

2.3.4 Summary to: Conductors - Special Applications

- Thermionic emission provides electron beams.
The electron beam current (density) is given by the *Richardson equation*:
- $A_{\text{theo}} = 120 \text{ A} \cdot \text{cm}^{-2} \cdot \text{K}^{-2}$ for free electron gas model
 $A_{\text{exp}} \approx (20 - 160) \text{ A} \cdot \text{cm}^{-2} \cdot \text{K}^{-2}$
 - E_{A} = work function $\approx (2 - >6) \text{ eV}$
 - Materials of choice: **W**, **LaB₆** single crystal
- High field effects (tunneling, barrier lowering) allow large currents at low T from small (nm) size emitter
- There are several thermoelectric effects for metal junctions; always encountered in non-equilibrium.
- Seebeck effect*: Thermovoltage develops if a metal A-metal B junction is at a temperature different from the "rest", i.e. if there is a temperature gradient

$$j = A \cdot T^2 \cdot \exp\left(-\frac{E_{\text{A}}}{kT}\right)$$

Needs **UHV!**

Essential for measuring (high) temperatures with a "thermoelement"
Future use for efficient conversion of heat to electricity ???

Questionnaire

All Multiple Choice questions to 2.3