FUNDAMENTALS OF NANOELECTRONICS

Basic Concepts

1. The New Perspective

Energy Band Model →

3. What and Where

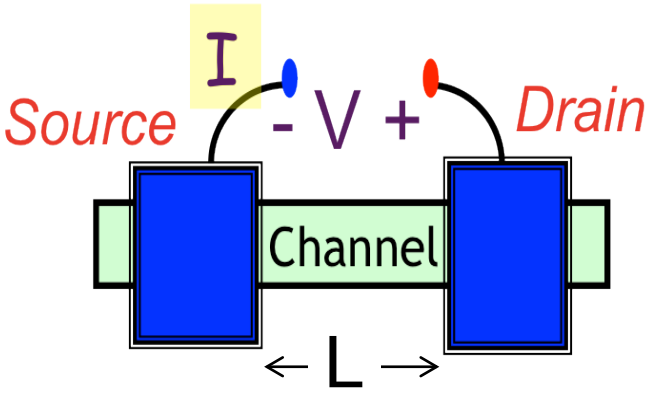
   is the Voltage?

4. Heat & Electricity:

Second Law & Information

- 2.1. Introduction
- 2.2. E(p) or E(k) relation
- 2.3. Counting States
- 2.4. Density of states
- 2.5. Number of modes
- 2.6. Electron density (n)
- 2.7. Conductivity vs n
- 2.8. Quantum Capacitance
- 2.9. The Nanotransistor
- 2.10. Summing up ..

2.7a Conductivity versus n



New perspective

$$\sigma = \frac{G_B}{A}\lambda$$

$$\sigma = q^2 \frac{n}{m}\tau$$

Drude formula

$$M = \left(\frac{p}{h}\right)^{d-1}\{1 \quad 2W \quad \pi A\}$$

$$\frac{G_B}{A} = \frac{q^2}{h}\left(\frac{p}{h}\right)^{d-1}\{1 \quad 2 \quad \pi\}$$

$$n = \left(\frac{p}{h}\right)^{d}\left\{2 \quad \pi \quad \frac{4\pi}{3}\right\}$$

$$N(p) = \left(\frac{p}{h}\right)^{d}\left\{2L \quad \pi WL \quad \frac{4\pi}{3}AL\right\}$$

2.7b Conductivity versus n

$$\frac{G_B}{A} = \frac{q^2}{h}\left(\frac{p}{h}\right)^{d-1} \quad \{1 \quad 2 \quad \pi\}$$

$$\frac{q^2 n}{m} = \frac{q^2}{m}\left(\frac{p}{h}\right)^{d} \quad \left\{2 \quad \pi \quad \frac{4\pi}{3}\right\}$$

$$\frac{G_B / A}{q^2 n / m} = \frac{m}{p}\left\{\frac{1}{2} \quad \frac{2}{\pi} \quad \frac{3}{4}\right\}$$

$$\frac{\lambda}{\tau} = \frac{v\tau}{\tau}\left\{2 \quad \frac{\pi}{2} \quad \frac{4}{3}\right\}$$

New perspective

$$\sigma = \frac{G_B}{A}\,\lambda$$

$$\sigma = q^2 \frac{n}{m}\,\tau$$

Drude formula

2.7c Conductivity versus n

$$\frac{1}{m} = \frac{dv}{dp}$$ X

$$\frac{1}{m} = \frac{v}{p}$$

$$I/A = qnv \quad , \quad \frac{dp}{dt} + \frac{p}{\tau} = qF$$

$$v = \frac{p}{m} \qquad p = qF\tau$$

New perspective

$$\sigma = \frac{G_B}{A}\lambda$$

$$\sigma = q^2 \frac{n}{m}\tau$$

Drude formula

$$\frac{G_B \lambda / A}{q^2 n\tau / m} = \frac{mv}{p} \rightarrow 1$$

$$\frac{G_B / A}{q^2 n / m} = \frac{m}{p}\left\{\frac{1}{2} \quad \frac{2}{\pi} \quad \frac{3}{4}\right\}$$

$$\frac{\lambda}{\tau} = \frac{v\tau}{\tau}\left\{2 \quad \frac{\pi}{2} \quad \frac{4}{3}\right\}$$

Coming up next ..