3.091 Solid State Chemistry: Week 2

Logan Pachulski

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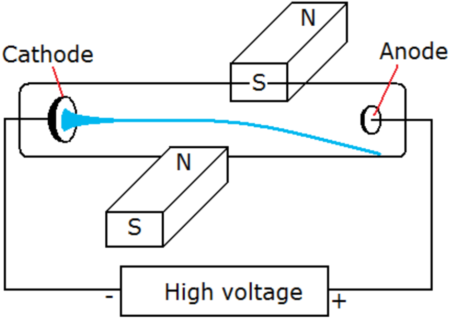
Progress Update

Over the past week I have:

1. Reintroduced to electrons and introduced a quantitative way to describe how two forces attract.
2. Observed how electric and magnetic fields affect the movement of an electron.
3. Introduced light and the photoelectric effect.
4. Gave a definition for the energy released by decaying atoms, in particular the beta radiation.
5. Introduced The Bohr model and it's relation to orbiting bodies.
6. Assigned wavelength and frequency to particles and introduced the basis of quantum mechanics.

Electrons & Fields

Electrons were discovered by placing a magnetic field around a cathode ray tube, where in turn the magnetic field caused the ray to shift and change angle.



Light & The photoelectric effect

Lights is made up of small packets of energy with associated frequency called photons. We can relate frequency λ to wavelength v and the speed of light c by the formula

$$c = \lambda v. \tag{1}$$

We can find the energy contained in a photon by the formula

$$E = hv \tag{2}$$

Where h is Planck's constant,

$$h = \frac{6.626 \cdot 10^{-34}\,\mathrm{J}}{s} \tag{3}$$

Radiation

When a radioactive element decays, it releases

1. Alpha radiation - helium nuclei
2. Beta radiation - electrons (at incredible speeds and energies)
3. Gamma radiation - gamma waves

The Bohr Model

The Bohr Model states that electrons exist in "quantized," or as I envision it, integer energy levels. We derive that the ionization energy of an atom with Z protons and n is

$$E_n = \frac{-Z^2}{n^2}(2.18 \cdot 10^{-19} J) \tag{4}$$

Louis de Broglie's Theory

Louis de Broglie proposed that if light, a particle previously believed to be a wave was acting through a particle, then what is there to stop particles from acting as waves? He proposed that particles have a wavelength

$$\lambda = \frac{h}{p} \tag{5}$$

where h is Planck's constant and p is the particles momentum. Similarly, a particle has associated frequency

$$V = \frac{E_{\text{tot}}}{h} \tag{6}$$

He then concluded by the derived formula for the standing wave of a particle that as we increase accuracy into knowing it's frequency, we decrease accuracy in knowing it's position and vice versa.