Development of ultra thin PT100 temperature sensors

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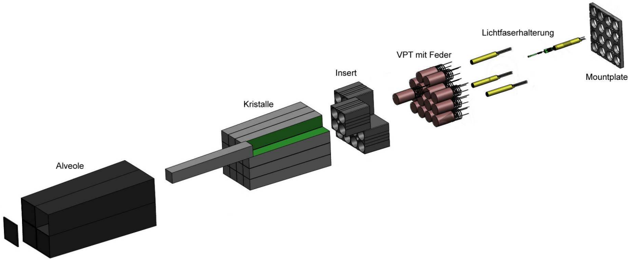
$\overline{\text{P}}$ANDA Electromagnetic Calorimeter and Proto192

- Change of light yield: 4%/K at $-25\,^\circ$C
  $\Rightarrow$ guarantee temperature gradient of < 0.1 K/cm
  $\Rightarrow$ temperature must be homogeneous along crystal and constant over time
  $\Rightarrow$ Monitoring temperature along crystal is mandatory
- Between alveole and crystal $\sim 100\,\mu$m space available
  $\Rightarrow$ Commercial temperature sensors can't be used

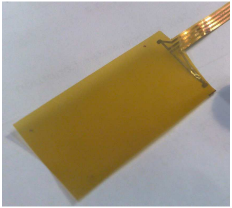


- $\Rightarrow$ Development of custom sensors is necessary
  Aim for sensitivity of 0.05 K ($\widehat{=}\,0.02\ \Omega$)

Basic Idea of ultra-thin PT100 sensors

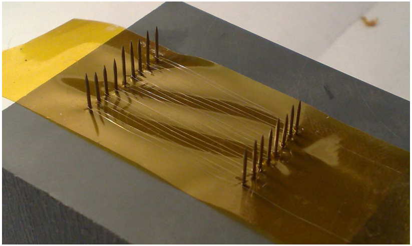
RUB

- Using polyimide foil coated with copper
- Etching traces with 1 mm pitch on polyimide foil as cable
- PT100 sensor at end of cable
- Using self-adhesive polyimide foil for insulation
- $\Rightarrow$ 70 μm thick cable/sensor



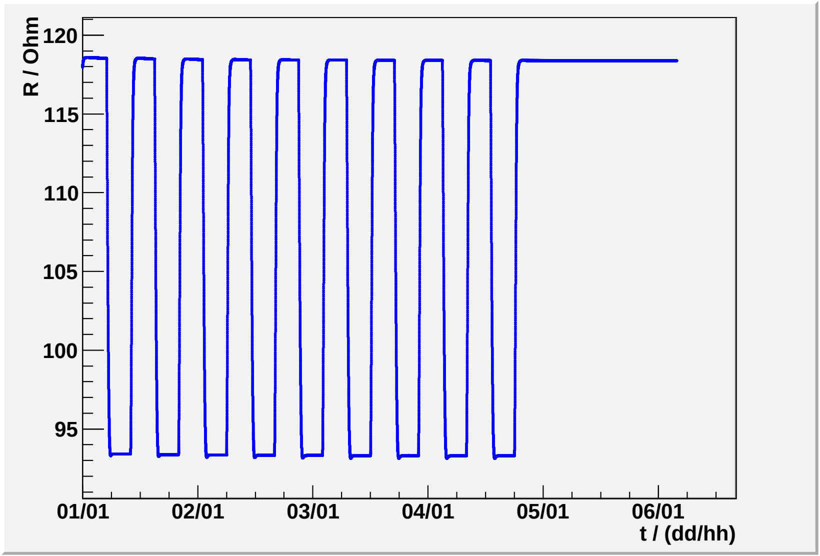
Development at RUB

- Using platinum wire with ø 25 μm
- Coating copper pads of cable with silver/gold
- Silver-plated conductor adhesive used to connect platinum wire to cable



Development at RUB

Prototype tested over 5 days measuring temperature cycles from $\pm 30\,^{\circ}$C



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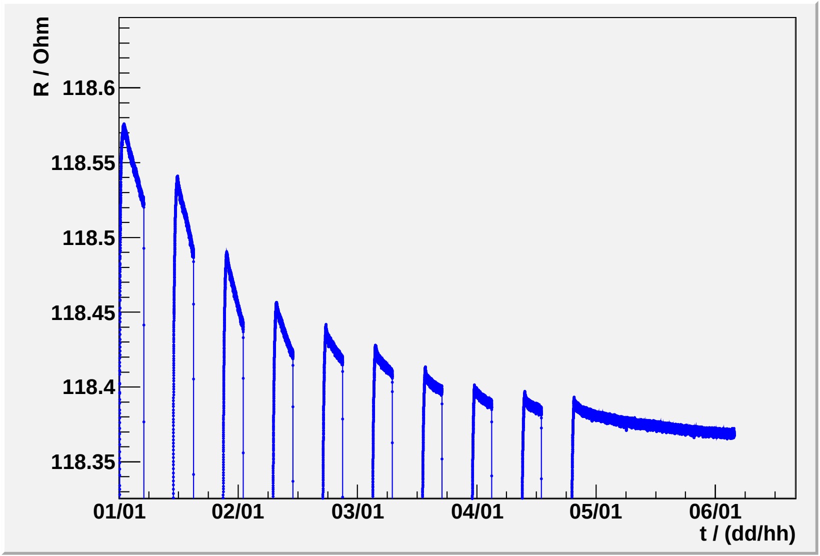
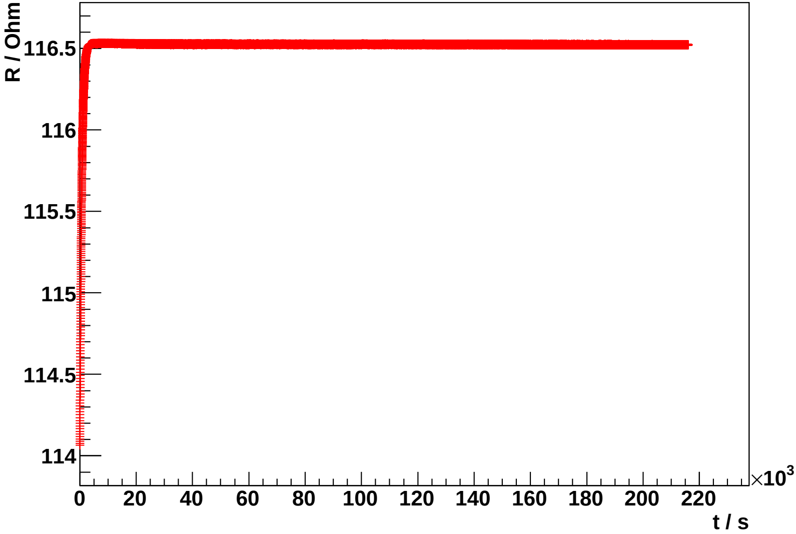


Development at RUB

2nd prototype baked at $+80\,^\circ$C and tested at $+30\,^\circ$C



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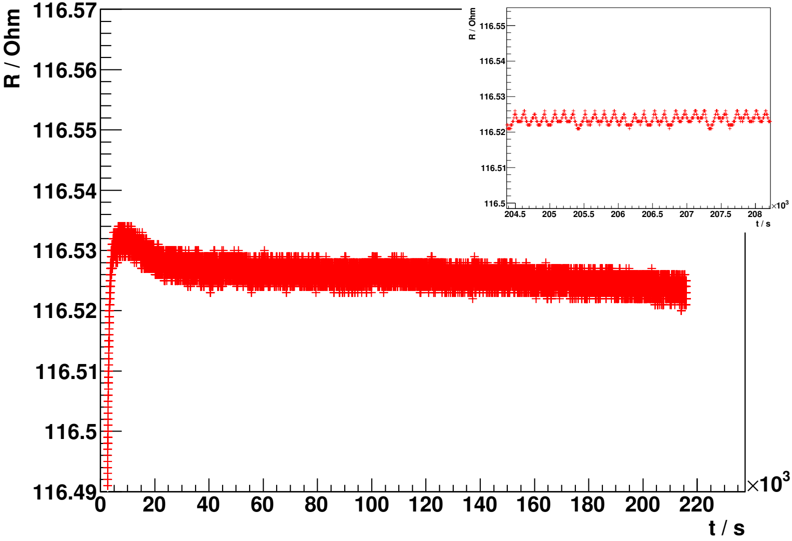

Development at SINS

- Two different ways of production are studied
- Evaporation of Pt in vacuum on polyimide cable
  - $R_0 = 120\,\Omega$
  - Slope coefficient comparable to comercial PT100 sensors
  - Long term stability not yet satisfactory
    $\Rightarrow$ Further studies needed
- Electrolytic deposition on polyimide cable
  Work in progress

Conlusion and Outlook

RUB

Conclusion

- Due to space requirements custom PT100 sensors have to be used
- Temperature sensors show decrement in resistance over time
- Baked sensor $\Rightarrow$ reduced “aging” effect

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Outlook

- Placing one sensor in exsiccator to outgas water inside ployimide
- Soldering platinum wire to copper pads to study effects of adhesive