

IHEP HGTD Sensor Status



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on behalf of the IHEP HGTD Sensor Team

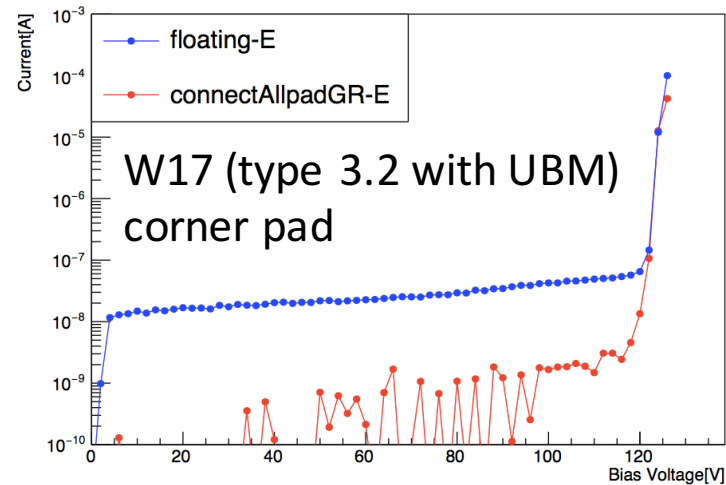
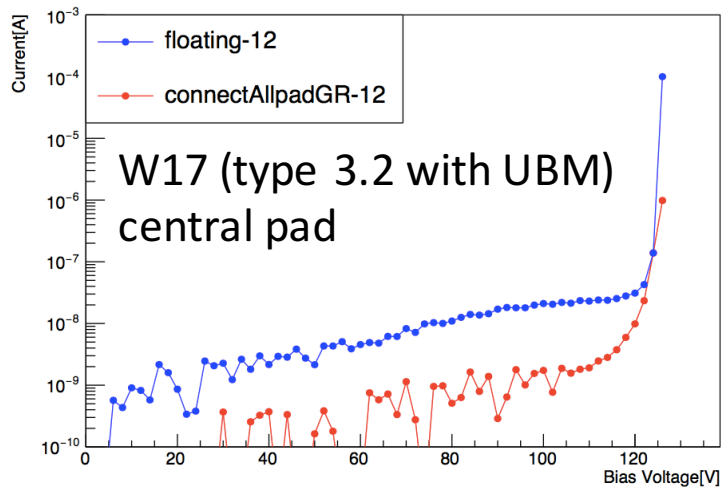
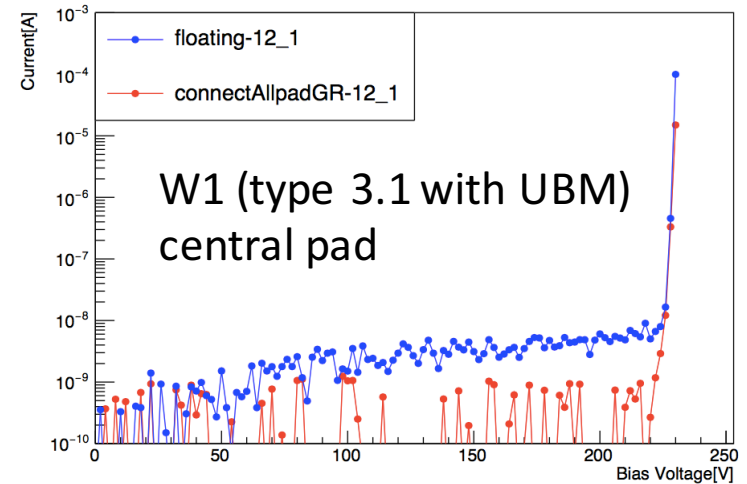
2019.02.20

Updates on measurements

- IV measurements on HPK LG5x5 sensors with UBM:
 - HPK-UBM-3.1-W1_LG5x5-SE5-IP9-P8
 - HPK-UBM-3.2-W17_LG5x5-SE5-IP9-P6
- CV measurements with different guard ring configurations:
 - HPK-SMPL-3.1-W8_Single_SET-P3

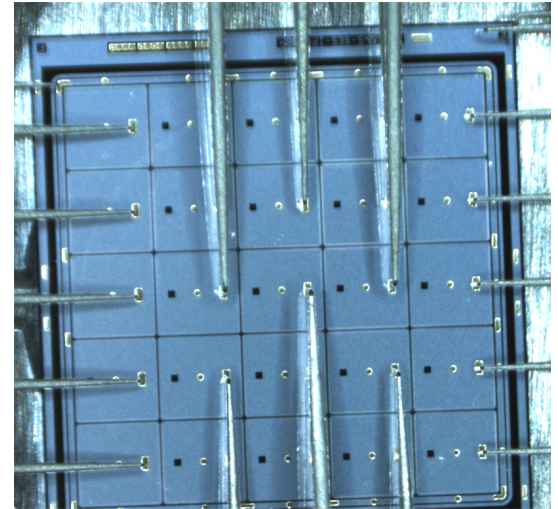
Comparison of floating/grounding

- Test two configurations:
 1. “Neighboring 24 pads + GR” **floating**
 2. “Neighboring 24 pads + GR” **grounded**
- Higher dark current before breakdown with the “floating” configuration.
- Breakdown voltage unchanged.



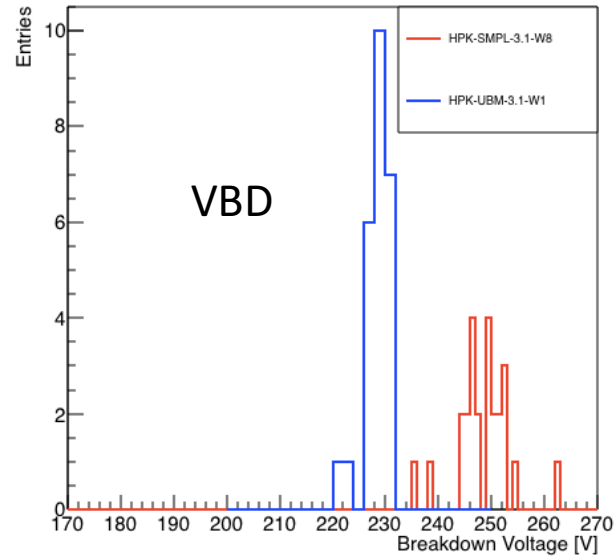
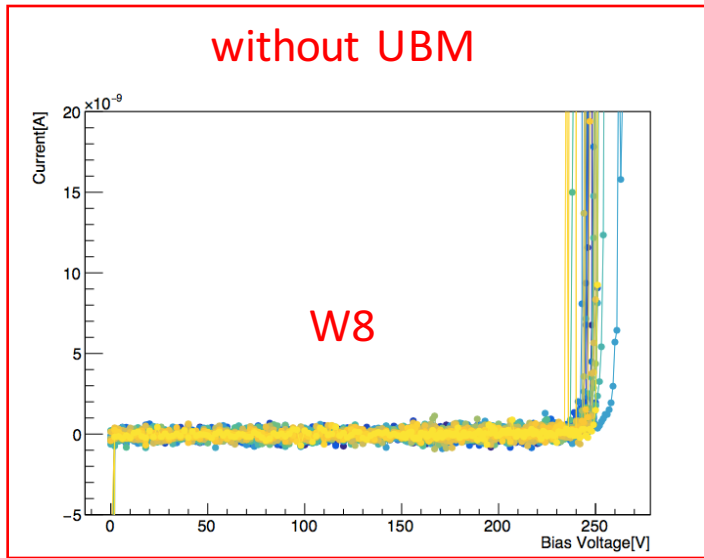
HPK 5x5 IV test settings

- Measurements done with all pads and GR connected.
 - Keithley 2410 provides HV applied to the back of the sensor.
 - Keithley 2400 measures the pad current.
 - The other 24 pads and the GR are connected to ground.
- Room temperature.
- Measure the current in 2V step.

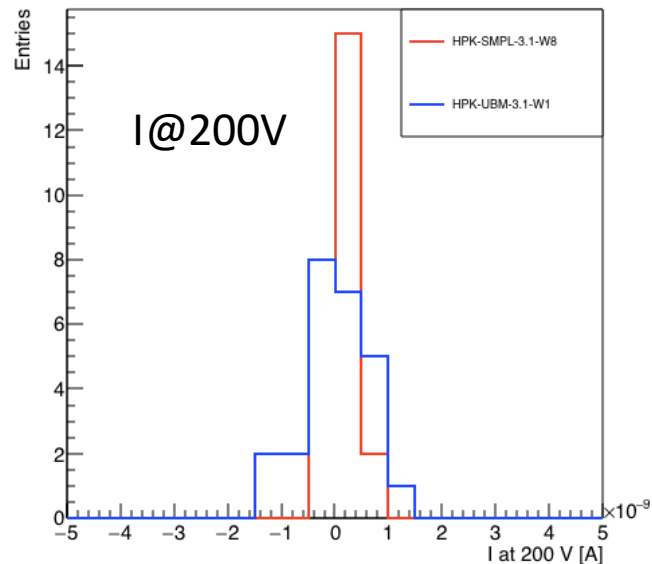
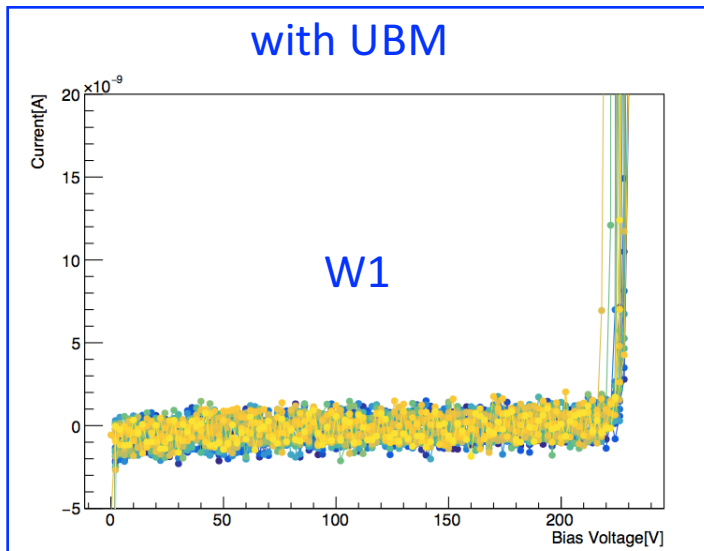


HPK 5x5 with UBM

Comparison of type 3.1 with and w/o UBM



Lower VBD with UBM.



Similar level of dark current before BD.

Comparison of type 3.2 with and w/o UBM

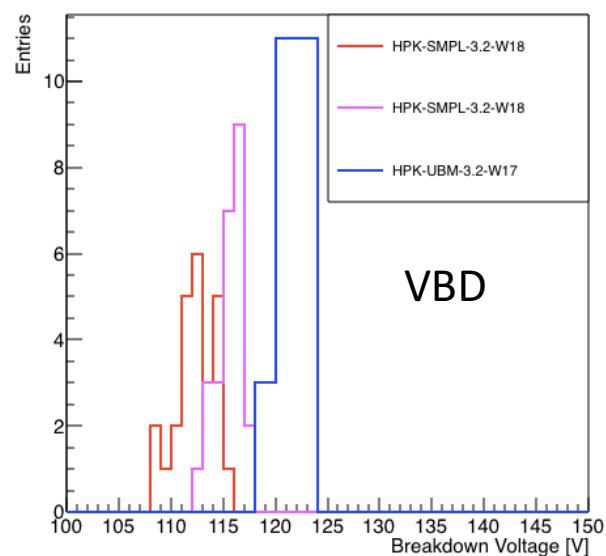
without UBM

with UBM

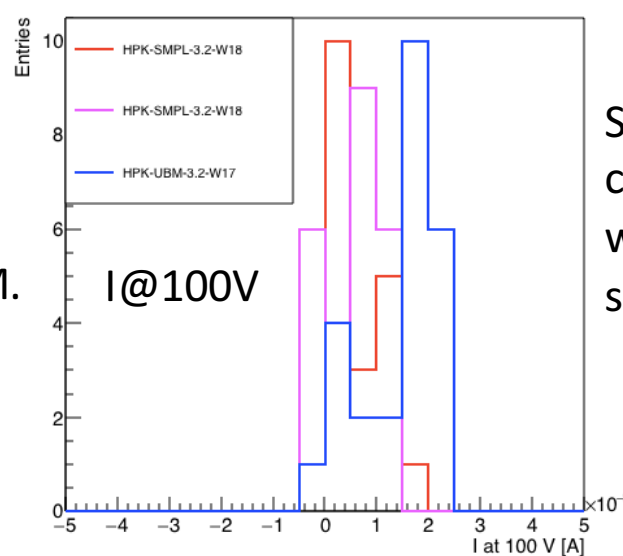
W18-P8

W18-P9

W17-P6



Slightly higher
VBD with UBM.



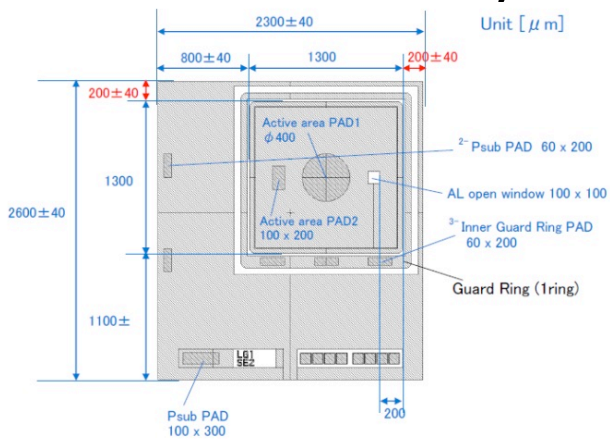
Slightly higher dark
current before BD
with UBM, but not
significant.

Updates on measurements

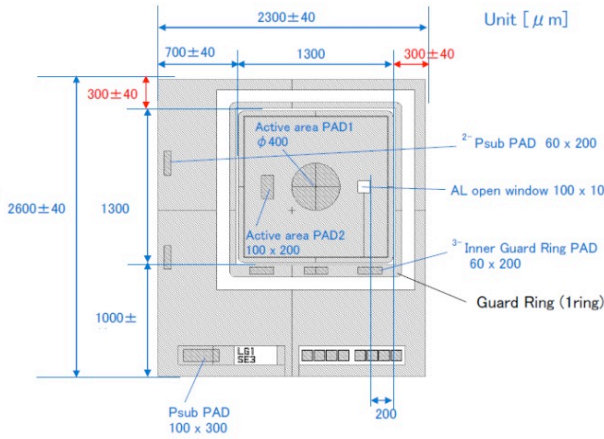
- IV measurements on HPK LG5x5 sensors with UBM:
 - HPK-UBM-3.1-W1_LG5x5-SE5-IP9-P8
 - HPK-UBM-3.2-W17_LG5x5-SE5-IP9-P6
- CV measurements with different guard ring configurations:
 - HPK-SMPL-3.1-W8_Single_SET-P3

CV test overview

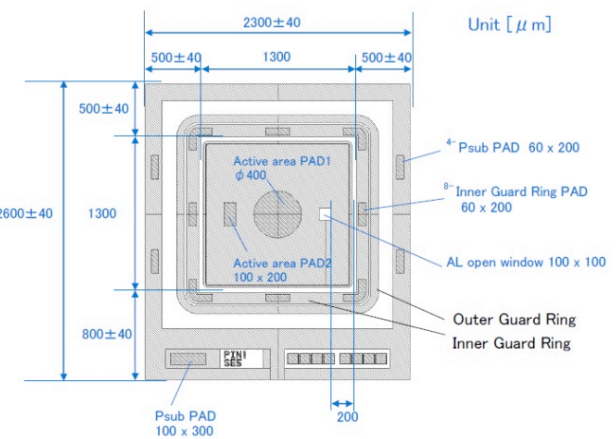
- We tested 7 single pads from HPK W8
 - SE2 x2, SE3 x2, SE5 x2 and PIN x1
 - compare the capacitance at full depletion for different sensor layout



SE2
1 guard ring



SE3
1 guard ring



SE5
2 guard rings

- Size of GR seems larger than SE2/SE3

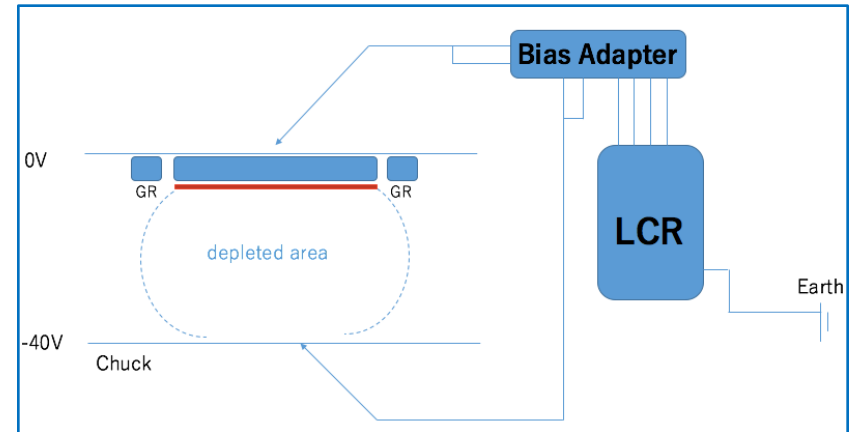
Questions:

1. Aluminum on the sensor: Is that pure aluminum or is it AlCu or AlSiCu?
2. What material is UBM made of? Do we know the height of UBM?

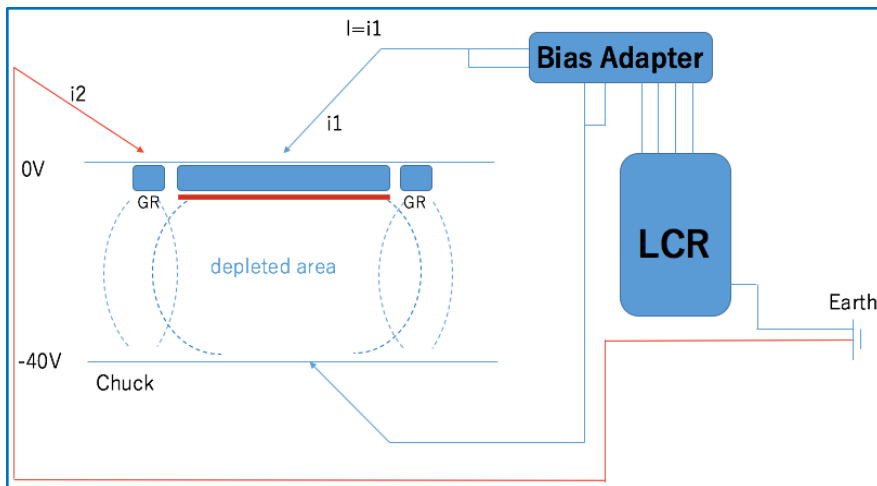
CV test settings

- Three configurations:
 1. GR floating
 2. GR grounded
 3. GR connected in parallel with the pad to be tested

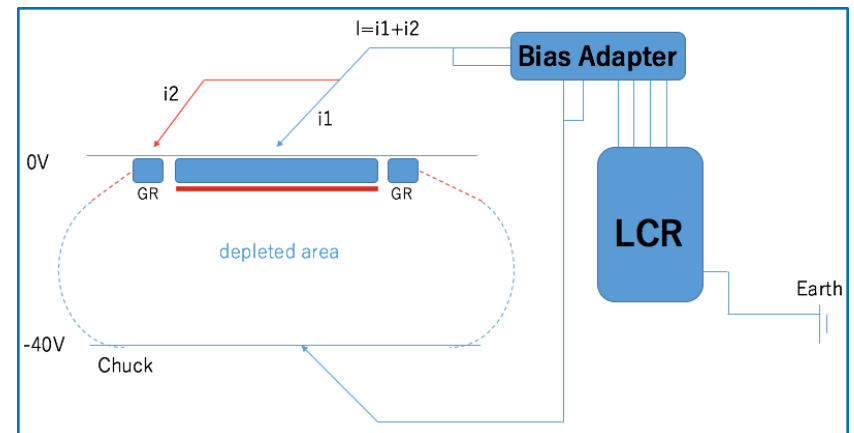
1. GR floating



2. GR grounded

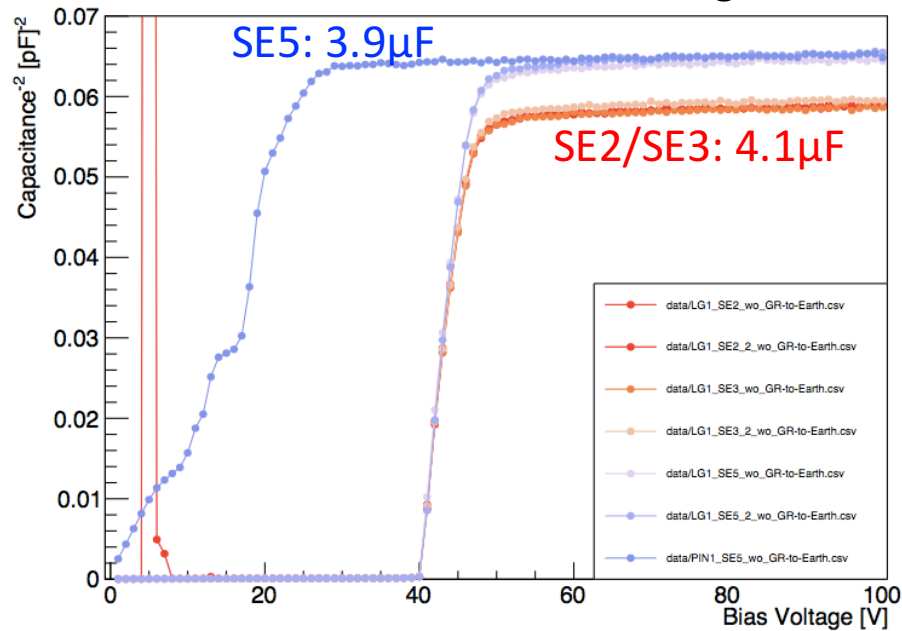


3. GR connected

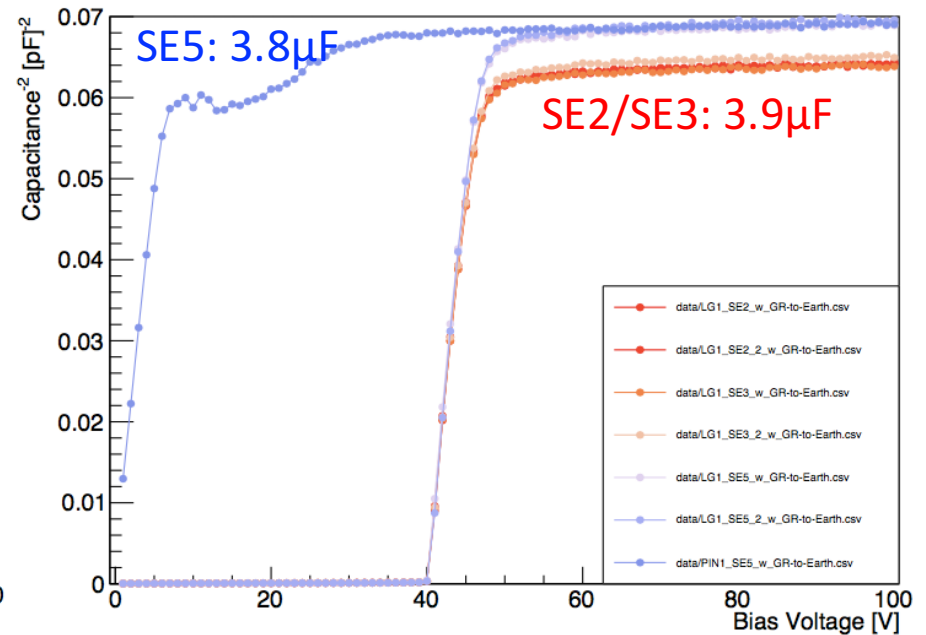


Comparing GR floating/grounded

1/C²-V for GR floating



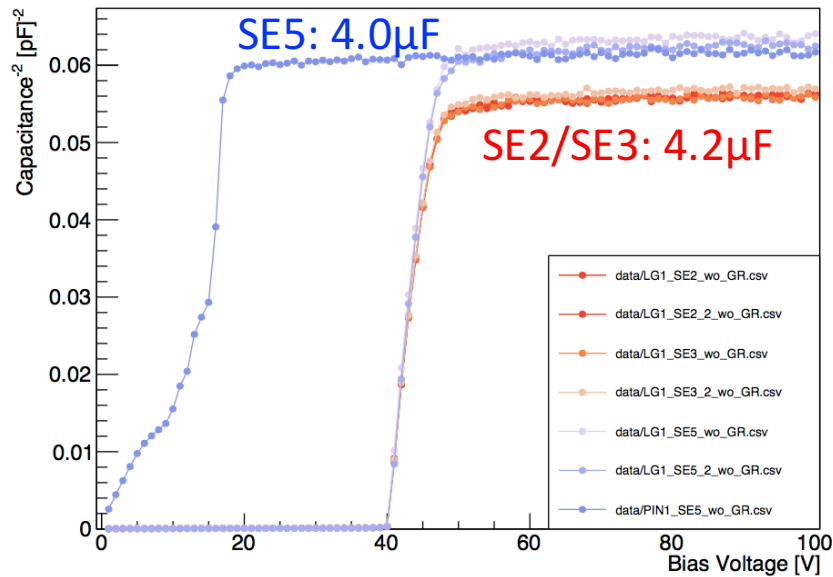
1/C²-V for GR grounded



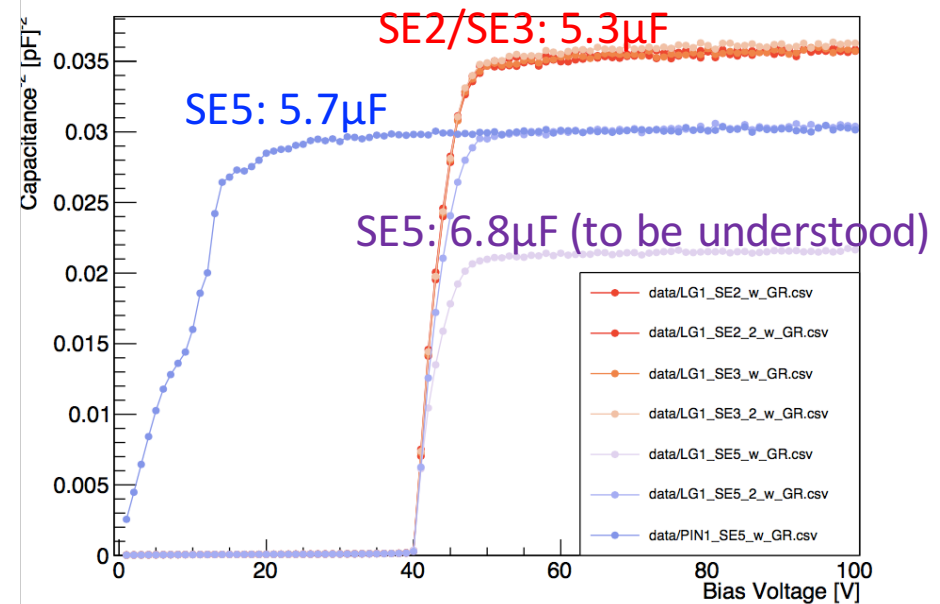
- Very similar capacitance at full depletion for GR floating and grounded.
- The difference between SE5 and SE2/SE3 remains the same.
- PIN seems to deplete faster when GR is grounded.

Comparing GR floating/connected

1/C²-V for GR floating



1/C²-V for GR connected



- When GR is connected, effectively measuring the “pad+GR” area:
 - The capacitance at full depletion for SE5 increases by 43%
 - The capacitance at full depletion for SE2/SE3 increases by 26%
- If we estimate the active area change (pad+GR)/pad:
 - For SE5: $(1.3+0.15)^2/1.3^2 = 124\%$
 - For SE2 and SE3: $(1.3+0.1)^2/1.3^2 = 116\%$
 - Only partially explain the capacitance increase.

Summary

- IV curves measured for HPK 5x5 W1 and W17 with UBM.
 - 100% good pads.
 - Similar dark current with and without UBM when all pads and GR are grounded.
- CV curves measured for different GR configurations.
 - Similar capacitance for GR floating/grounded.
 - Capacitance increases if GR is connected in for testing.
 - Capacitance of SE5 differs from SE2/SE3, probably reflecting the difference in sensor layout.
- **Questions**
 - Aluminum on the sensor: Is that pure aluminum or is it AlCu or AlSiCu?
 - What material is UBM made of ? Do we know the height of UBM?
- **Plan**
 - IV and CV tests on remaining 5x5 sensors (W2/3/4/7).
 - IV and CV on irradiated sensors (looking forward to irradiated sensors).
 - X ray irradiation tests for sensor and ALTIROC1.
 - TCT laser tests.