2.4.4 Summary to: Conductors - Special Applications

- Thermionic emission provides electron beams.
  The electron beam current (density) is given by the *Richardson equation*:
  - $A_{theo} = 120\ A \cdot cm^{-2} \cdot K^{-2}$ for free electron gas model
    $A_{exp} \approx (20 - 160)\ A \cdot cm^{-2} \cdot K^{-2}$
  - E_A = work function $\approx$ **(2 - >6) eV**
  - Materials of choice: **W**, LaB_6 single crystal

$$j = A \cdot T^2 \cdot \exp - \frac{E_A}{kT}$$

- High field effects (tunneling, barrier lowering) allow large currents at low ***T*** from small (nm) size emitter

Needs **UHV**!

- 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 form the "rest", i.e. if there is a temperature gradeient

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

  - *Peltier effect:*
    Electrical current ***I*** through a metal - metal (or metal - semiconductor) junction induces a temperature gradient $\propto I$, i.e. one of the junction may "cool down".

Used for electrical cooling of (relatively small) devices. Only big effect if electrical heating ($\propto I^2$) is small.

Questionaire

All Multiple Choice questions to 2.4