



Thermal studies of DEPFETs for SuperBelle

Oksana Brovchenko

Institut für Experimentelle Kernphysik, Universität Karlsruhe (TH)

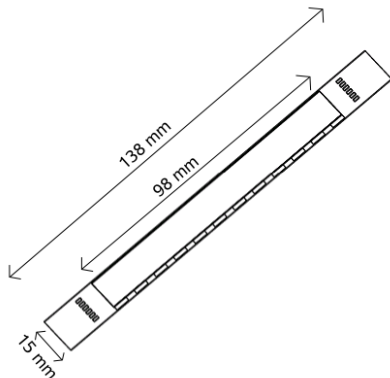
Ringberg Meeting, 05.05.2009



1 Simulation

2 First mock up

Design

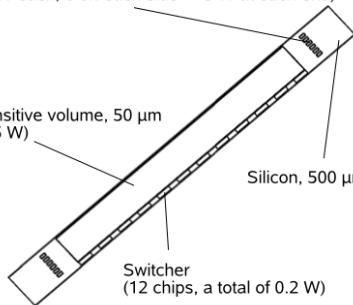


DCDs
(0.5 W each, 6 on each side \rightarrow 3 W at each end)

Sensitive volume, 50 μm
(0.5 W)

Silicon, 500 μm

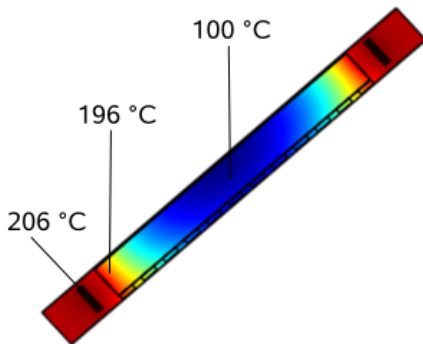
Switcher
(12 chips, a total of 0.2 W)





No cooling

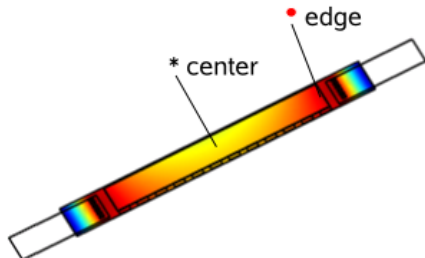
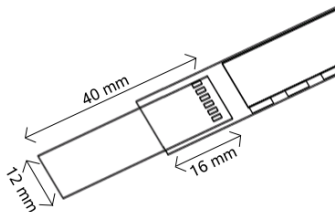
All heat sources switched on (total of 7.3 W)
ambient temperature = 27° C



Sensitive area: $\Rightarrow \Delta T \sim 96^\circ \text{C}$



Contact cooling



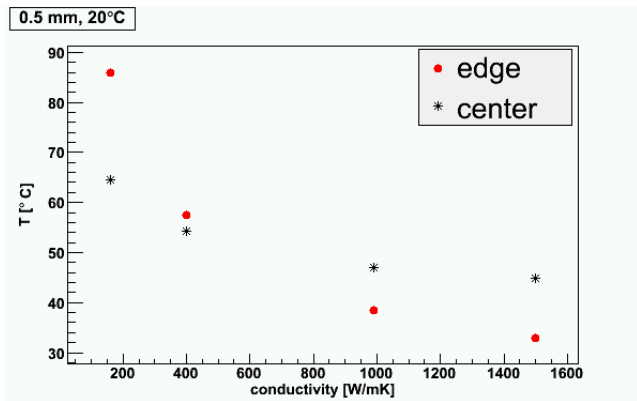


Contact cooling

comparison of 4 different materials

thickness = 0.5 mm

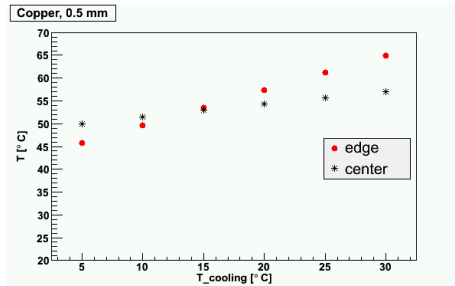
cooling temperature = 20° C





Contact cooling

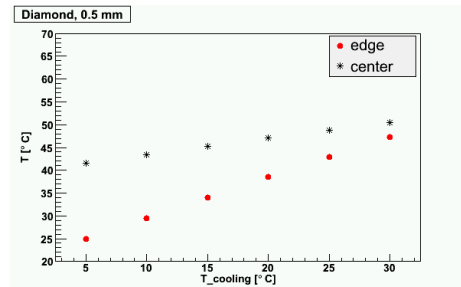
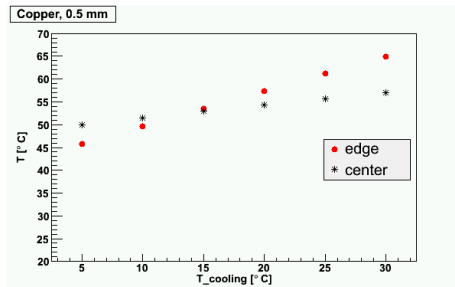
Cooling Temperature:





Contact cooling

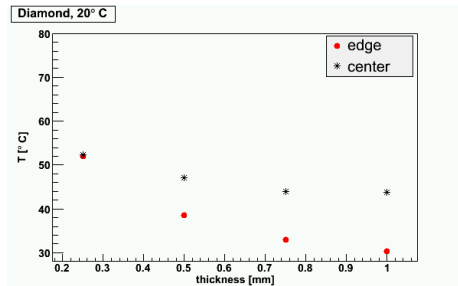
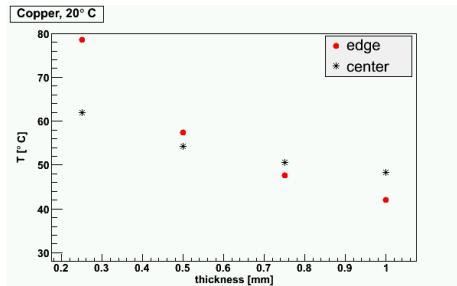
Cooling Temperature:





Contact cooling

Thickness of the cooling bars:





Outlook

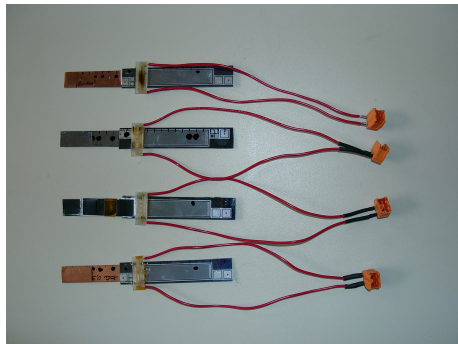
Next steps:

- adjust the simulation to current DEPFET-Design (DHP-chip)
- different dimensions/different placement of the cooling bars
- other materials for the cooling bars
- air cooling

New setup

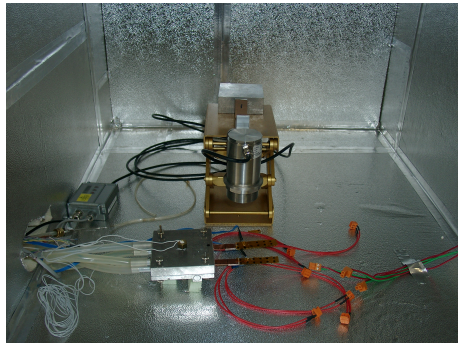
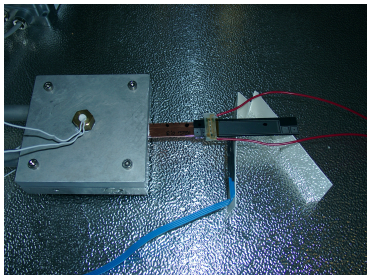
Study of the cooling power of different cooling bars (copper, carbon, TPG)

- 4 SMD-resistors as heat source (DCDs)
- cooling bar glued on the backside of silicon

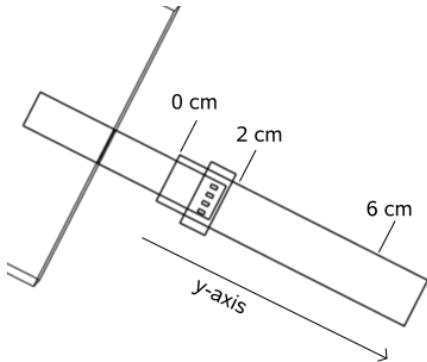
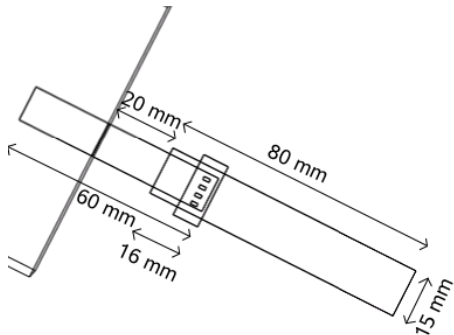


New setup

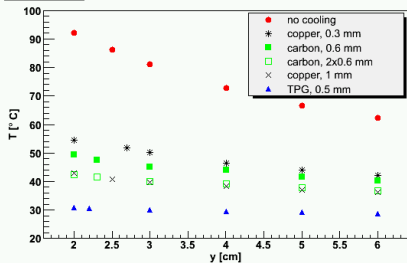
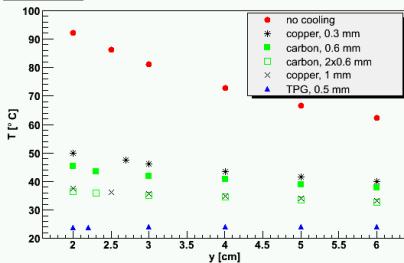
- Other end of the cooling bar between two water cooled aluminium plates
- Temperature measurement with an infra-red measurement device (+ some PT100/PT1000 for checking)



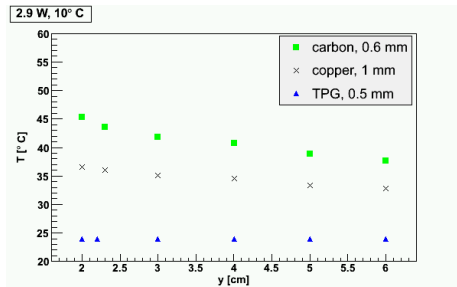
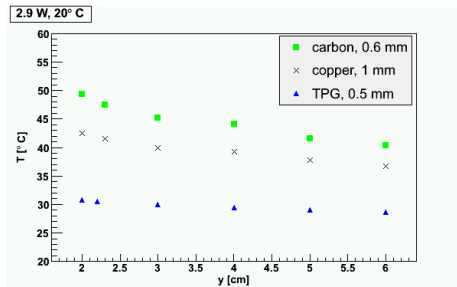
Dimensions



Results

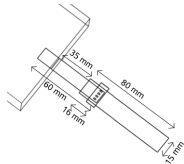
2.9 W, 20° C

2.9 W, 10° C


Results

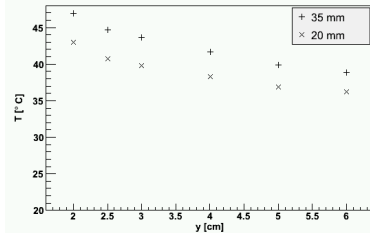




■ Distance to the cooling plates



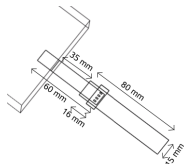
Copper, 1mm, 2.9 W, 20° C



Results

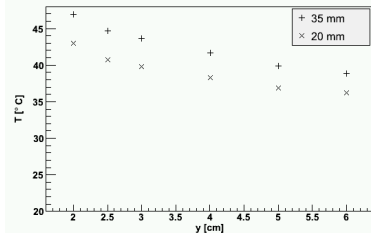


- Distance to the cooling plates

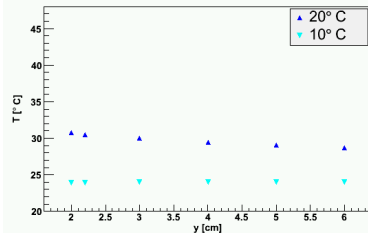


- Temperature of the cooling plates

Copper, 1mm, 2.9 W, 20° C



TPG, 0.5 mm, 2.9 W





Conclusions

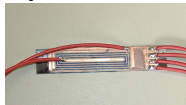
- cooling bars seem to be in general a good solution to cool down at least the heat from DCDs
- for a cooling bar's thickness of ≤ 0.5 mm a material with thermal conductivity of $\geq 1000 \frac{W}{mK}$ needed
- TPG material shows good cooling results, but has disadvantages as supporting material



Outlook

Next steps:

- replace SMD-resistors by a circuit board routed on a foil to simulate



all heat sources

- longer silicon pads
- change the dimensions of the cooling bars
- test a CVD-diamond
- air cooling