2.2.3 Resistors and Heating

Resistors

- Basic requirements for **resistors** (still one of the most numerous component in circuits) are:
  - Large region of ***R*** values (= device resistance in Ω) within *one* production technology.
  - Small (ideally vanishing) temperature coefficient .
  - Minimal noise.
  - Small dependence of ρ on production parameters (good repeatability).
  - No Ageing.
  - Small thermoelectrical coefficients to **Cu** (you want a resistor, not a thermoelement).
- Materials of choice include
  - **Ta**, **Ta** based alloys, and in particular "**Constantan**" (**55% Cu, 44% Ni, 1% Mn**), a resistor material with an especially small temperature coefficient α_ρ, but a large thermoelectric coefficient).
  - Strange mixtures of conductors and insulators including "**Cermet**" (short for Ceramics - Metals), e.g. **Cr - SiO_2**.
- Details and data in the *(future)* link.

Heating

- Basic requirements for **heating elements** are:
  - High melting point.
  - Chemical stability at high temperatures and in potentially corrosive environments.
  - Mechanical strength at high temperatures.
- The choice of a materials depends significantly on the range of temperatures envisioned. We have:
  - **FeNiCr**, **FeNiAl** alloys.
  - **Pt**, **W**, **Ta**, **Mo** - stable elements with a high melting point.
  - **$MoSi_2$** Among more industrial applications also used as heaters in dish washers - this is very aggressive environment!
  - Graphite (up to **3000 K** in non-oxidizing gas).
- Some details and data can be found in the links.
  - **Overview of resistivity and temperature range for some materials**
  - **Maximum temperatures for some materials**