

Sensor overview

Ulrich Heintz

Brown University, Providence, RI



Prototype sensors

- MAPSA light sensors:
 - Produced by CIS. Low yield. First samples tested by KIT and HEPHY. Observed that breakdown voltage decreases with every IV ramp.
 - Next batch in about one month.
 - Test MAPSA light assemblies (Brown, Cornell, Rutgers)
- Infineon sensors:
 - 8" by end of summer
 - 6" in October – November
- HPK sensors:
 - 6" in September.
- Novati:
 - first round in hand (see Sinan's talk)
 - second round end of 2016. What do we want to include in the design? (see Ron's talk)
- Need characterize sensors and rad test materials
- Open questions:
 - p-spray or p-stop (baseline)?
 - Do we need punch through biasing for MAPSA?
 - Beam loss protection: do punch through structures protect chip? Need close to final electronics system to test.
 - Radiation qualify Infineon materials.



Beam tests

- Beam test of full size 2S module made of 6” HPK sensors
 - Planned at CERN in November 2015
 - 9.5 days of beam time



SPS: November 2015

schedule issue date: 13-May-2015

Version: 2.2

		Mon 2 Nov	Tue 3 Nov	Wed 4 Nov	Thu 5 Nov	Fri 6 Nov	Sat 7 Nov	Sun 8 Nov	Mon 9 Nov	Tue 10 Nov	Wed 11 Nov	Thu 12 Nov	Fri 13 Nov	Sat 14 Nov	Sun 15 Nov	Mon 16 Nov	Tue 17 Nov	Wed 18 Nov	Thu 19 Nov	Fri 20 Nov	Sat 21 Nov	Sun 22 Nov	Mon 23 Nov	Tue 24 Nov	Wed 25 Nov	Thu 26 Nov	Fri 27 Nov	Sat 28 Nov	Sun 29 Nov	Mon 30 Nov	Tue 1 Dec	Wed 2 Dec	Thu 3 Dec	Fri 4 Dec	Sat 5 Dec	Sun 6 Dec					
Week		45							46							47						48						49													
Machine		UA9																																							
North Area	T2 - H2	NA61 SHINE	D. Lazic				CMS ECAL																																		
	T2 - H4	RD51 (+GIF)	G. Mallot				NA58 ECAL				H. Dong												HERD																		
	T4 - H6	ALICE FOCAL	D. Lazic				CMS Outer Tracker																																		
	T4 - H8	RD52 DREAM	H. Schindler				LHCb																																		
	T4 - K12	A. Ceccucci				NA62																																			
	T6 - M2	J. Bernhard				NA58 COMPASS																																			
For further information contact the PS/SPS-Coordinator. Email: Sps.Coordinator@cern.ch , Tel: +41 76 487 3845.																																									



Beam tests

- Beam test of MAPSA light:
 - None scheduled yet (?).
 - Could use stack of two MAPSA sensors to find stubs.
 - Treat one as strip sensor and feed hits to MPA light chips on other module.
 - Should happen in early 2016.
 - We could do this at Fermilab.
- Need faster beam telescope
 - Base on CBC or APV chips for 2016 tests.
 - Currently have AIDA telescope with Mimosa chips – too slow.



Sensor QC

- Number of centers: 2 (probably need more)
- Scope:
 - Sample testing of sensor quality
 - CV/IV curves for 20% of all sensors → 8000 sensors or 4000/center
 - Complete strip measurements for 1-2% of all sensors → 400-800 sensors
- Equipment:
 - semiautomatic probe station, measurement instruments, switching matrix.
- Tasks:
 - Receive sensors unpack, store, update database (5min/sensor → 333h)
 - Visual inspection of all sensors (10min/sensor → 333h)
 - CV/IV curves take about 1h and complete strip measurements (coupling capacitance, pin hole test, polysilicon resistor, strip current) take 8h/sensor – 1h attended to setup and monitor → 4000h
 - Interstrip measurements (resistance, capacitance) only for trouble shooting
 - Update database, package sensor, ship to assembly center (5min/sensor → 333h)
- Total time = 5000h = 833d = 4 FTE



Process QC

- Number of centers: 2 (probably need more)
- Scope:
 - Process qualification using test structures
 - Measure Oxide thickness & breakdown voltage, resistivity of Al, n+, PolySi, Si-SiO₂ surface currents, breakdown voltage, depletion voltage, interstrip capacitance, interstrip resistance, flatband voltage.
 - Test about 10% of all wafers → 3000 test structures or 1500/center.
- Equipment:
 - manual probe station with probe card, switching matrix, and measurement equipment.
- Tasks:
 - Receive, unpack, store, update database (5min/structure → 125h)
 - Visual inspection of all structures (5min/structure → 125h)
 - Load structure on chuck, align probe card, and do measurements (35min/structure → 875h - based on current tracker per Thomas Bergauer)
 - update database, store test structure (5min/structure → 125h)
- Total time = 1250h = 208d = 1 FTE



Irradiation QC

- Number of centers: 2
- Scope
 - Rad hardness qualification using test structures.
 - Characterize test structure before and after irradiation using the same set of measurements as for process QC.
 - About 1% of all wafers will be tested → 300 test structures or 150 per center.
- Equipment
 - Manual probe station with probe card, switching matrix, and measurement equipment.
 - Have to run cold (-20°C)
- Tasks
 - Irradiate test structures with neutrons (8h/irradiation, assume 15 trips for 2 people → 240h)
 - load structure on chuck, align probe card, and do measurements (35min/structure → 88h)
 - update database, store test structure (5min/structure → 12h)
- Total time = 340h = 56d = 0.3 FTE



Next steps

- Characterization and rad test of prototype sensors
- Develop beam tests
- Setup QC procedures, test for reliability and speed.

