Fundamentals of Nanoelectronics, II: Energy Band Model

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L2.7 Quiz

Answers

2.7. Conductivity vs n

2.7a. A material with an energy momentum relation $E(p)=E_c+K\,p^{a}$, has a conductivity function $s(E)$ given by (d: number of dimensions, K: positive constant)

(a) $s(E) \sim \left(E - E_c\right)^{(d-1)/a}\, t$

(b) $s(E) \sim \left(E - E_c\right)^{(d+1)/a}\, t$

(c) $s(E) \sim \left(E - E_c\right)^{(d+a-1)/a}\, t$

(d) $s(E) \sim \left(E - E_c\right)^{(d+a-2)/a}\, t$

(e) none of the above

$$\sigma = q^2\frac{n(\mathrm{p})\tau(\mathrm{p})}{m(\mathrm{p})} \sim \frac{nv\tau}{p} \sim p^{d-1}v(\mathrm{p})\tau(\mathrm{p})$$

$$\sim p^{d-1}p^{\alpha-1}\tau \;\sim \mathrm{p}^{d+\alpha-2}\tau \sim (\mathrm{E}-\mathrm{E}_c)^{\frac{d+\alpha-2}{\alpha}}\,\tau$$

2.7b. A material with an energy momentum relation $E(p)=\sqrt{E_g^2+n_0^2p^2}$, has a conductivity function $s(E)$ given by (d: number of dimensions, K: positive constant)

(a) $s(E) \sim \left(E - E_c\right)^{(d-1)/2}$

(b) $s(E) \sim \left(E^2 - E_g^2\right)^{(d/2)+1}\, t$

(c) $s(E) \sim \left(E^2 - E_g^2\right)^{(d/2)-1}\, t$

(d) $s(E) \sim \left(E^2 - E_g^2\right)^{d/2}\, t$

(e) none of the above

$$\sigma \sim p^{d-1}v(\mathrm{p})\tau(\mathrm{p}) \sim \; p^{d-1}\frac{p}{E}\tau \;\sim \frac{(\mathrm{E}^2-E_g^2)^{d/2}}{E}\tau$$