2.3.3 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**