

Update on RD50 project NitroStrip

An RD50 project

30th RD50 Krakow
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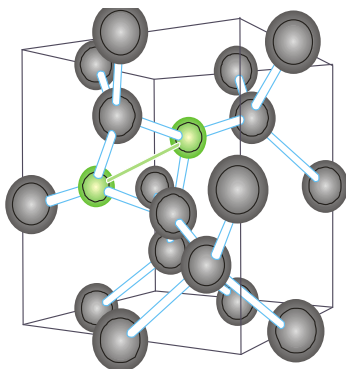
Institut für Experimentelle Kernphysik (IEKP)



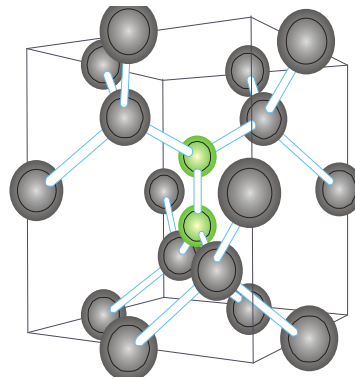
Motivation

■ As shown in previous RD50 Workshops Nitrogen enriched wafers show promising behavior after irradiation:

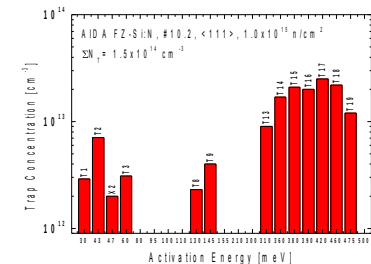
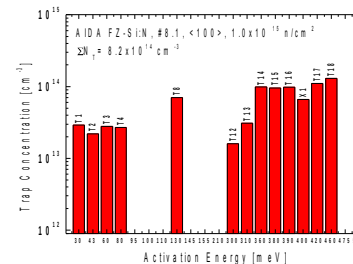
The concentrations of defect centers with the activation energies of 30 meV, 310 meV, 360 meV, 380 meV, and 460 meV are found to be significantly lower in the material with a higher nitrogen concentration.



$N_i N_i$ idren
wt o ps ti ri Æ s



$N_i N_i$ ap ri
Nsp+ il tri Æ l



Fluence: $1 \times 10^{15} n_{eq} / cm^3$

[Vaitkus RD50 Workshop, November 2014]

Results for NitroSil project (with diodes fabricated on different wafers) are presented in different talks

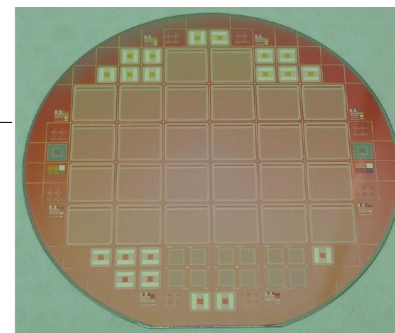
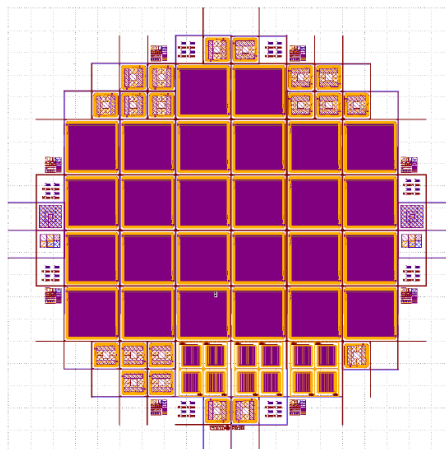
New fabrication on Strip p-in-n sensors

■ CNM Barcelona fabricated 24 wafers on 4 different materials:

- FZ
- Nit
- DOFZ
- MCz

Wafers	Label	Substrate
1-6	FZ	HR FZ 100 mm, <100>, n-type (phosphorus), 2000-2400 Ω -cm, 300 \pm 15 μ m, 1-side polished (Topsil, NitroSil, LOT: 15-2880-50)
7-12	NIT	HR FZ Nitrogenated 100 mm, <100>, n-type (phosphorus), 1500-1900 Ω -cm, 300 \pm 15 μ m, 1-side polished (Topsil, NitroSil, LOT: 3140815, laser marked: 46-56)
13-18	DOFZ	HR FZ Oxygenated Same as FZ, but oxygenated in run 9394 (estimated resistivity around 1000 Ω -cm, from 4-point measurements on 1 wafer)
19-24	MCZ	HR MCZ 100 mm, <100>, n-type (phosphorus), 800-1000 Ω -cm, 300 \pm 10 μ m, 2-side polished (Okmetic, 3-digit counter mark)

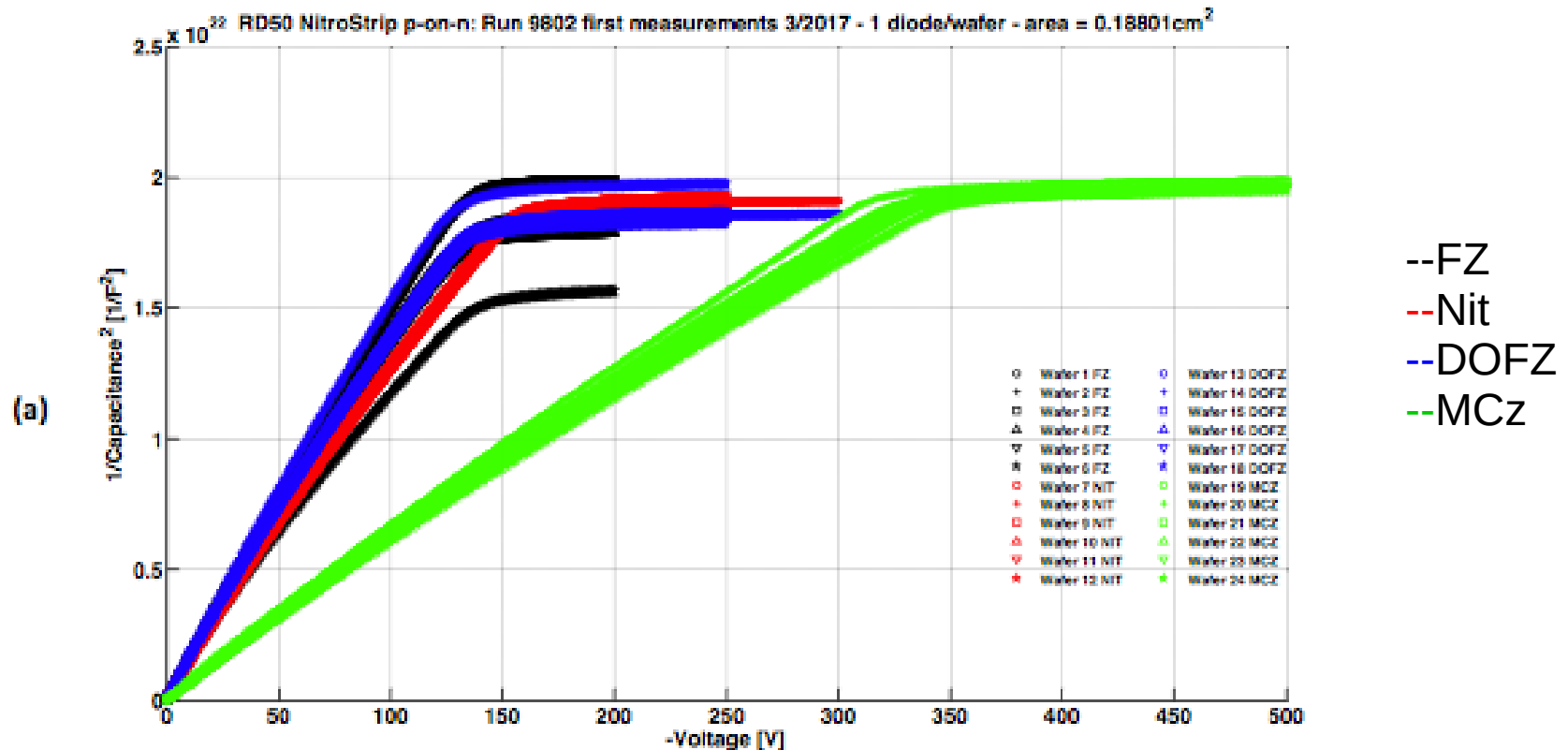
■ Those sensors are distributed in CERN, Freiburg, Hamburg, ITME, KIT and CNM to study its performance after irradiation



RD50 NitroStrip: first C-V and I-V results on run 9802 diodes and microstrips, J-M Rafi

Those sensors were first characterized at CNM

- CV characterization at CNM for diodes of the wafer



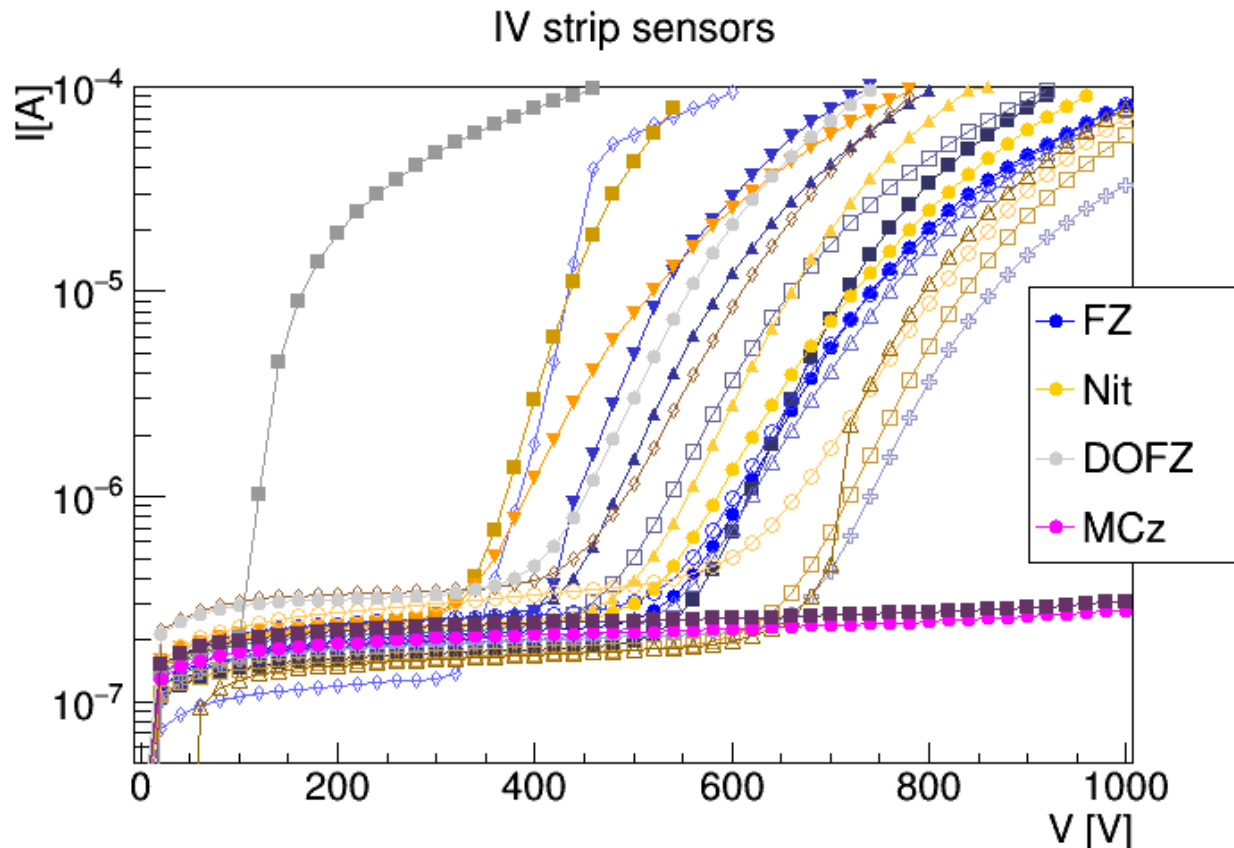
RD50 NitroStrip: first C-V and I-V results on run 9802 diodes and microstrips, J-M Rafi

Electrical measurements at KIT

- Measurements were taken at the KIT probe station
- The measurements were taken at 20°C
- Measurements for FZ, Nit, DOFZ were taken at 200V
- Measurements for MCz were taken at 400V
- Measurements for interstrip resistance and interstrip capacitance were taken with the measured strip and the neighboring strip

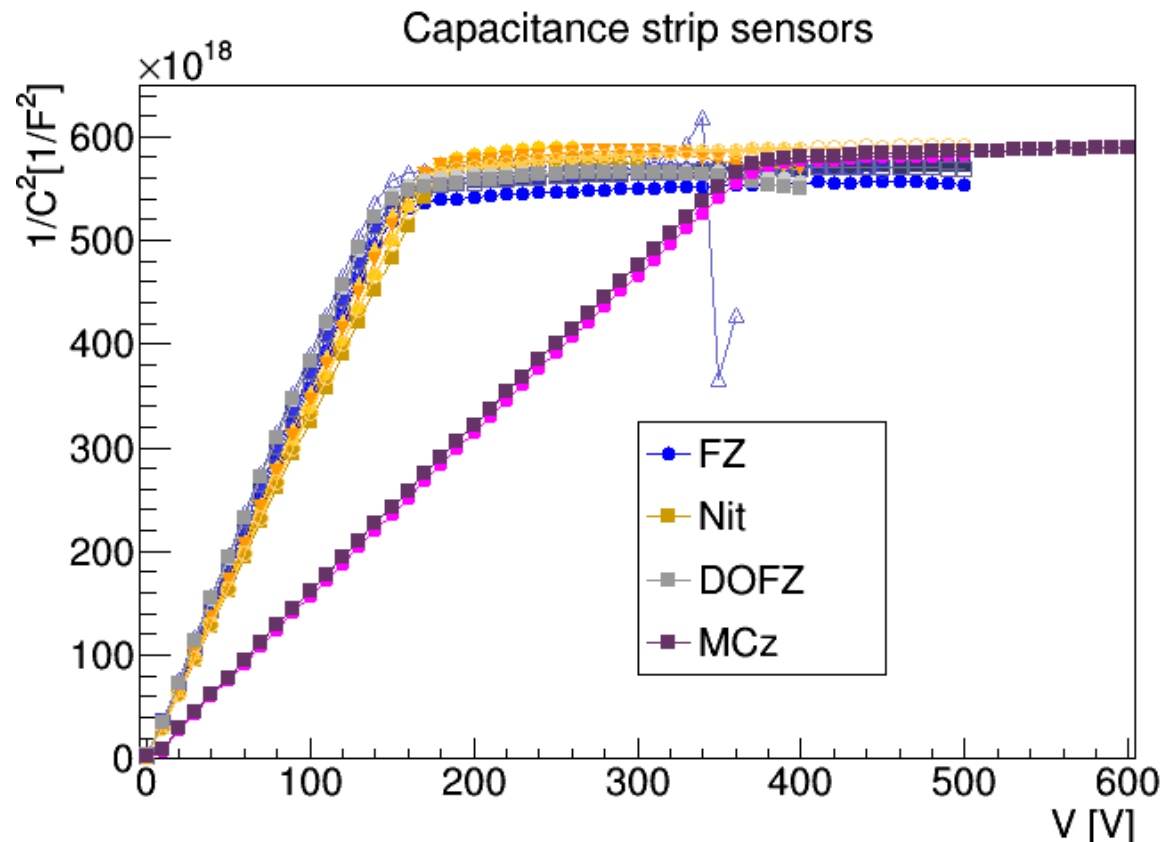
Some measurements taken at KIT for the strip sensors

- Measurements of the strip sensors
- MCz show the higher breakdown voltage and have higher depletion voltages



CV strip 1cm²

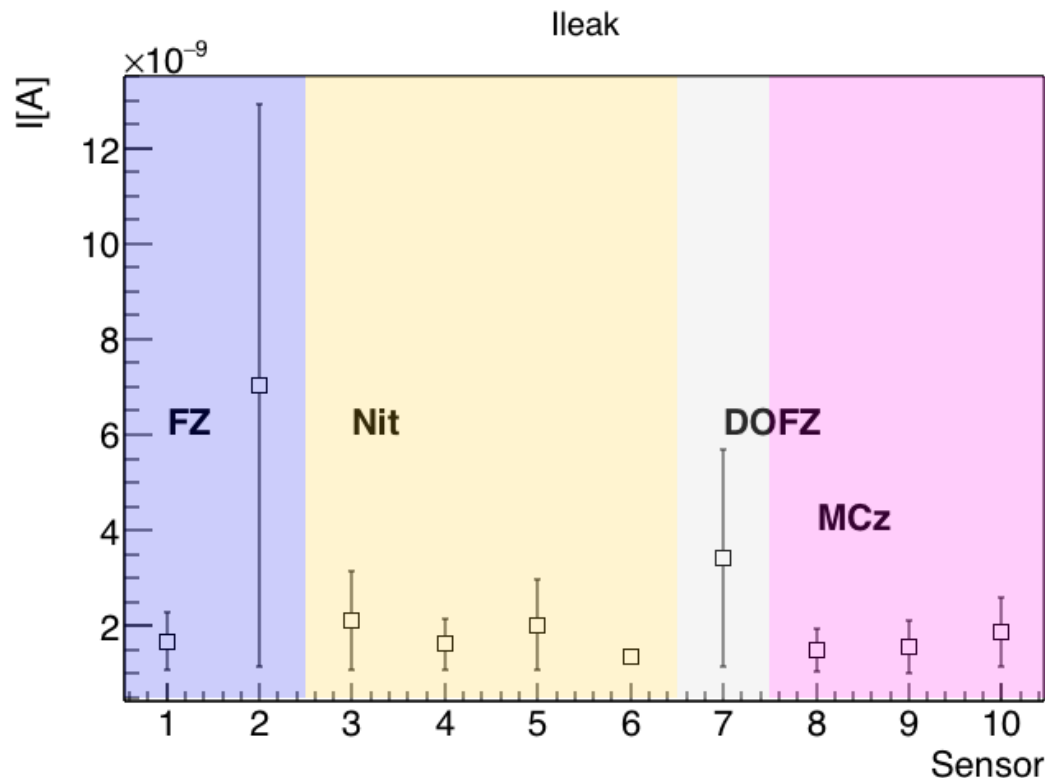
- Strip sensors deplete around 150V
- MCz full depletion voltage at 360V



- Similar results as in: *RD50 NitroStrip: first C-V and I-V results on run 9802 diodes and microstrips, J-M Rafi*
- Strip measurements for FZ, Nit, and DOFZ will be at 200V and MCz at 400V

Leakage current strips

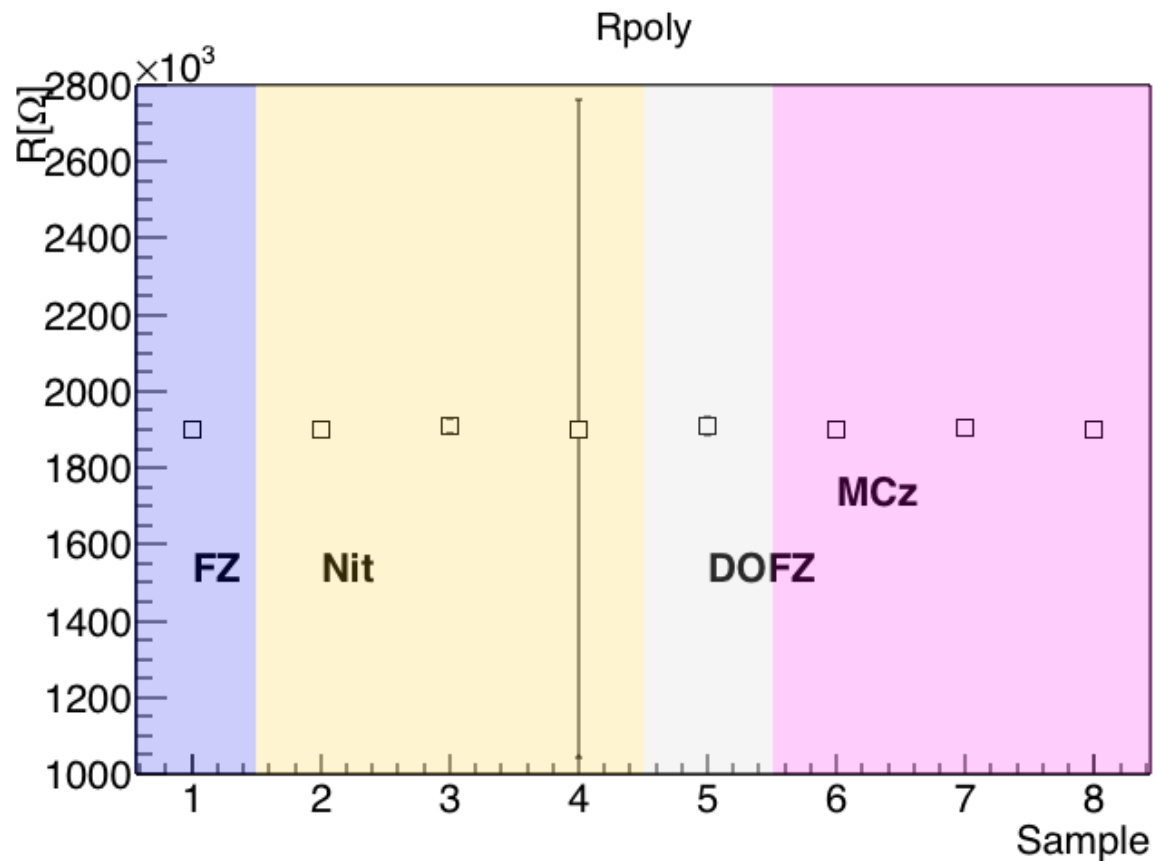
- Leakage current at the expected values, around 2nA per strip
- They are in the order of magnitude of the total current
- Data measured as an average of 131 strips, and the error bars are the minimum value



MCz measurements are carried out at 400V, the FZ wafers are measured at 200V

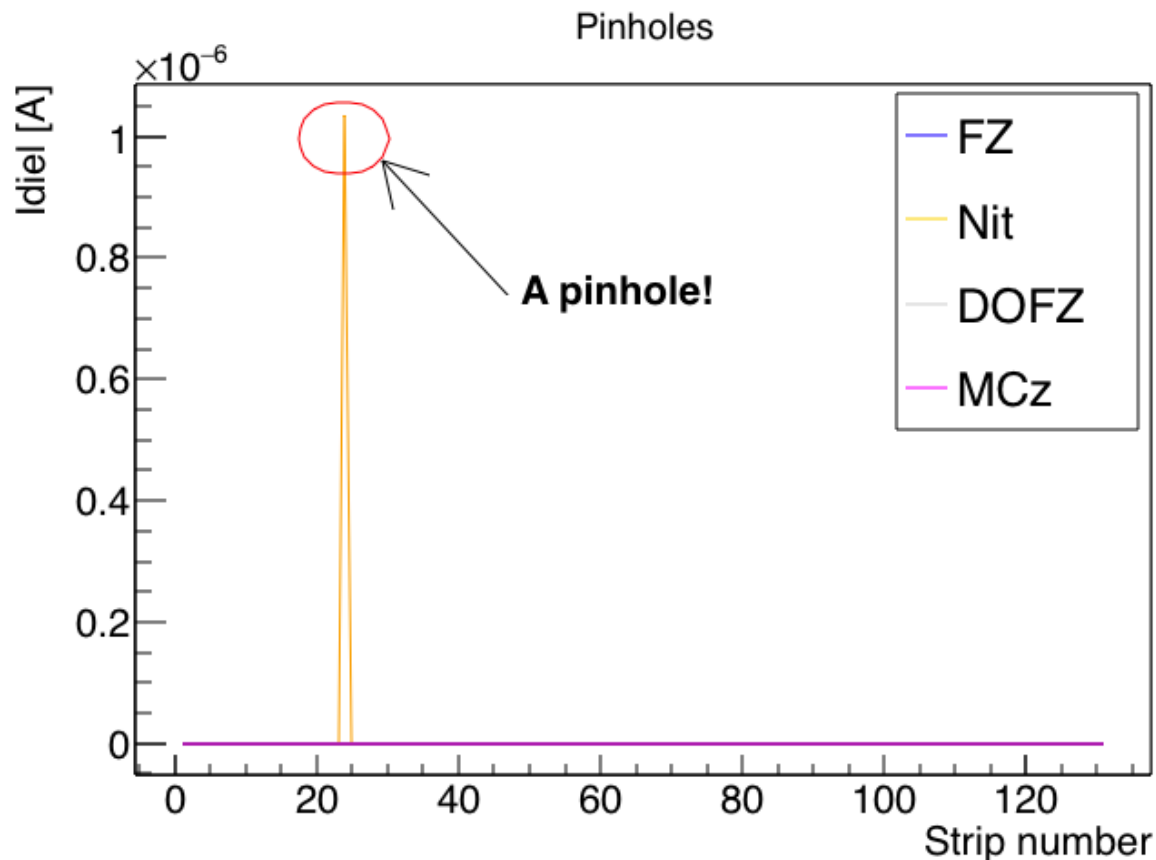
Polysilicon resistance

- Values around 1.9MΩ
- Average of 131 strips



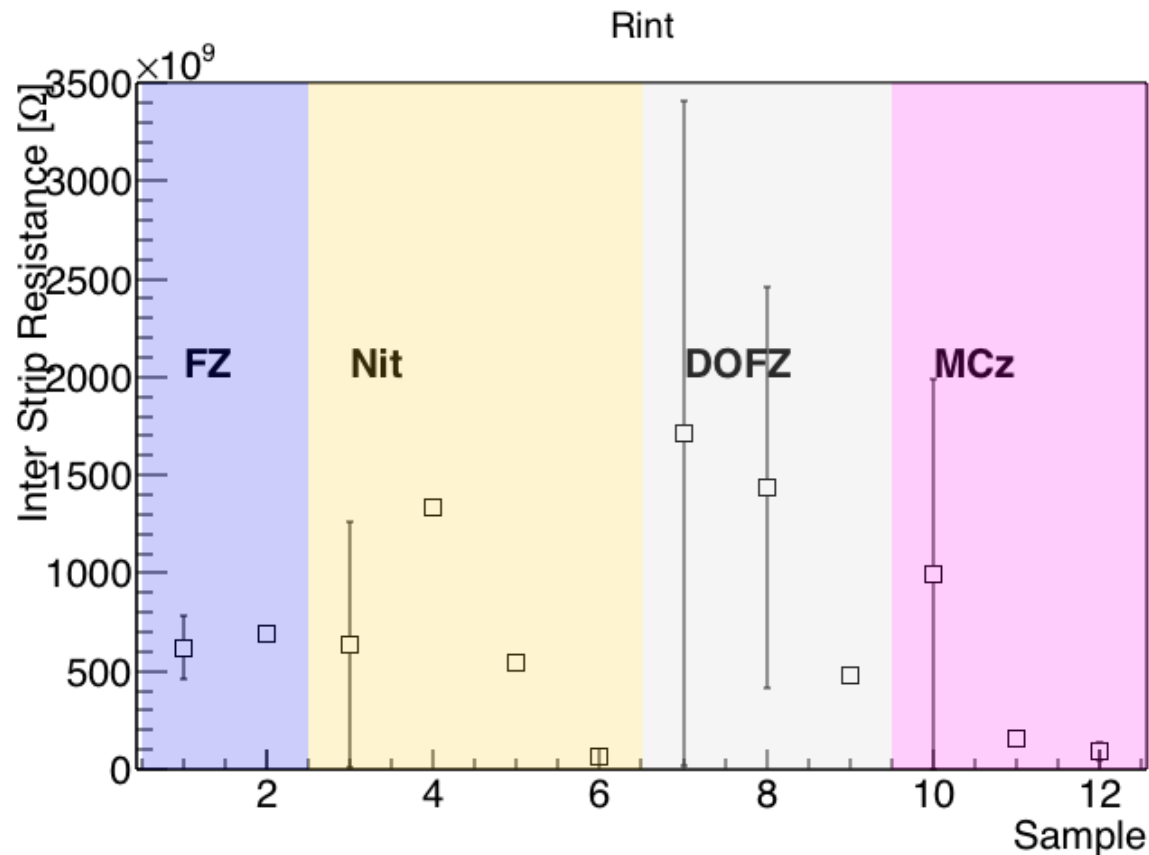
Pinholes

- Plot shows the measurement of 17 measurements for different wafers, with the strip number
- Only a pinhole for 17 samples measured



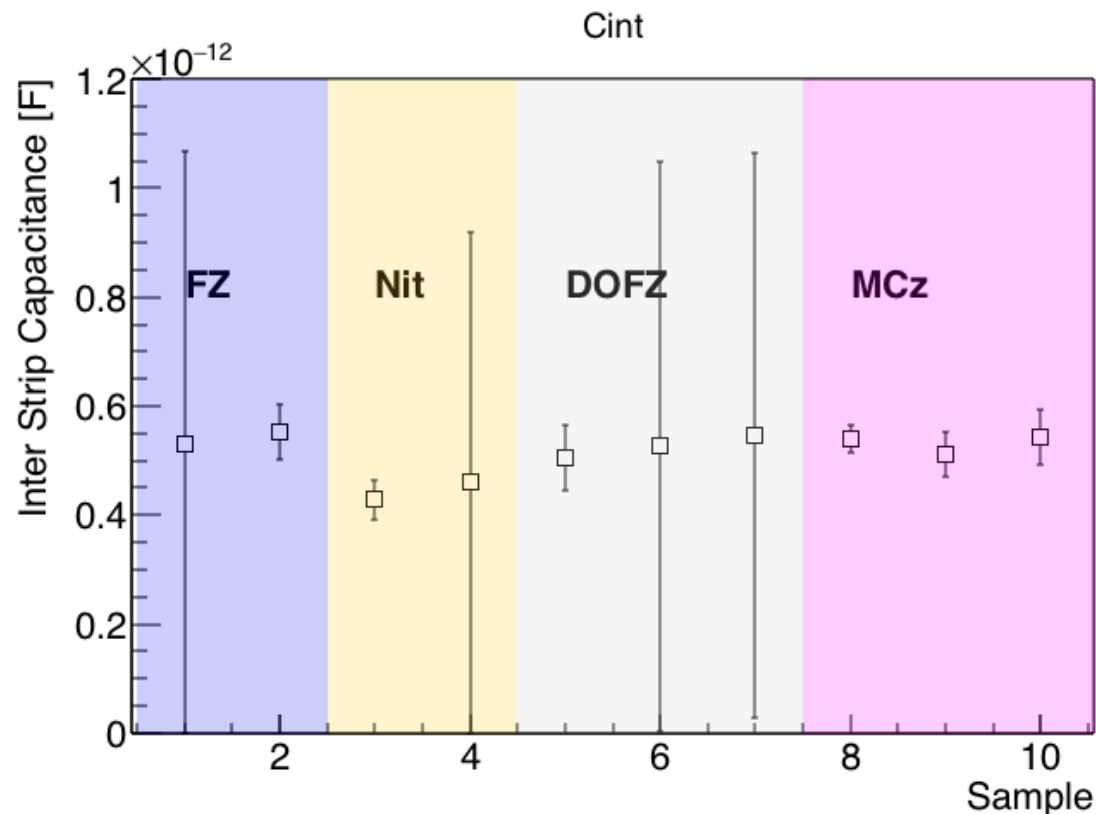
Inter Strip Resistance

- Measurement connecting only one neighbor strip, average of 130 strips
- The numbers are between 0.5-1.5GΩ.



Inter Strip Capacitance

- Measured with only one neighbor, error bar belongs to the minimum measurement, average of 130 measurements
- C_{int} is around 0.55 pF/cm



Summary

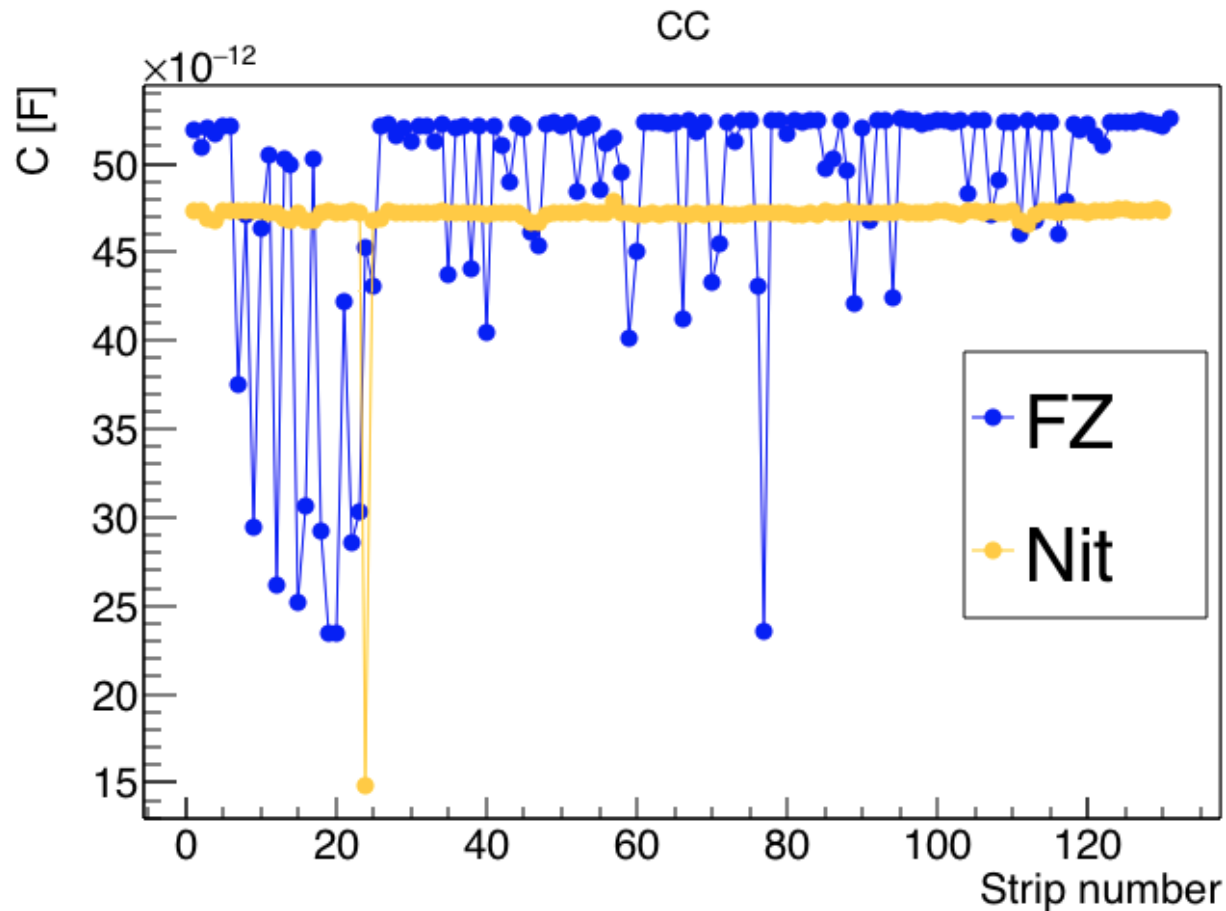
- The strips 1x1cm² show good electrical behavior
- Strip leakage current is around 2nA
- Polysilicon resistance of 1.9M Ω
- Inter strip resistance 0.5-1.5G Ω
- Inter strip capacitance around 0.5pF/cm

Future work

- CCE characterization before irradiation with ALiBaVa setup
- Irradiate samples with neutrons, protons and neutrons+protons , as baseline: 23MeV protons and reactor neutrons; possible 24GeV protons, Co source
- After irradiation characterize electrically and CCE with ALiBaVa setup
- At UHH: TSC, DLTS, e-TCT

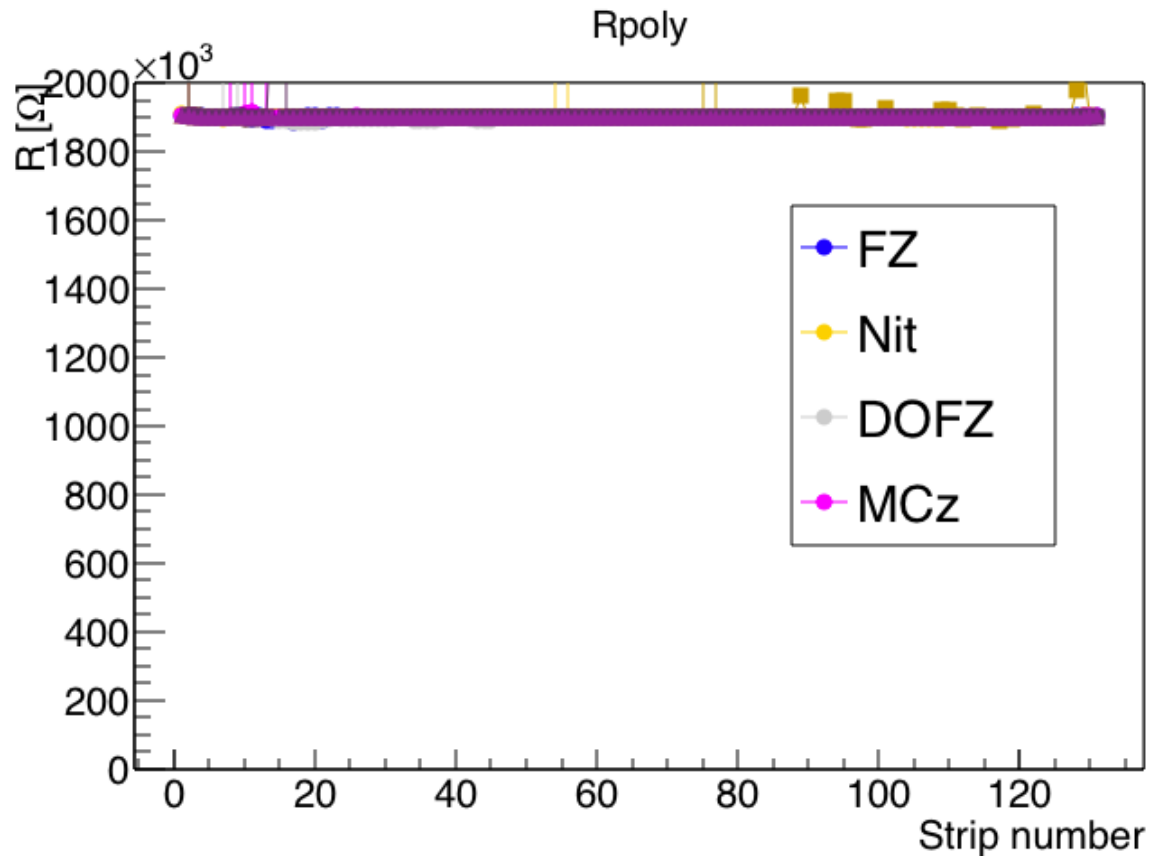
Backup

■ Coupling capacitance



Backup

■ Measurement Rbias



Backup

■ Measured data:

