Fundamentals of Nanoelectronics, II: Energy Band Model

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L2.4 Quiz

Answers

2.4. Density of states

2.4a. A material with an energy momentum relation $E(p) = E_c + K\,p^{a}$, has

(d: number of dimensions, K: positive constant)

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

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

(c) $D(E) \sim \left(E - E_c\right)^{d/a}$

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

(e) none of the above

$$D(E) = \frac{dN/dp}{dE/dp} \sim \frac{p^{d-1}}{p^{a-1}} \sim p^{d-a} \sim \left(\frac{E - E_c}{K}\right)^{(d-a)/a}$$

2.4b. A material with an energy momentum relation $E(p) = \sqrt{E_g^2 + n_0^2 p^2}$, has

(d: number of dimensions, n_0; constant)

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

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

(c) $D(E) \sim E^{d+1}$

(d) $D(E) \sim E^{d-1}$

(e) none of the above

$$E^2 = E_g^2 + n_0^2 p^2 \;\rightarrow\; 2E\frac{dE}{dp} = 2n_0^2 p \;\rightarrow\; \frac{dE}{dp} = \frac{n_0^2}{E}p \sim \frac{\sqrt{E^2 - E_g^2}}{E}$$

$$D(E) = \frac{dN/dp}{dE/dp} \sim \frac{p^{d-1}}{p/E} \sim E\,p^{d-2} \sim E\left(E^2 - E_g^2\right)^{(d-2)/2}$$