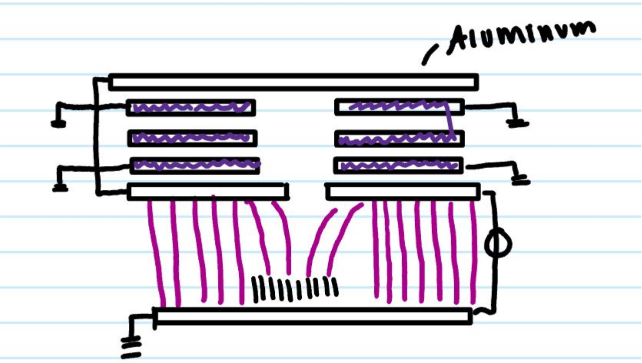
FIELD EMISSION EQUATIONS



1) Current Density of Nanotubes

$$J = C_1 E^2 exp\{\frac{-C_2}{E})$$

[Nordheim Fowler Equation]

$$C_1 = \frac{e^3}{8\pi h t y^2 \varphi} \qquad C_2 = \frac{8\pi\sqrt{2m}}{3he}\varphi^{3/2}\theta(y)$$

$$y = \frac{e\sqrt{eE}}{\varphi} \qquad E = \frac{v}{d}$$

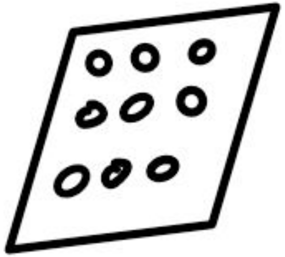
e - charge of electron
h - planck's constant
φ - work function of the metal (Energy required to move electron from the surface)
m - mass of electron
E - applied field strength (measured in volts per length)
E=V/d
V - applied voltage
d - distance between CNT & conducting material
y - characterizes strength in electric field

J is the current density for one CNT

J_{total}= # of nanotubes (J)

C_1 & C_2 are const $C_1 = \frac{e^3}{8\pi h t y^2 \varphi}$

2) Current Measurements (I_1 & I_2)



$$I = J_{total}(A)$$

$$A_1 = A_{metal} - A_{hole}(20\ holes)$$

$$A_2 = A_{hole}(20\ holes)$$

J_{total} - total current density given by nanotubes

A - area of surface current density is applied to

A_{metal} - area of conducting sheet of metal

A_{hole} - area of the holes in conducting sheet of metal

($2\pi r^2$)

3) Focal Length of Einzel Lens

$$f = \frac{1}{T^2 d}$$

$$T(z) = \frac{\sqrt{3}\,\varphi'(z)}{4\,(V_0 - \varphi(z))}$$

$$\varphi_z(z) = -\varphi(z-d) + \varphi(z+d)$$

V_0 - initial potential corresponding energy
z - distance from the center lens to hole in plate

- z=0 is at the center of the lens
- There are 20 holes in the conducting metal sheet and one einzel lens per hole

d - diameter of Einzel lens
φ - potential from single charge ring

- 2 lenses are at a particular voltage