Thermionic Emission

"The process of electron emission from a metal surface by supplying thermal energy. So it is known as **thermal emission**."

→ To supplying 2500°C

→ The no. of electron emitted depend upon temperature of the metal

→ This concept is empty vacuum tube (Tungsten - 2300°C)

Richardson - Dushman Equation

⇒ The emission of current density per unit area is,

$$J = AT^2 e^{-b/T} \text{ amp/m}^2$$

where, $b = \frac{e\phi}{K}$

$e\phi$ - Work Function

$e\phi = E_a - E_f$

⇒ The minimum amount of energy necessary to remove an electron from the metal is equal to $(E_a - E_f)$ and is defined as work function of the metal

$$J = AT^2 e^{-e\phi/KT} \text{ amp/m}^2$$

Where, J - Emission current density

T - Absolute temp. of emitter

A - Constant $\left[A = \frac{4\pi mcK^2}{h^3}\right]$

ϕ - Work function

e - Charge of electron

K - Boltzmann Constant

$$\therefore \text{cb} = \frac{e\phi}{K} = \frac{1.6 \times 10^{-19} \times \phi}{1.38 \times 10^{-23}}$$

$$\text{cb} = 11600\phi$$

$$J = AT^2 e^{-11600\phi/T}$$

$$\frac{J}{T^2} = A \exp\left[-\frac{e\phi}{KT}\right]$$

$$\log_e\left[\frac{J}{T^2}\right] = \log A - \frac{e\phi}{K}$$

→ The eqn indicate that the emission current density depends upon the work function of the metal and the square of the absolute temp.