fp} \approx E_f$ , 即空穴的准费米能级与热平衡时不变。

2.  $N_0 = 2 \times 10^{16}$ ,  $p_0 = \frac{n_i^2}{n_0} = 1.125 \times 10^4$

$$n_0 = 2 \times 10^{16} \text{ cm}^{-3}, \quad p_0 = \frac{n_i^2}{n_0} = 1.125 \times 10^4 \text{ cm}^{-3}$$

少子是空穴

$$N_t = 3 \times 10^{15} \text{ cm}^{-3}, \quad N_{sc} = 10^{10} \text{ cm}^{-2}$$

$$\tau_p = 1.15 \times 10^{-7} \text{ cm}^2 \cdot \text{s}^{-1}, \quad \tau = \tau_p = \frac{1}{N_t \tau_p} = \frac{1}{3.45 \times 10^{-8} \cdot \text{s}^{-1}} = 2.8986 \text{ ns}$$

[少子寿命]

$$L_p = \frac{1}{\sqrt{D_p \tau_p}} = \frac{1}{\sqrt{\frac{kT}{q} \mu_p \tau_p}} = \frac{1}{\sqrt{0.0259 \times 500 \times 2.8986 \times 10^{-9}}} = 5161.4 \text{ cm} \text{ [扩散长度]}$$

$$s_p = r_s N_{sc} = 2 \times 10^{-6} \times 10^{10} = 2 \times 10^4 \text{ cm/s} \text{ [表面复合速度]}$$

3.  $N_0 \approx N_D = 10^{15} \text{ cm}^{-3}$ ,  $p_0 = \frac{n_i^2}{n_0} \approx \frac{n_i^2}{N_D} = 2.25 \times 10^5$

利用第1题的结论知

$$E_{fn} - E_f = kT \ln\left(1 + \frac{\Delta n}{n_0}\right) = 0.0259 \times \ln 1.1 = 0.002469 \text{ eV}$$

$$E_f - E_{fp} = kT \ln\left(1 + \frac{\Delta p}{p_0}\right) = 0.0259 \times \ln(0.444 \times 10^9) = 0.5157 \text{ eV}$$

~~$$E_f = \frac{E_{fn} + E_{fp}}{2} = kT \ln\left(\frac{N_D}{n_i}\right)$$~~

$$E_f - E_{fn} = kT \ln\left(\frac{N_D}{n_i}\right) = 0.0259 \times \ln(0.667 \times 10^5) = 0.2877 \text{ eV}$$

$$\Rightarrow E_{fn} - E_{fn} = 0.2877 + 0.002469 = 0.2902 \text{ eV}$$

$$E_{fn} - E_{fp} = 0.5157 - 0.2877 = 0.2280 \text{ eV}$$

