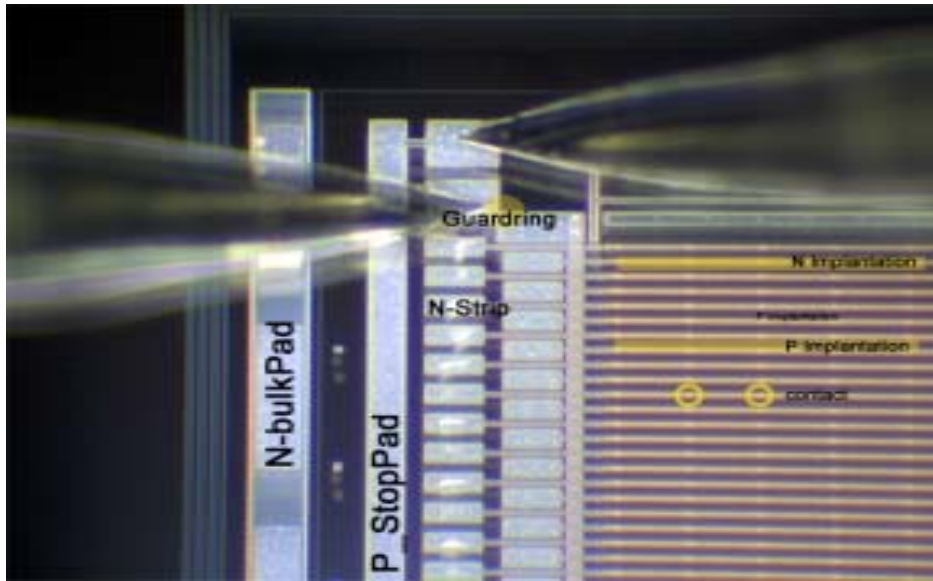


Development of Double-sided Silicon Strip Detector



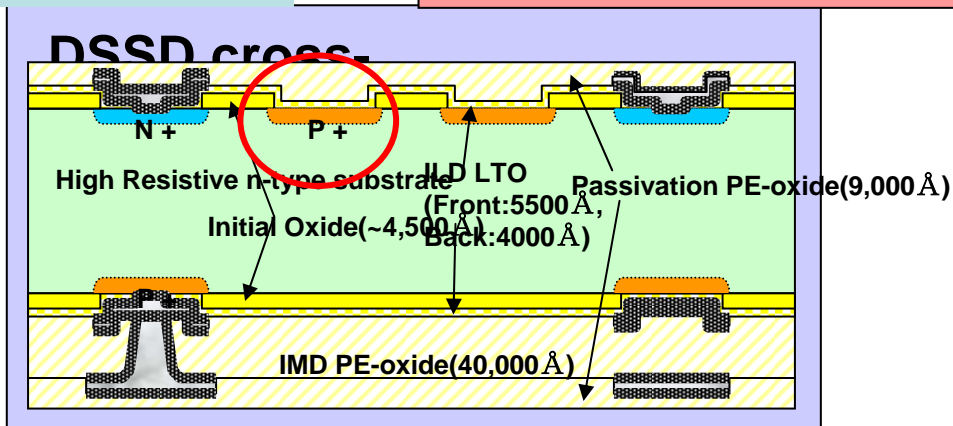
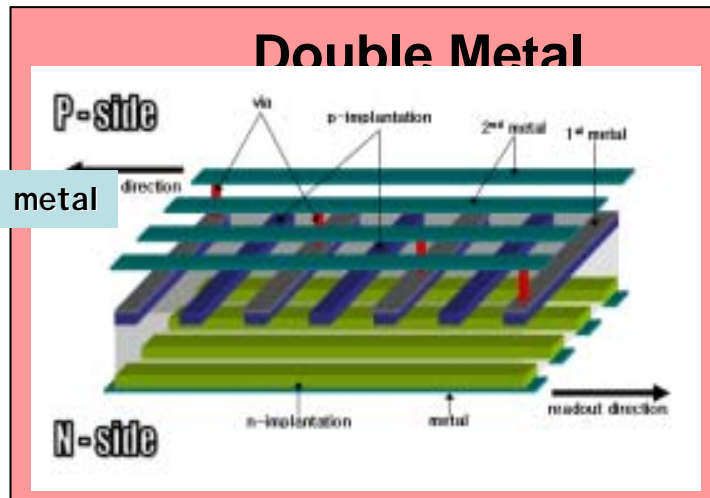
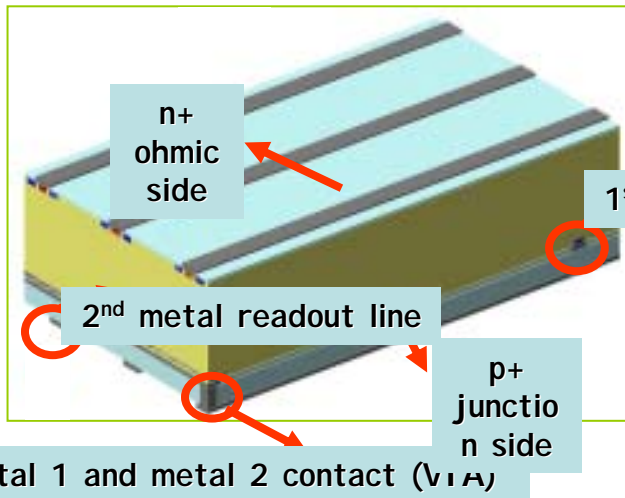
- Introduction
- Electrical Test
- Source Test
- Radiation Damage Test
- Summary and Future Plan

H. Park (BAERI, KNU)
On behalf of Korean Silicon Group



Introduction: DSSD

- We fabricate DSSD (no company involved; a fab in research inst.)
- 5" wafer is used



Introduction: Sensor Parameters

LIST	DC-TYPE		unit
	p+ side	n+ side	
Sensor size	55610 X 29460 (include sawing line)		μm
Wafer thickness	380		μm
pitch	100	50	μm
readout trace pitch	50	50	μm
implant strip #	512	512	sensor
number of readout	512	512	sensor
strip length	25600	51072	μm
strip width	9	9	μm
readout trace width	8	11	μm

1st DSSD Prototype

5 MASKS for n-side
6 MASKS for p-side

n+ implanted

p-stop in atoll

readout pad in staggering

guard ring

p+ implanted

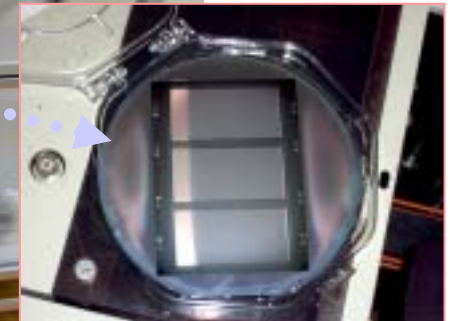
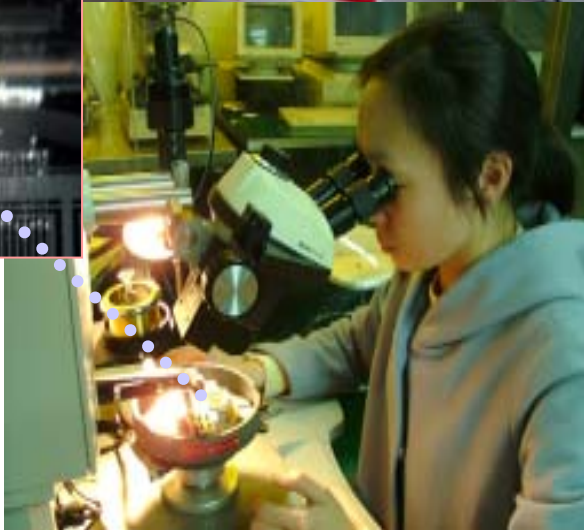
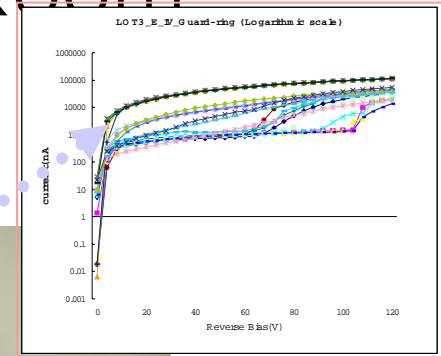
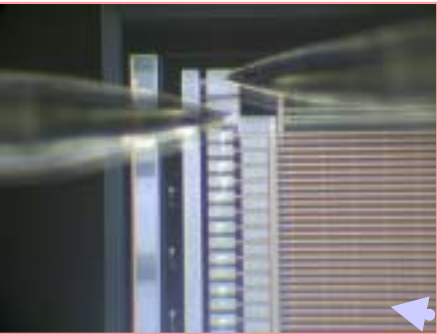
readout strip

via in hourglass

N side

P side

Electrical Test: Cleaning Room

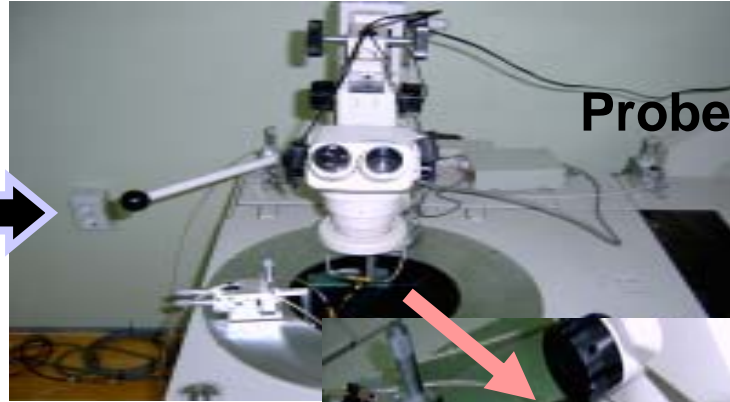


Electrical Test: Devices

picoammeter



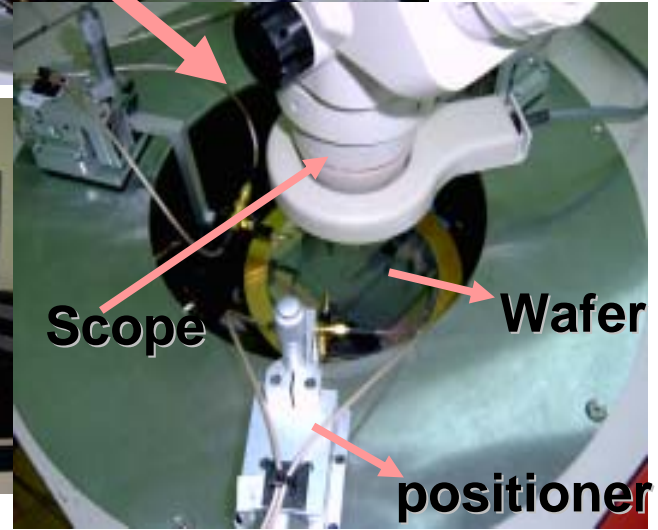
LCZ meter



Probe station



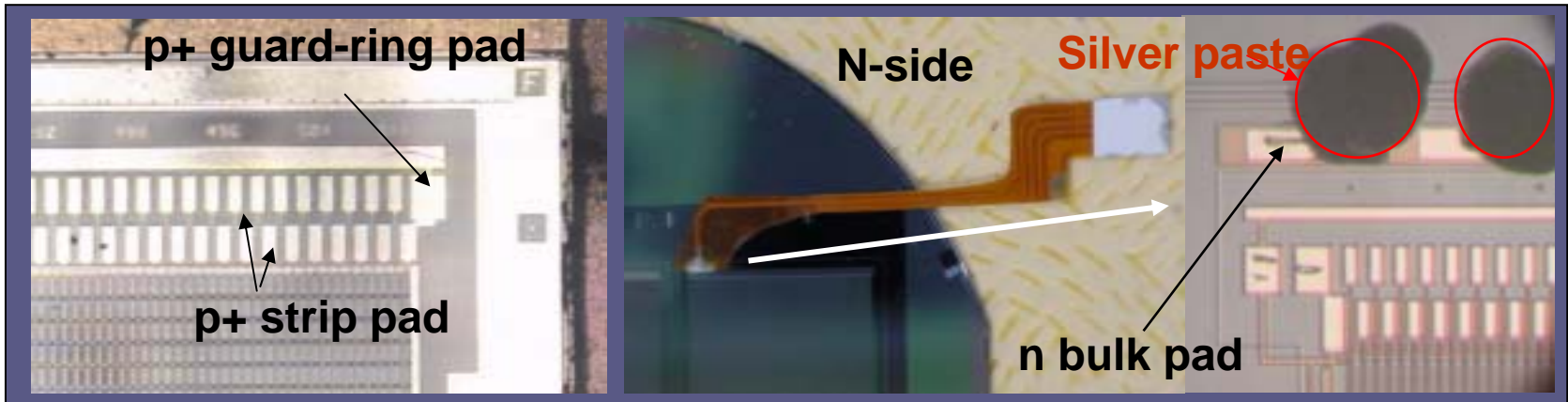
Auto test system



Scope

Wafer

positioner



p+ guard-ring pad

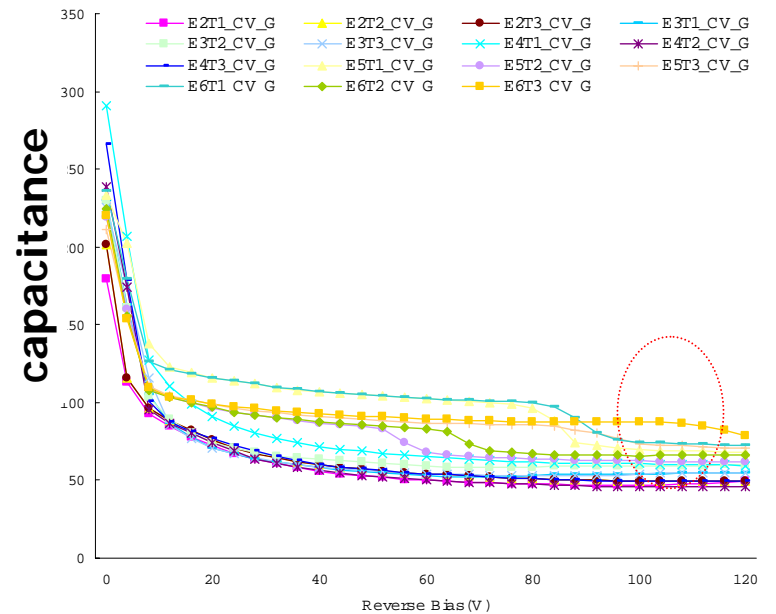
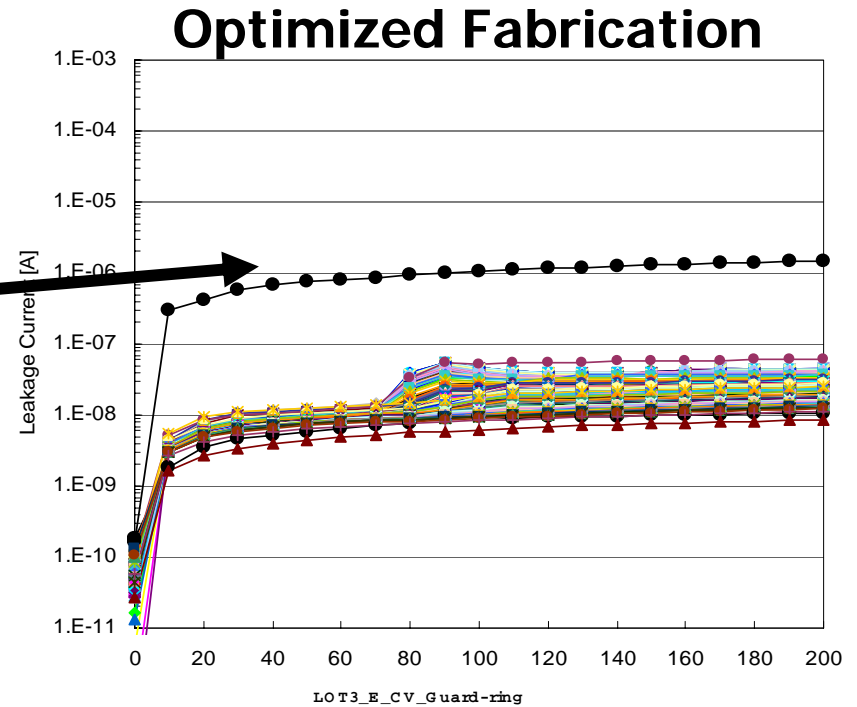
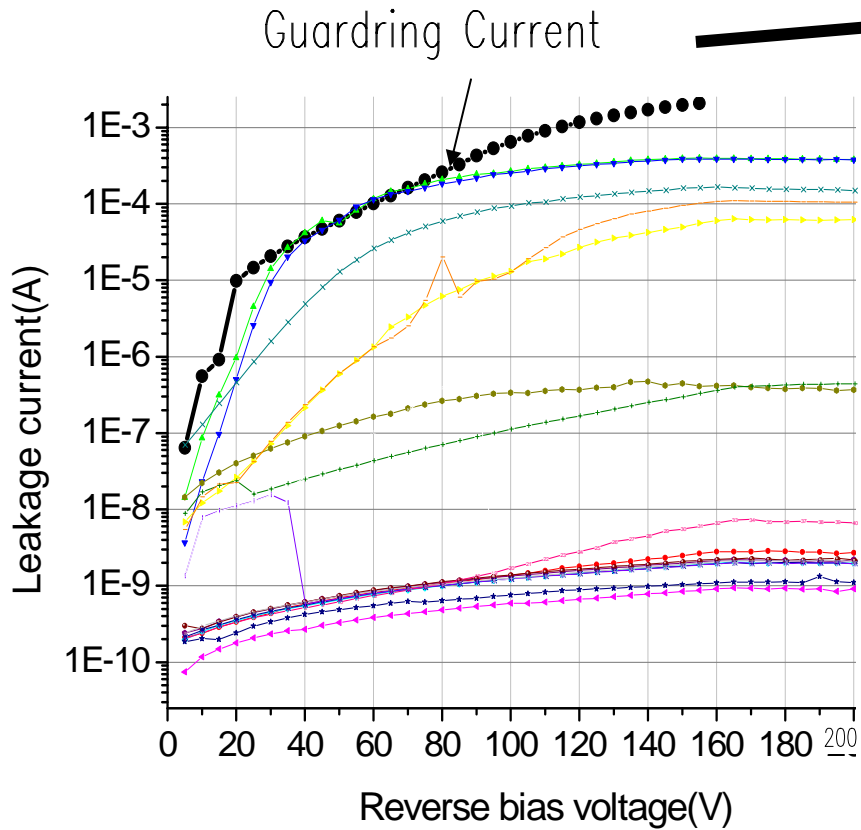
p+ strip pad

N-side

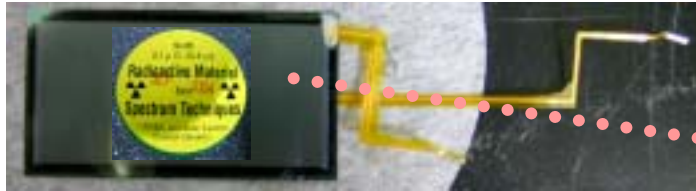
Silver paste

n bulk pad

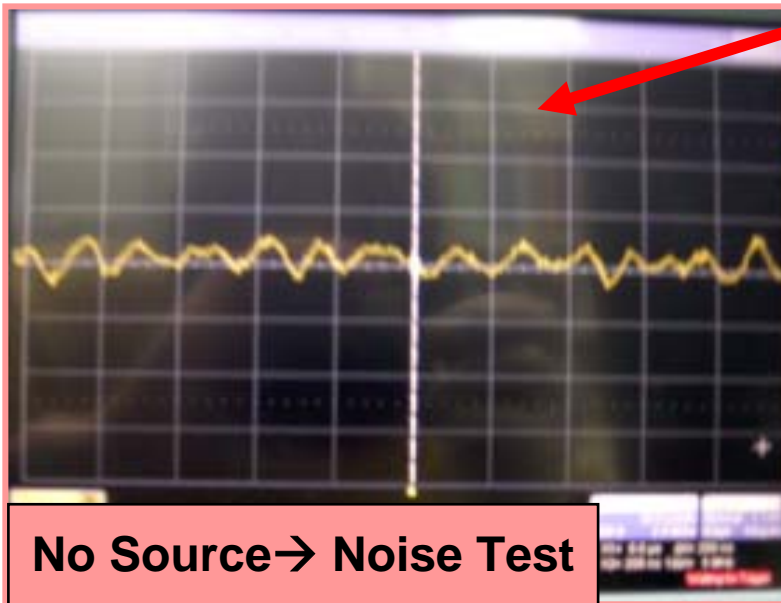
Electrical Test: I-V



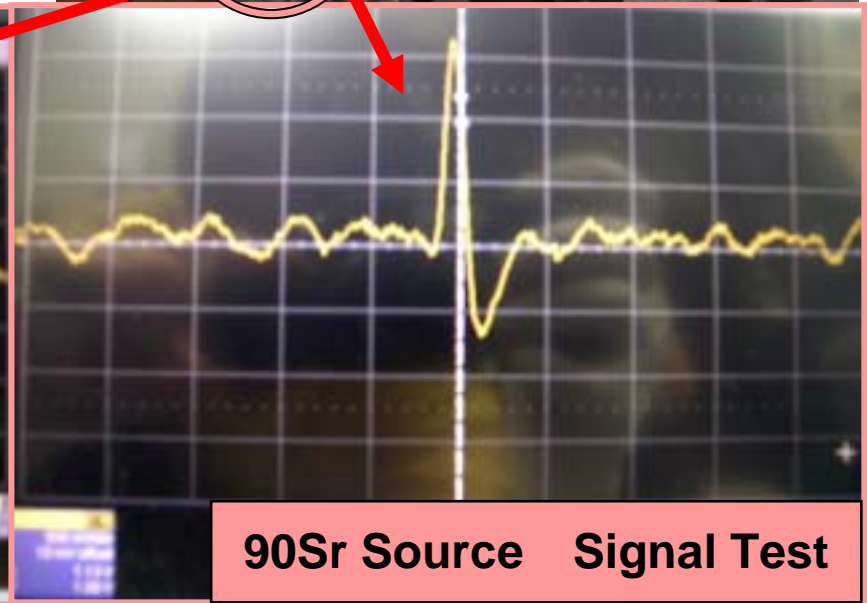
Source Test: ^{90}Sr



Dark Box



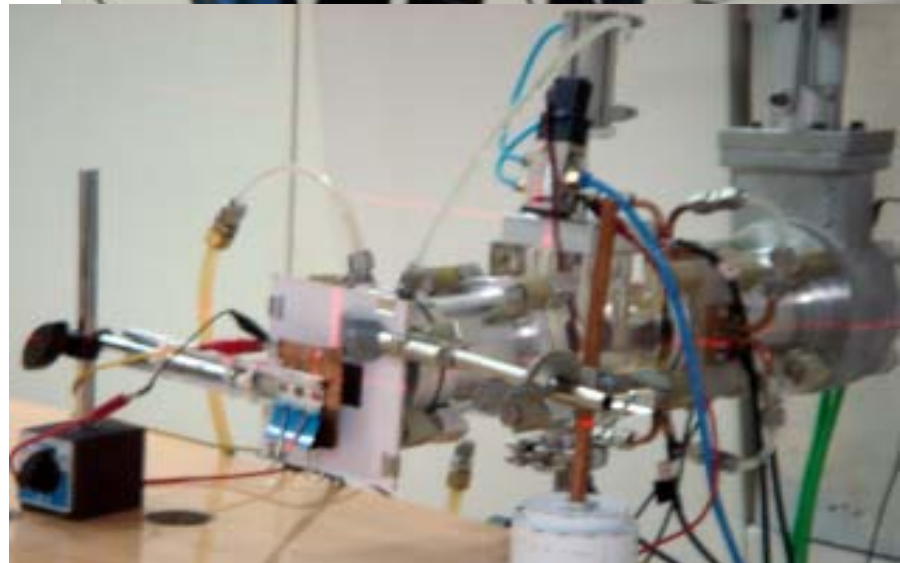
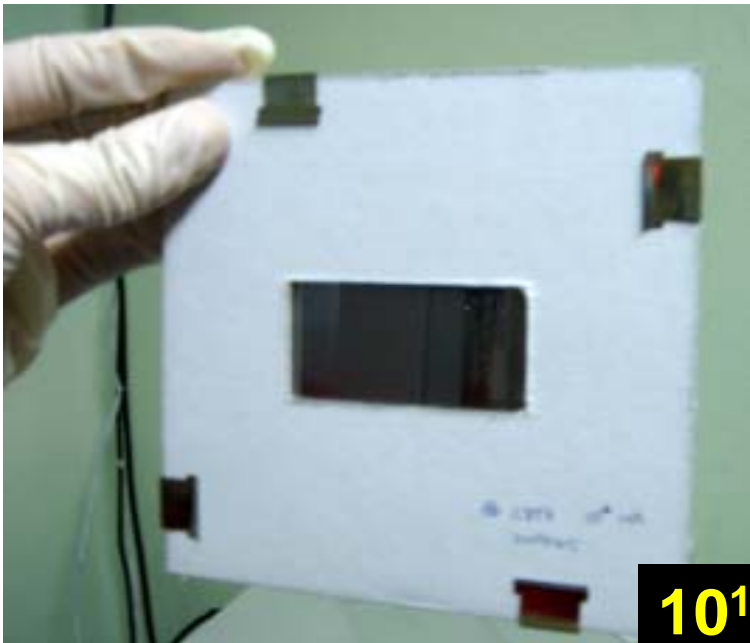
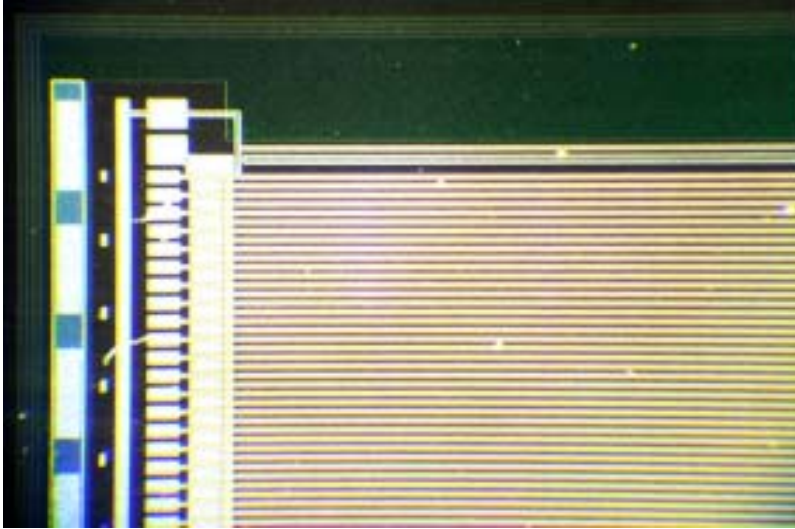
No Source → Noise Test



^{90}Sr Source Signal Test

Radiation Damage Test : 35 MeV Proton Beam

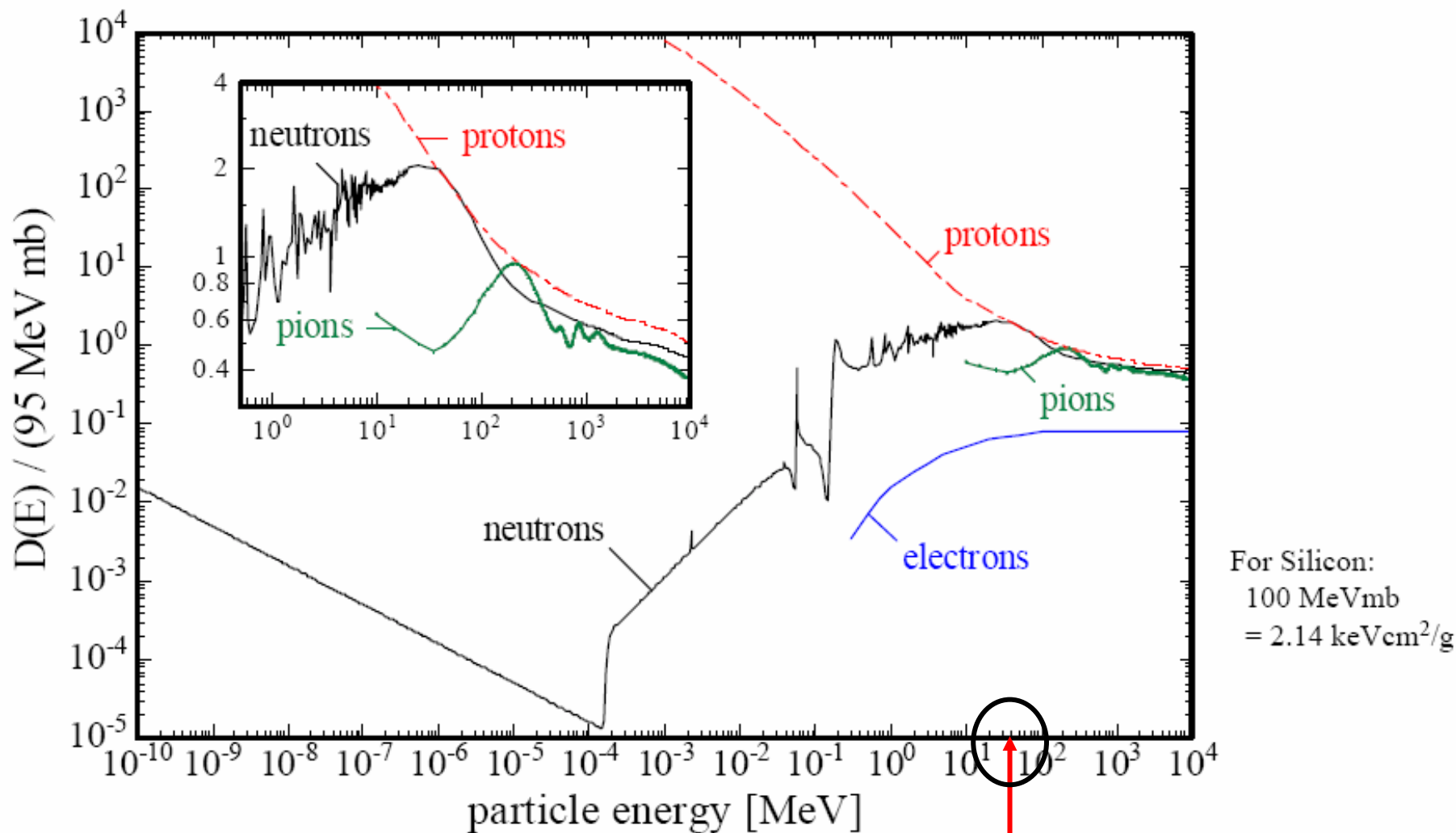
Korea Cancer Center Hospital



10^{12} , 10^{13} , 10^{14} , 10^{15} [# of proton/cm²]

Radiation Damage Test

Displacement damage functions

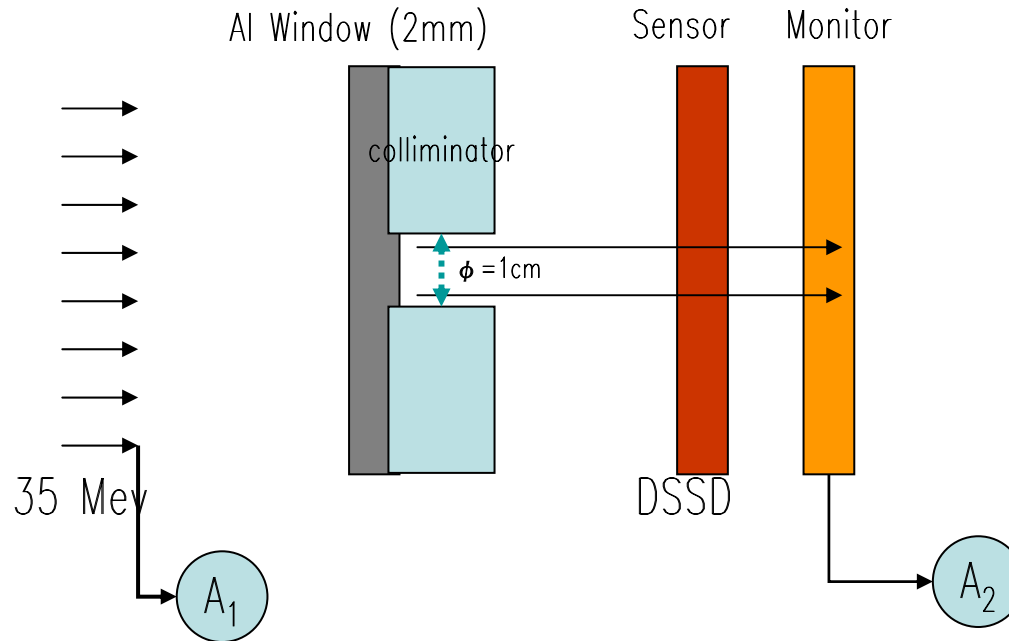


Radiation Damage: Method

1. Log table

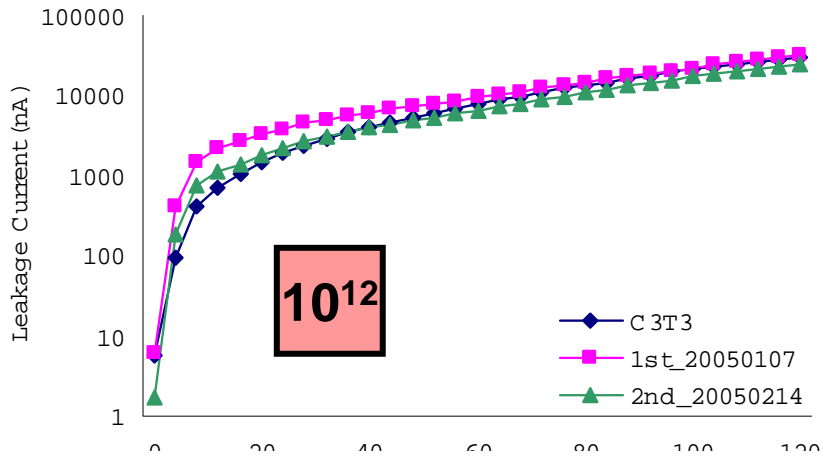
Target	Sensor	Average Current	Number of Proton	Time(KST)
10^{12}	C3T3	2.78 nA, 63sec	1.08×10^{12}	2:45~2:46
10^{13}	G5T2	10.24 nA, 125sec	8×10^{12}	2:56~2:58
10^{14}	C3T2	56.83 nA, 250sec	8.88×10^{13}	3:19~3:23
10^{14}	E3T2	57.75 nA, 250sec	9.02×10^{13}	3:32~3:36
10^{15}	E3T3	56.60 nA, 42min	8.91×10^{14}	3:45~4:27

2. Test Schematic

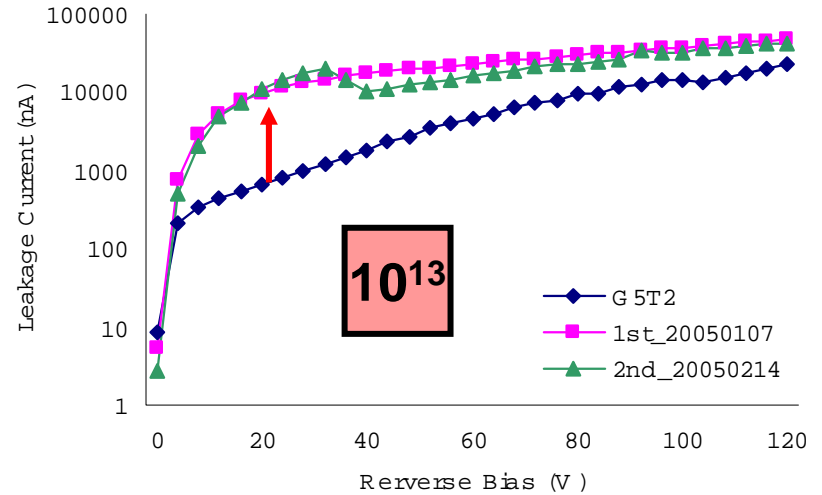


Radiation Damage Test : I-V Test Result

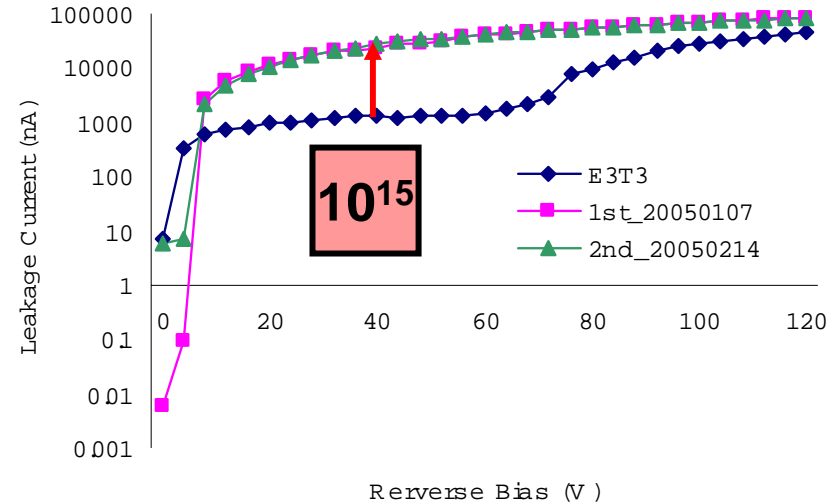
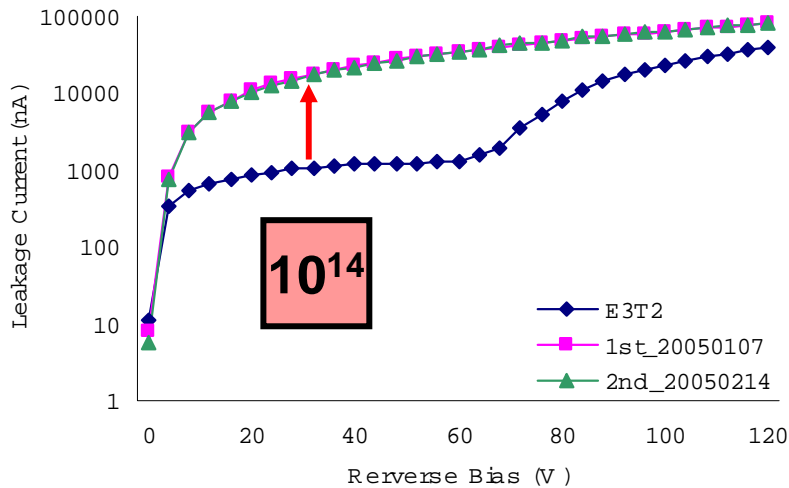
BEAM TEST_C3T3_IV_Pside_10¹²

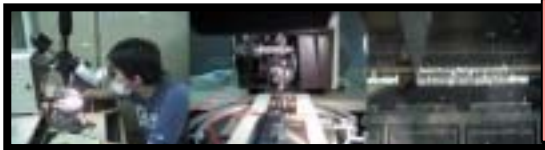


BEAM TEST_G5T2_IV_Pside_10¹³



BEAM TEST_E3T2_IV_Pside_10¹⁴





Design Optimization and Wire bonding

Collaboration Effort with KEK

A type Readout pads are
In Guardring

B type Readout pads are
out Guardring

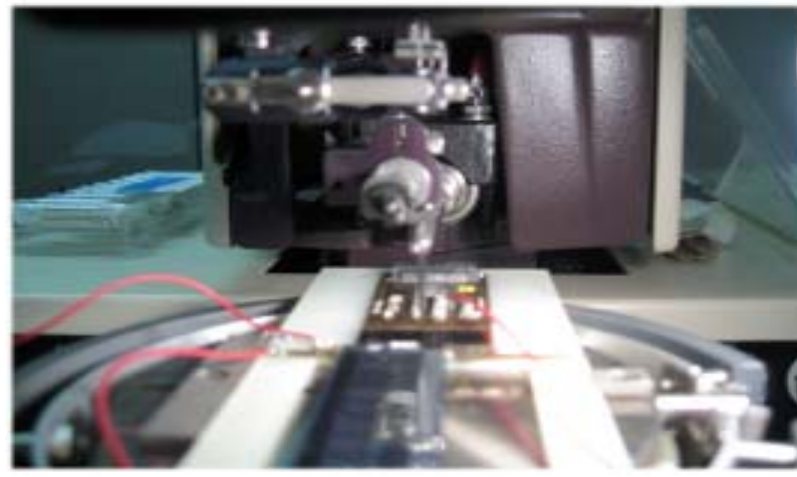
Region1-original

Region2-1/2 [read/strip]
Al Floating

Region3-overhang

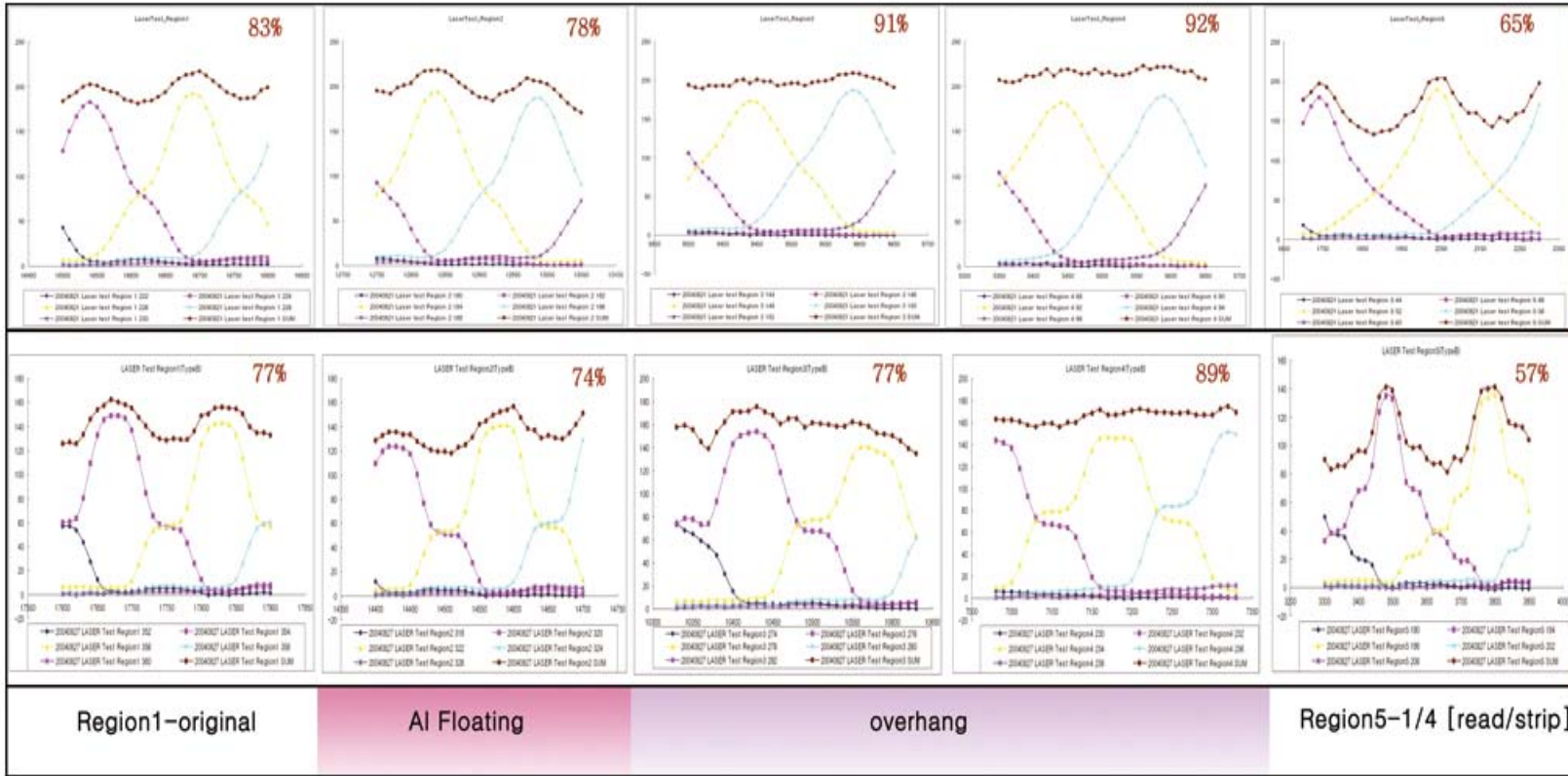
Region4-overhang

Region5-1/4 [read/strip]



[결과]

*전하수집효율(%)=최저값/최고값*100



Type A

Type B

Region1-original

AI Floating

overhang

Region5-1/4 [read/strip]

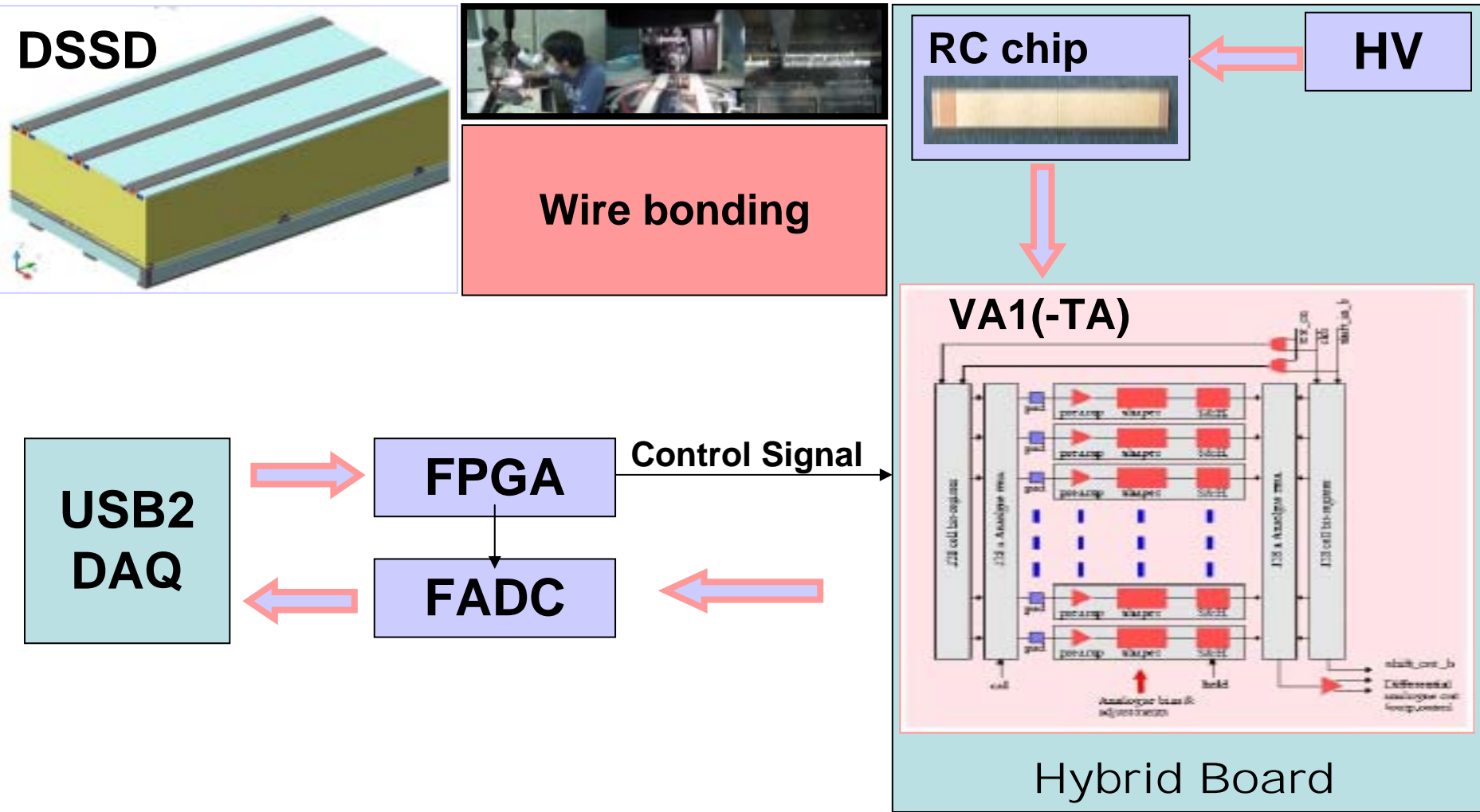
결론 : Type A가 Type B 보다 좋다.

Floating Strip(Region2) 결과가 기대보다 좋지 못함

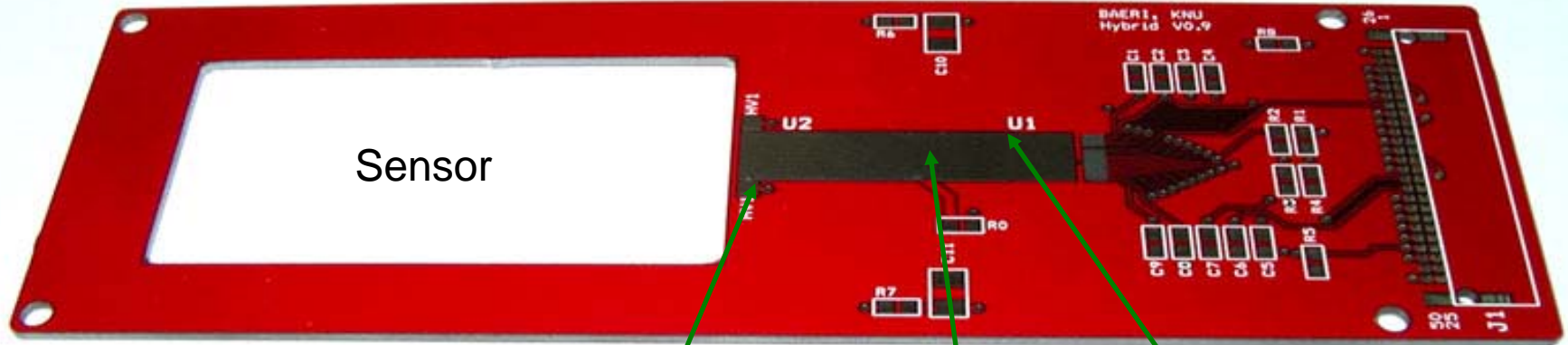
Overhang (Region3,4) 전하 수집 효율은 좋으나, 정확한 위치 파악 여부에 대해서는 조사가 더 필요

Region5 는 ReadOut 채널이 다른 센서 보다 적기 때문에 효율이 떨어짐

Schematics of Readout and DAQ



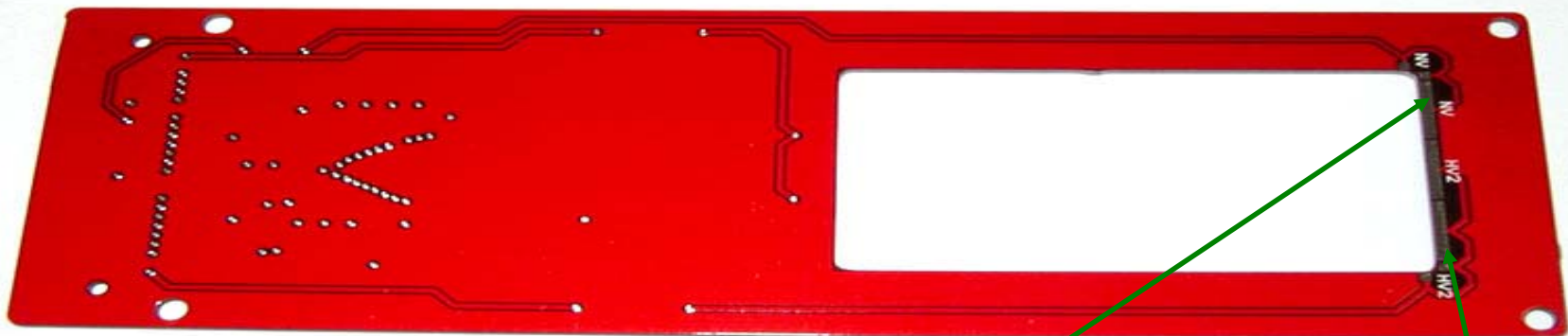
Hybrid Board: 1st prototype



1st Bias

RC Chip

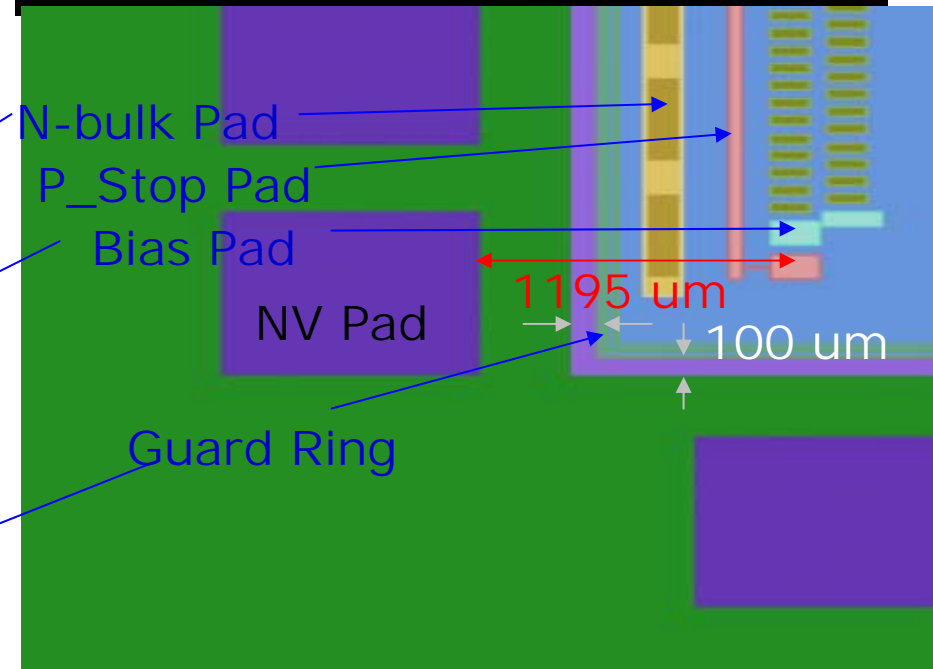
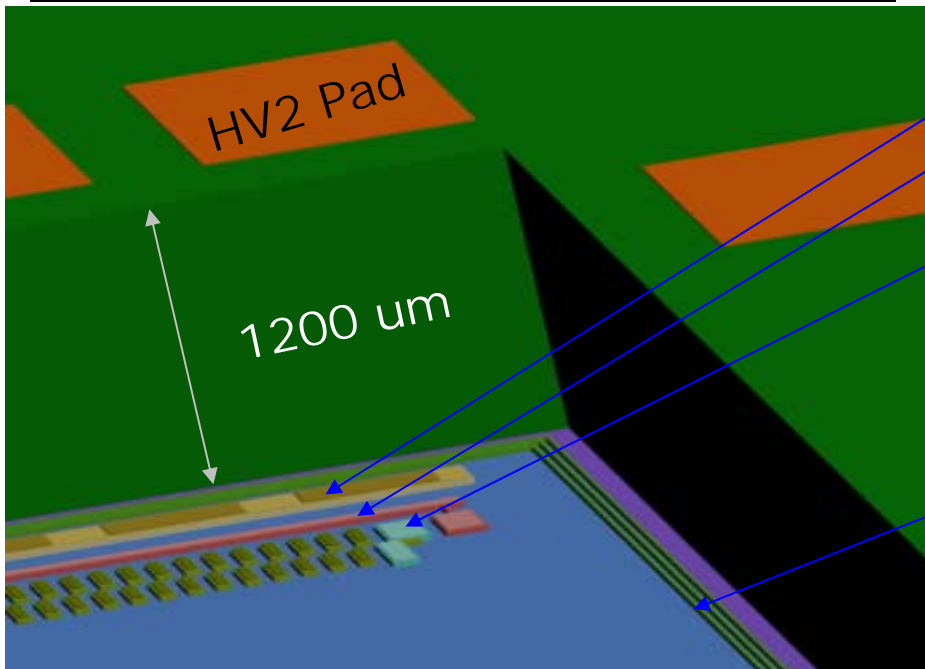
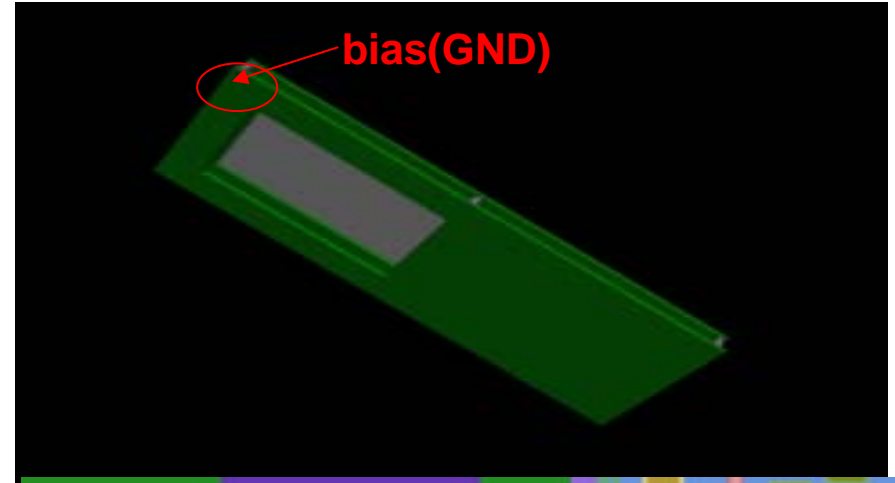
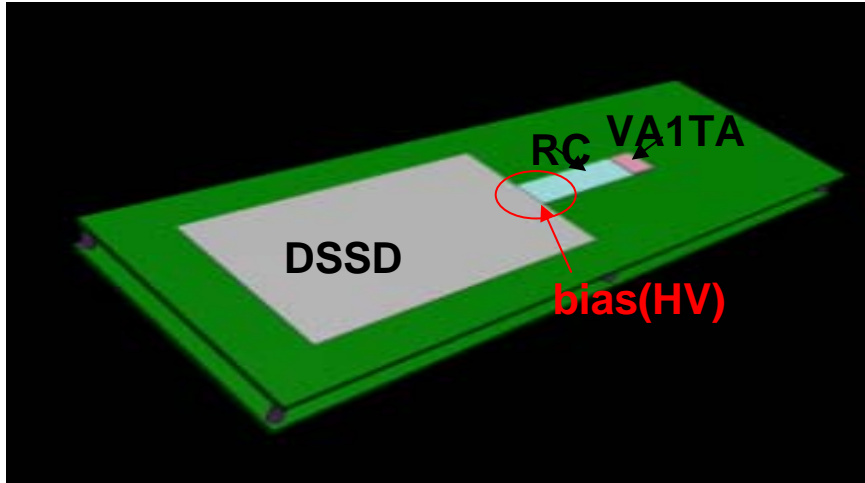
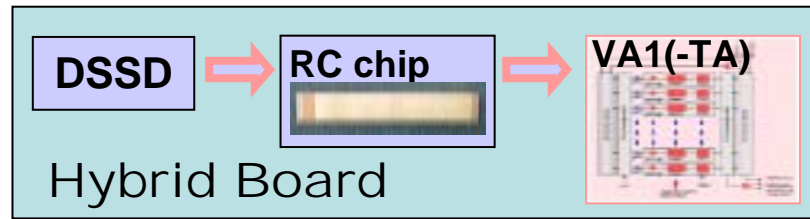
VA Chip



15V Supply

2nd Bias

Hybrid Board Design



SUMMARY and Future Plan

- **1st Design Sensor – 5th, 6th, 7th Fab. done**
- **New Fabrication(2nd Design) is just started**
 - Expect in the middle of the next month
- **Source Test**
 - DAQ System , S/N measurement
- **Radiation Damage Test**
 - During summer break
- **Hybrid Board Prototype Revision**
 - Expect by the end of the next month

Stay Tuned !