

Silicon sensor module production
for PHENIX FOCAL

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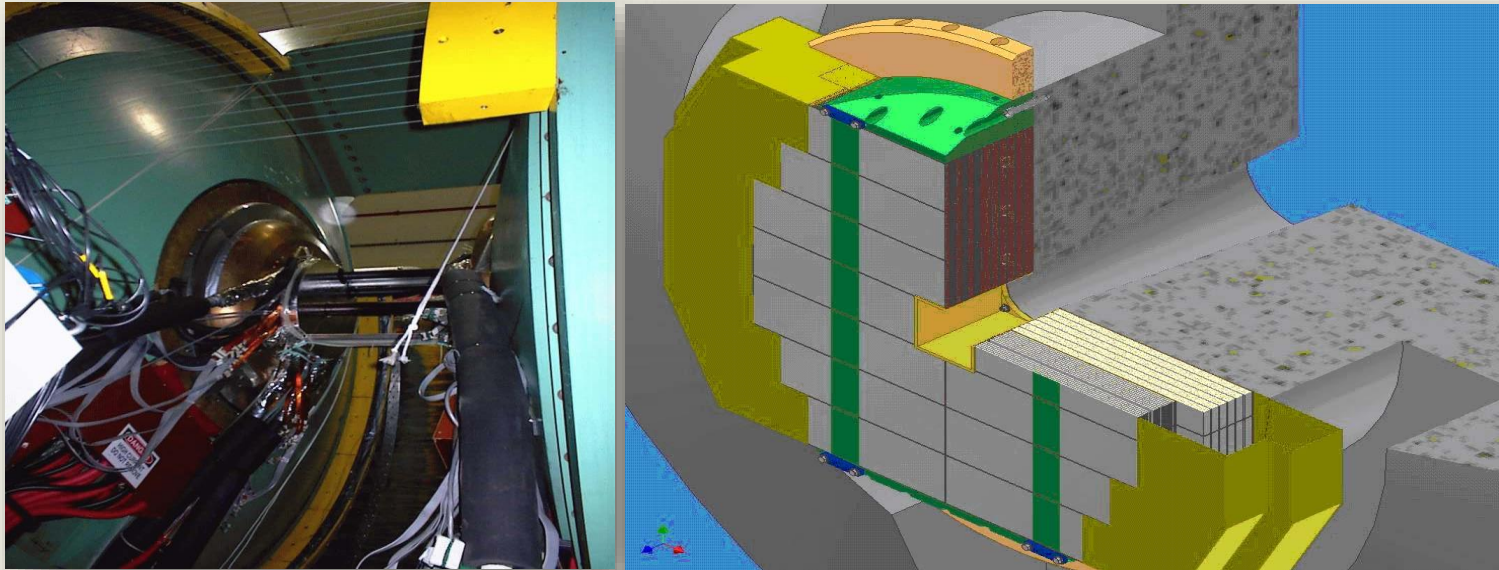
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 - Silicon pad sensor
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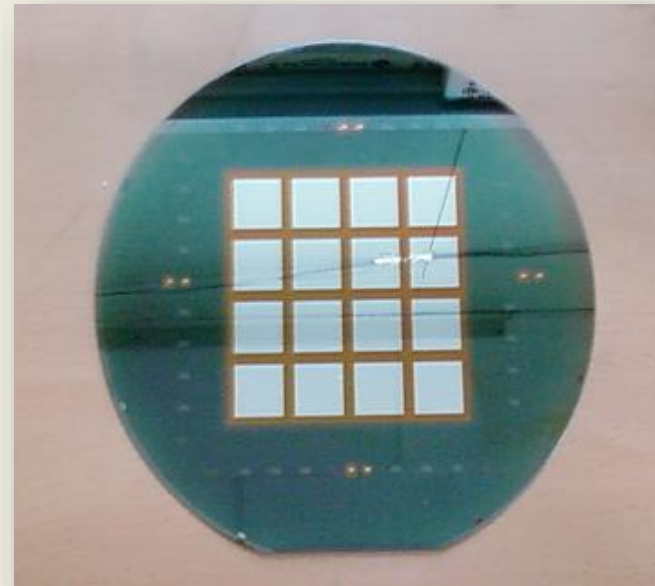
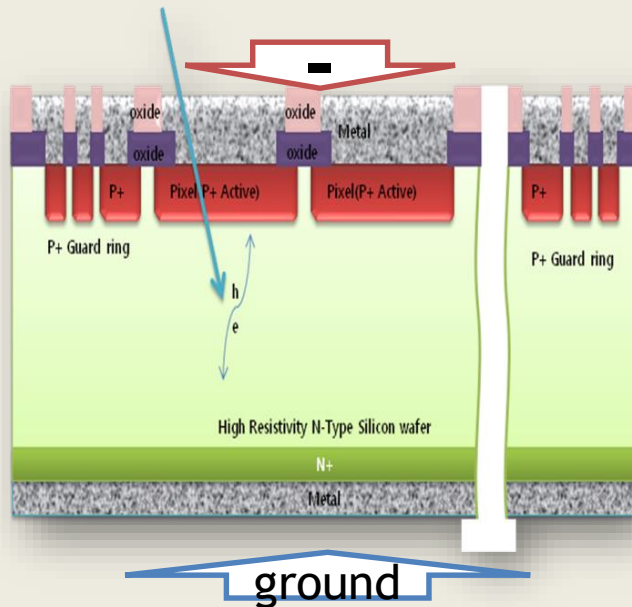
PHENIX FOCAL



- FOCAL is a **F**ORward **C**ALorimeter for PHENIX experiment.
- Two types of silicon sensors
 - Strip and **pad** sensor
- **Beam test** at CERN is planned in June.

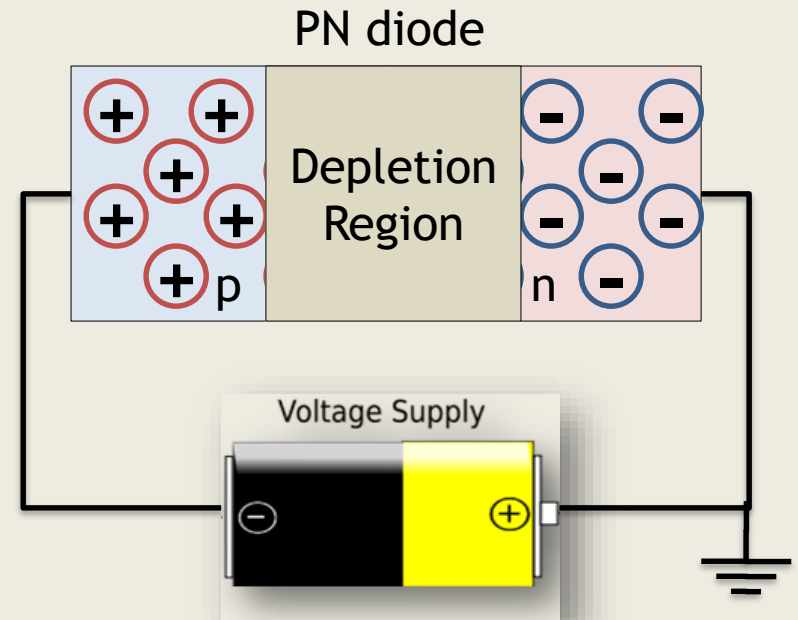
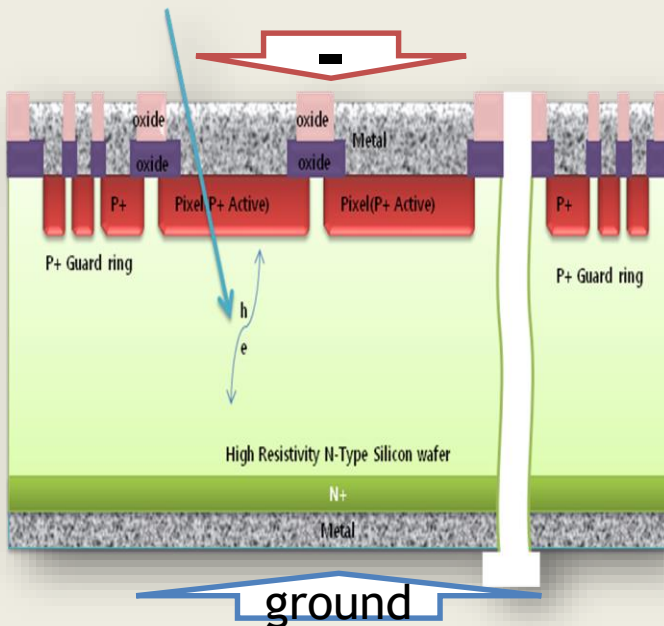
Silicon pad sensor

- Basically PN junction diode in reverse bias mode.
 - N-type substrate and p-type pattern for high energy application => electrons are carriers
- 16 square(1.5cm×1.5cm) pads in one micro-module



Sensor operation

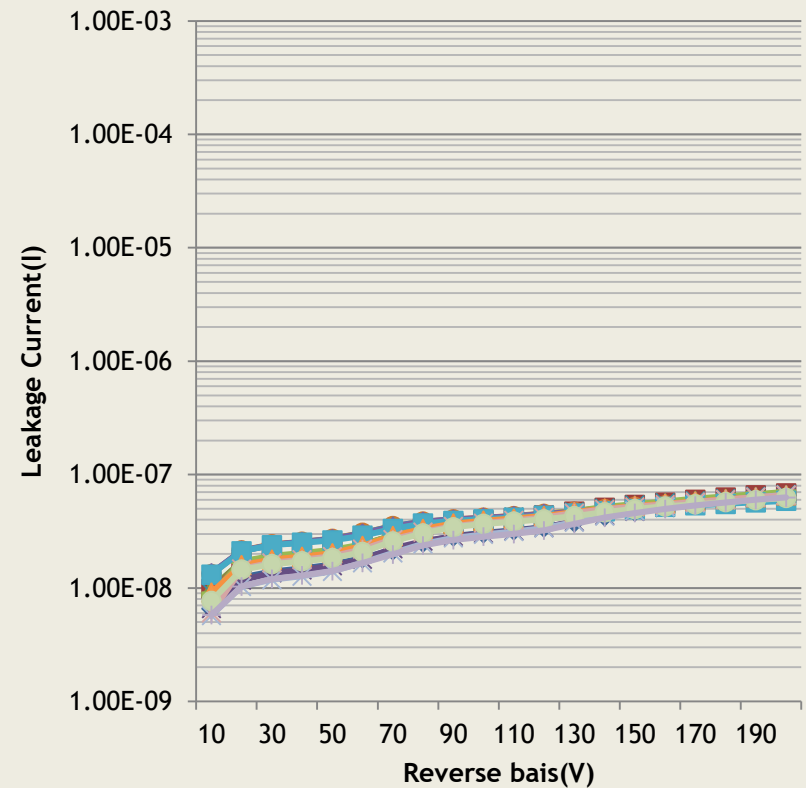
- Reverse bias => Depletion Region



Leakage current

- Reasons
 - Thermal excitation
 - Bulk defect
 - Surface defect
- IV characteristics
 - Sensor **quality monitoring**

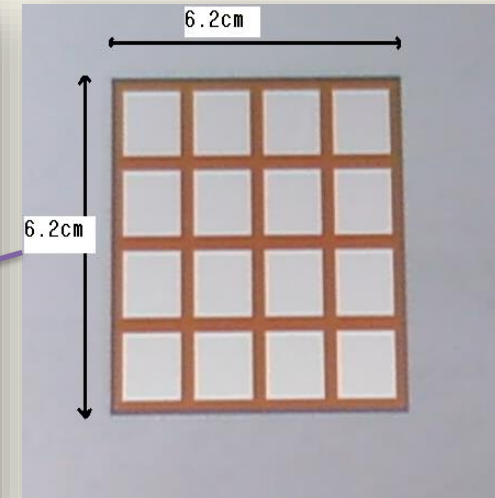
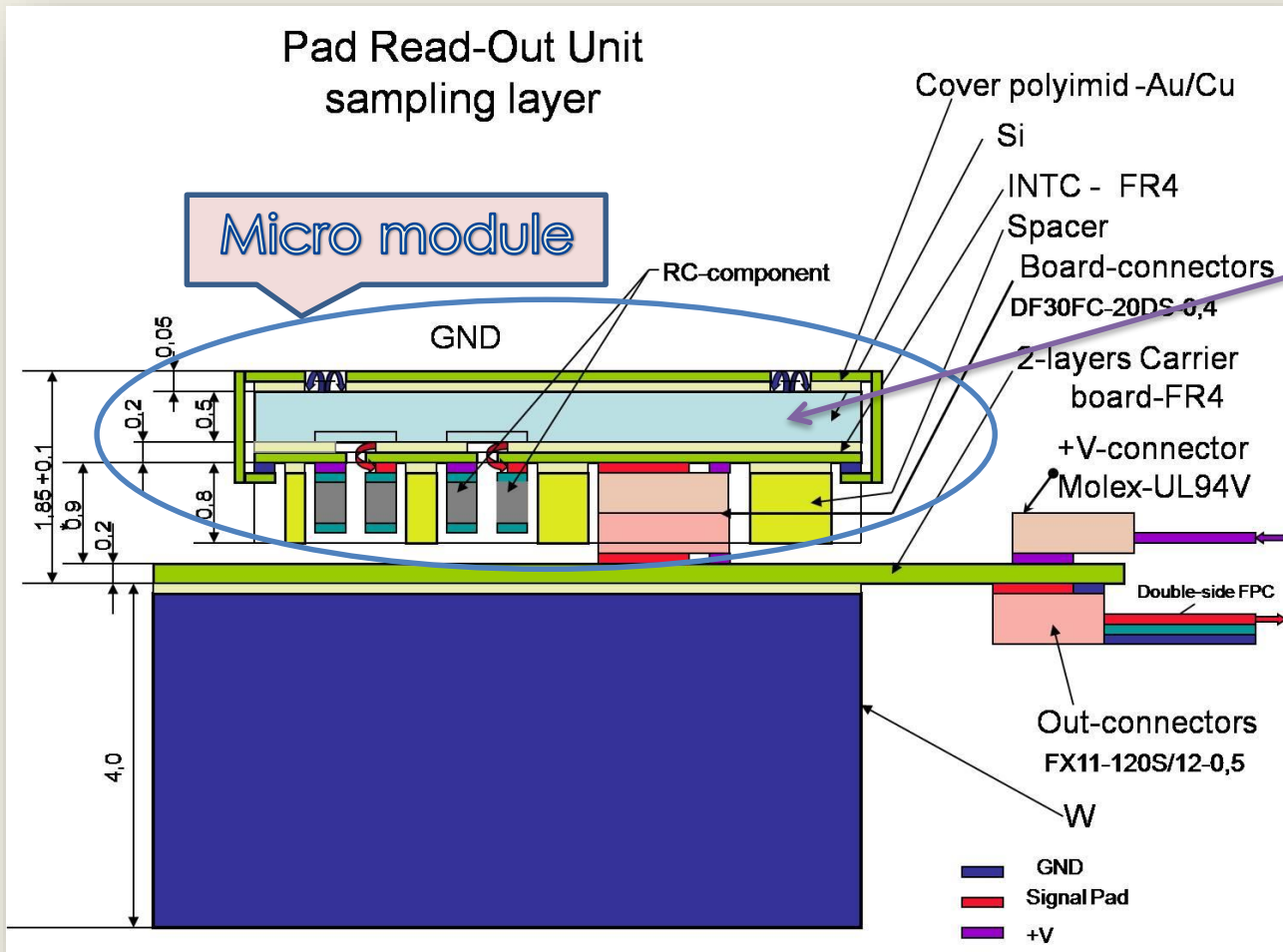
•IV measurement data



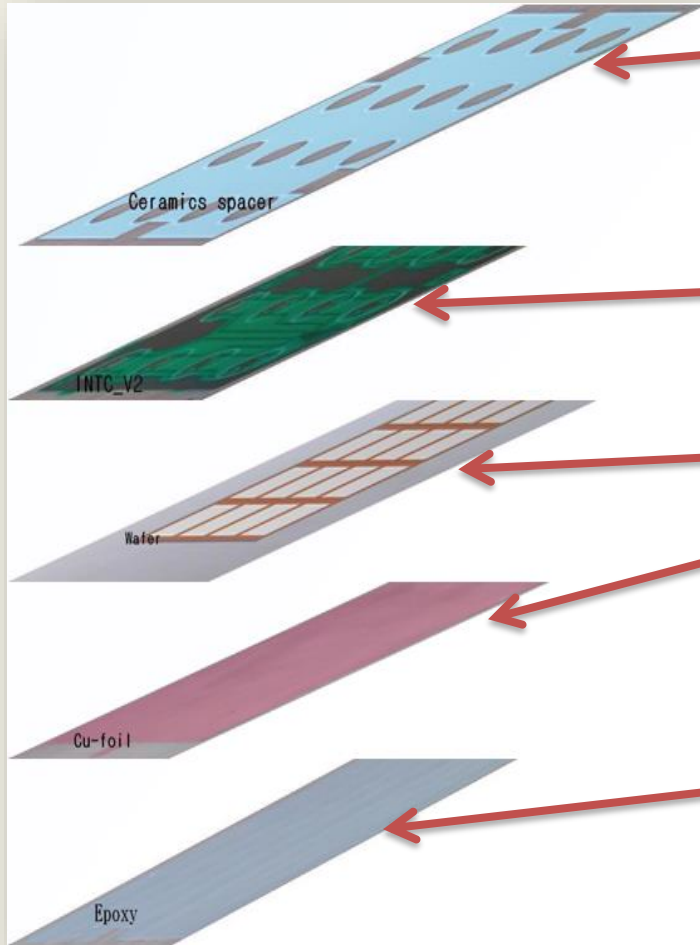
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Micro-module schematics

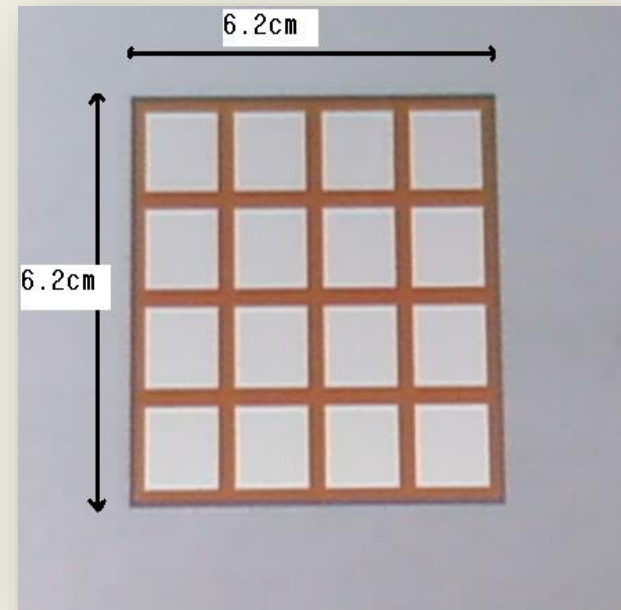
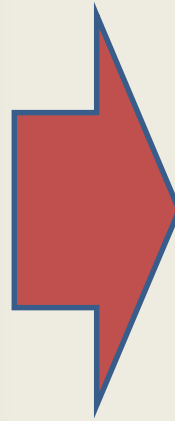
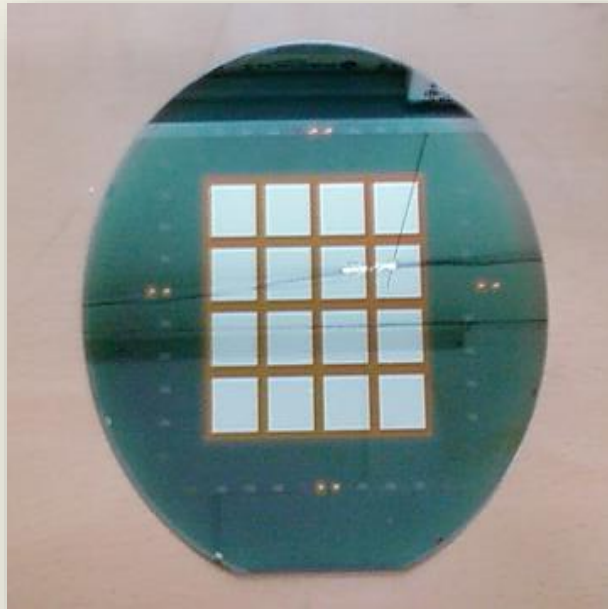


Components for micro-module



- Ceramic spacer
 - Protection from warping and heat
- INTC(Inter connect) board
 - Electrical connection to sensor
- Silicon Sensor
- Cu foil
 - Connection of sensor back plane to ground
- Epoxy plate
 - Electrical and physical protection

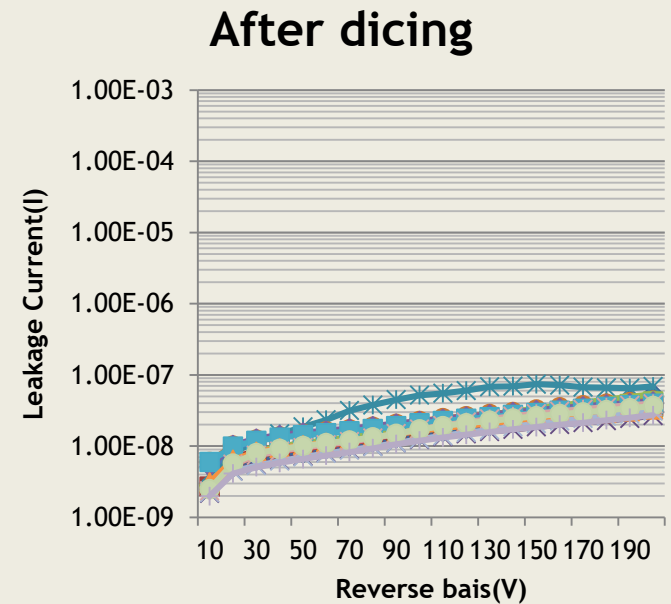
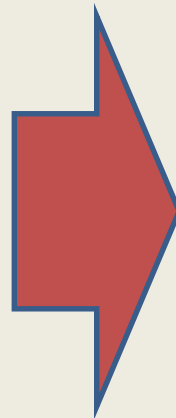
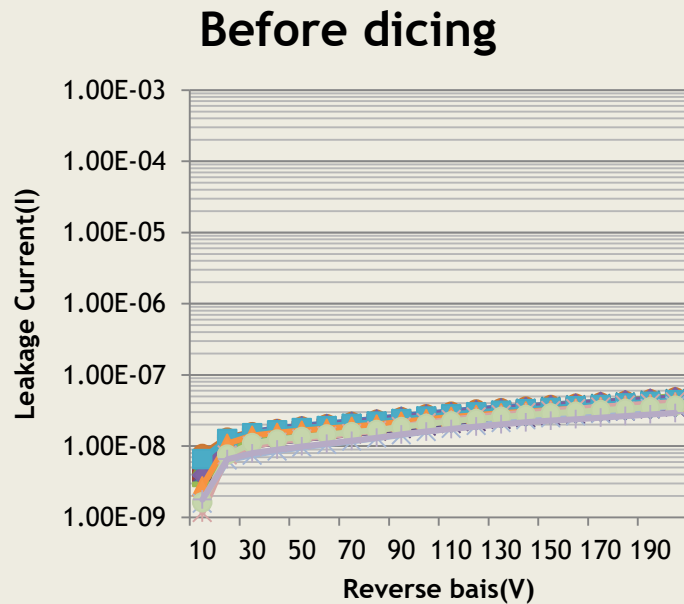
Wafer Dicing



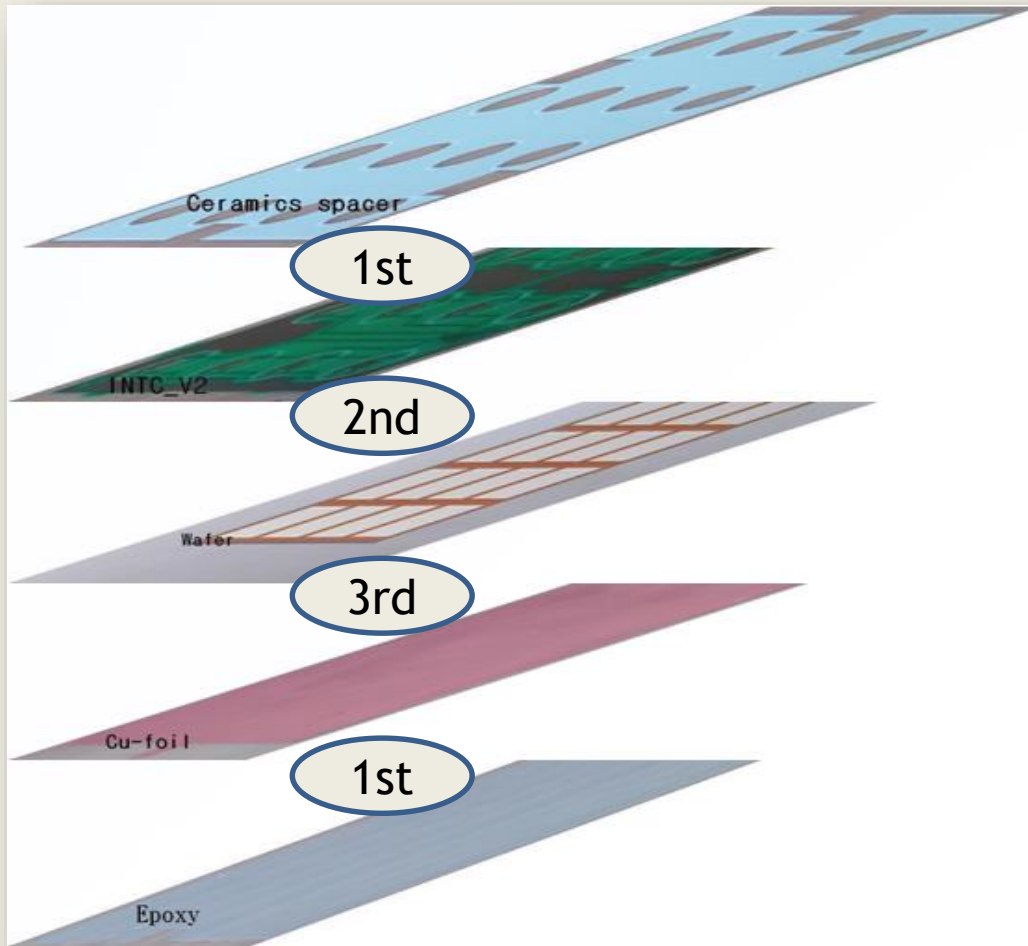
- electric shock and moisture absorption can degrade sensors
=> IV characteristics monitoring

IV characteristics after dicing

- Avg. leakage current at 150V
 - 32nA \rightarrow 30nA
- No major variation \Rightarrow procedure validation




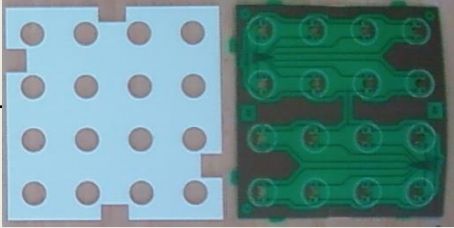
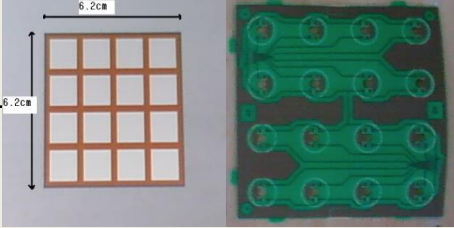
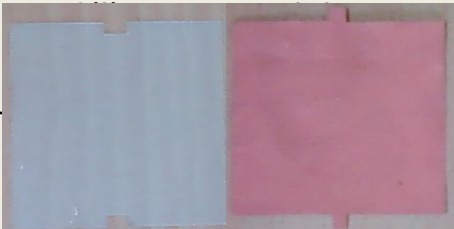



Gluing Process



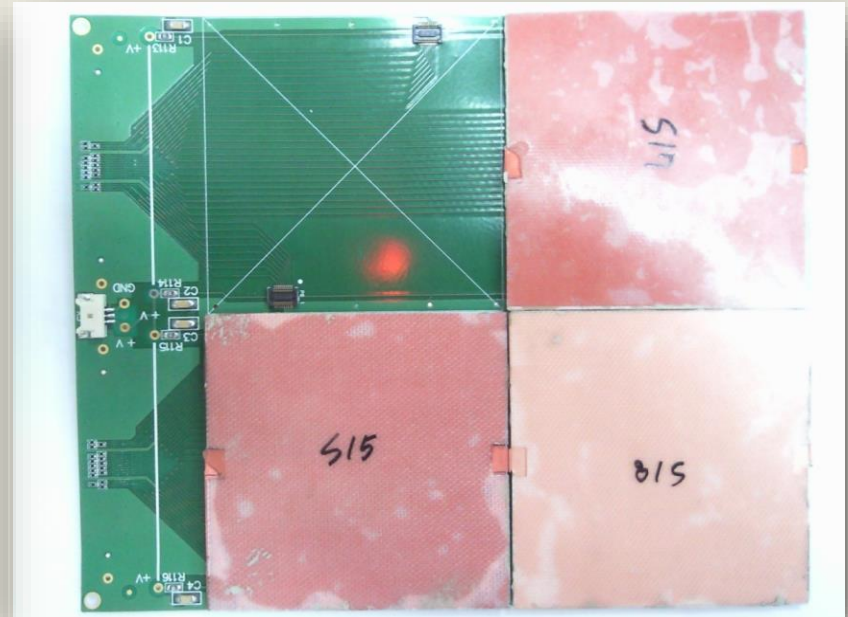
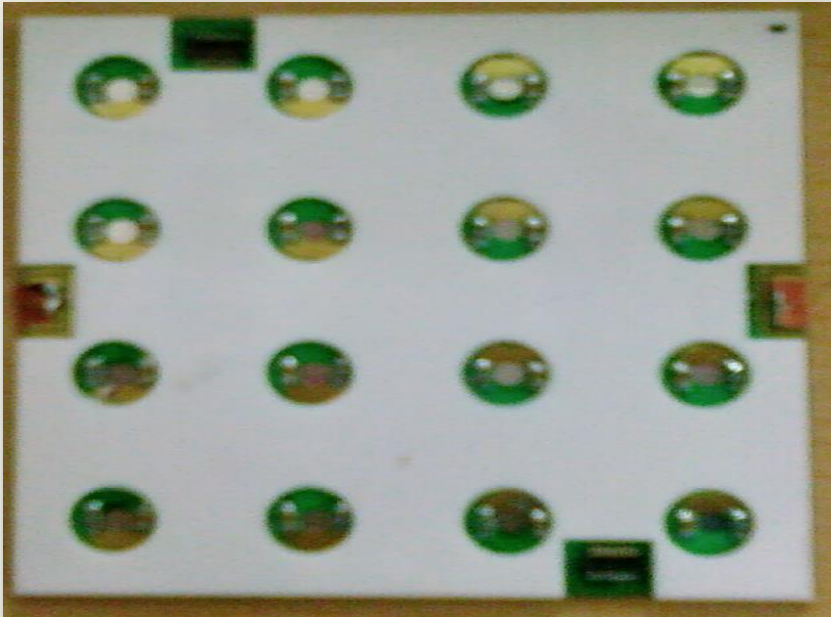
- Gluing process
 - 3 Steps
 - 1 day for each step

Glue properties



			
Company			
Material	Epoxy		Silver epoxy
Color / appearance	Creamy liquid Amber liquid		Bright silver Gray silver
Specific gravity	1.17 /Resin 0.92 /Hardener	1.05	2.85
Feature			

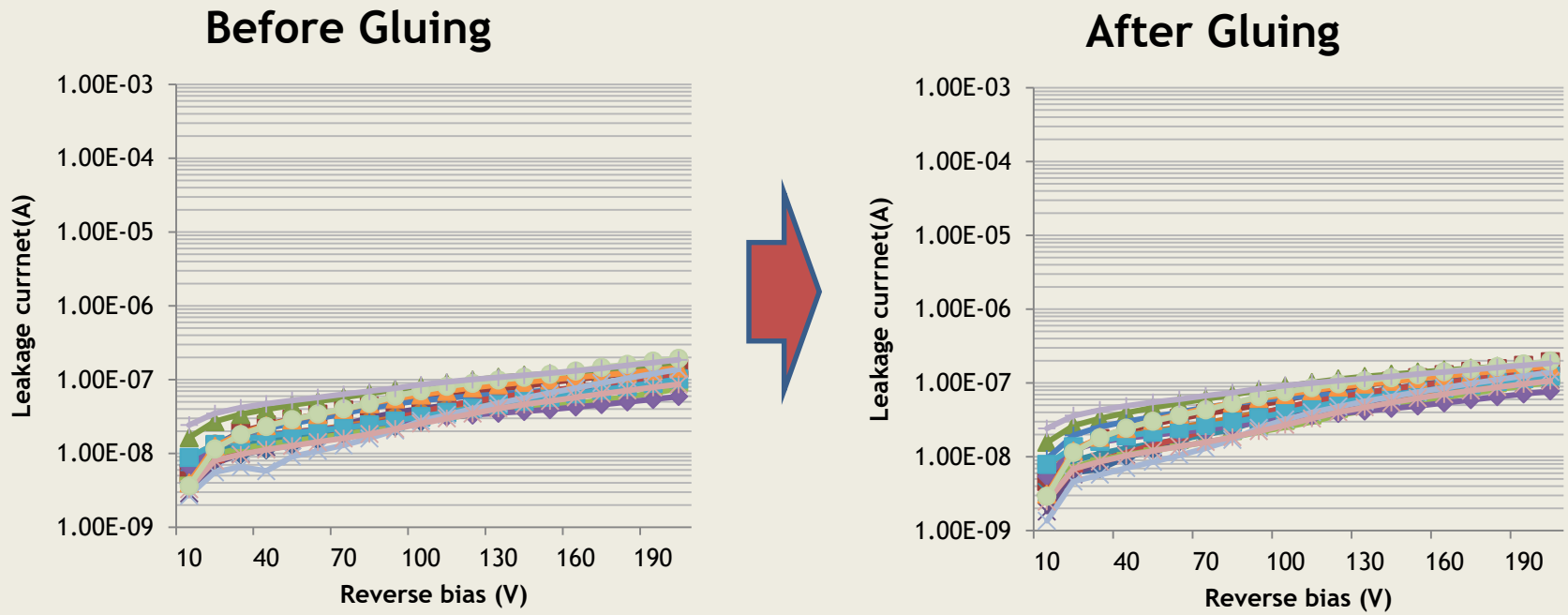
Production results



- 4 sample micro-module production has completed.
- Mechanical and electrical issues have been checked

IV characteristics after gluing

- Avg. leakage current at 150V
 - $74\text{nA} \rightarrow 90\text{nA}$
- Little variation => procedure validation



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Summary & Outlook

- We completed a cycle of micro-module production successfully up to requirement.
- cosmic muon tests are in preparation.

THE END

THANK YOU