Semiconductors and Conduction theory

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1 Semiconductor

There can be materials that are between the conductor and insulator. They change the propoety depending on the temperature (energy content).

Carbon, Silicon

So, we can see the materials have these electrons that exactly fill up the roon possible. When one electron can be moved, they reach the codunction stage. We call the state as conduction band.

- Conduction Band is the state of moving
- Valence Band is staying where the elctron belongs.

The probability of having the Conduction Band state requires energy from Heat to leave the Valence Band. Like the energy to take of a Lego 1×1 plate from a *snot*. Now, the probabilty is,

$$\frac{p_2}{p_1} = e^{-\frac{\Delta E}{kT}} \tag{1}$$

So, I like to think the semiconductor as some induced conductor that bevcomes a conductor when there is adequete temperature.

Example: What will be the proportion of the electrons (ratio) that will be in the conduction band in room temperature if the band energy difference is $1.12\,eV$?
First of all, this eV can be made to Joule, so,

$$1.12\,eV = 1.12 \times 1.6 \cdot 10^{-19}\,J = 1.8 \times 10^{-19}\,J \tag{2}$$

Now,

$$\frac{p_2}{p_1} = e^{-\frac{1.8\times10^{-19}}{k_B(300K)}} = 1.3 \times 10^{-19} \tag{3}$$

I don't know how this makes any sense. I did some mistake I guess.

Doping:
We should know that,

- Boron has 5 electron in it's last shell.

- Aluminium has 3.
- Last Shell of Semiconductors have 4 and that makes it enough anyway.
- Excess Electron stands for negative. Sure.

If we can mix any of them above with Semiconductor, waht we can have is that the excess or the lack can be made. As Boron has more electron in that last shell, we are up with that,

- Boron mixing gives 1 electron more. So, *Negativated became,* n - type.
- Aluminium mixing gives a lack of 1 electron. So, *Positivated* p - type.

These holes can move anyway.

Holes are positrons.

Okay then. I still don't hear if there is any Azan or not.

2 The Idea of Current

Current is just the charge per unit time, everybody knows.

The things that one might not know is that the charge density.

The Charge flown by a unit area per unit time, or the current through the region per unit area is the *Charge Density*.

so,

$$I = \int_A \vec{J} \cdot \mathrm{d}\vec{a} \tag{4}$$

And this seems to make nice sense with fluid flow and stuff.

$$\int_A \vec{J} \cdot \mathrm{d}\vec{a} = -\frac{\mathrm{d}}{\mathrm{d}t} \int_V \rho \, \mathrm{d}v \tag{5}$$

And this is known fact that I use quite often once,

$$\vec{J} = \sigma \vec{E} \tag{6}$$

And in the differential form,

$$\frac{\partial I}{\partial a} = \sigma E \qquad \text{1 Dimension case.} \tag{7}$$

Go further,

$$\frac{\partial I}{\partial t} = -\sigma \frac{\partial V}{\partial x} \tag{8}$$