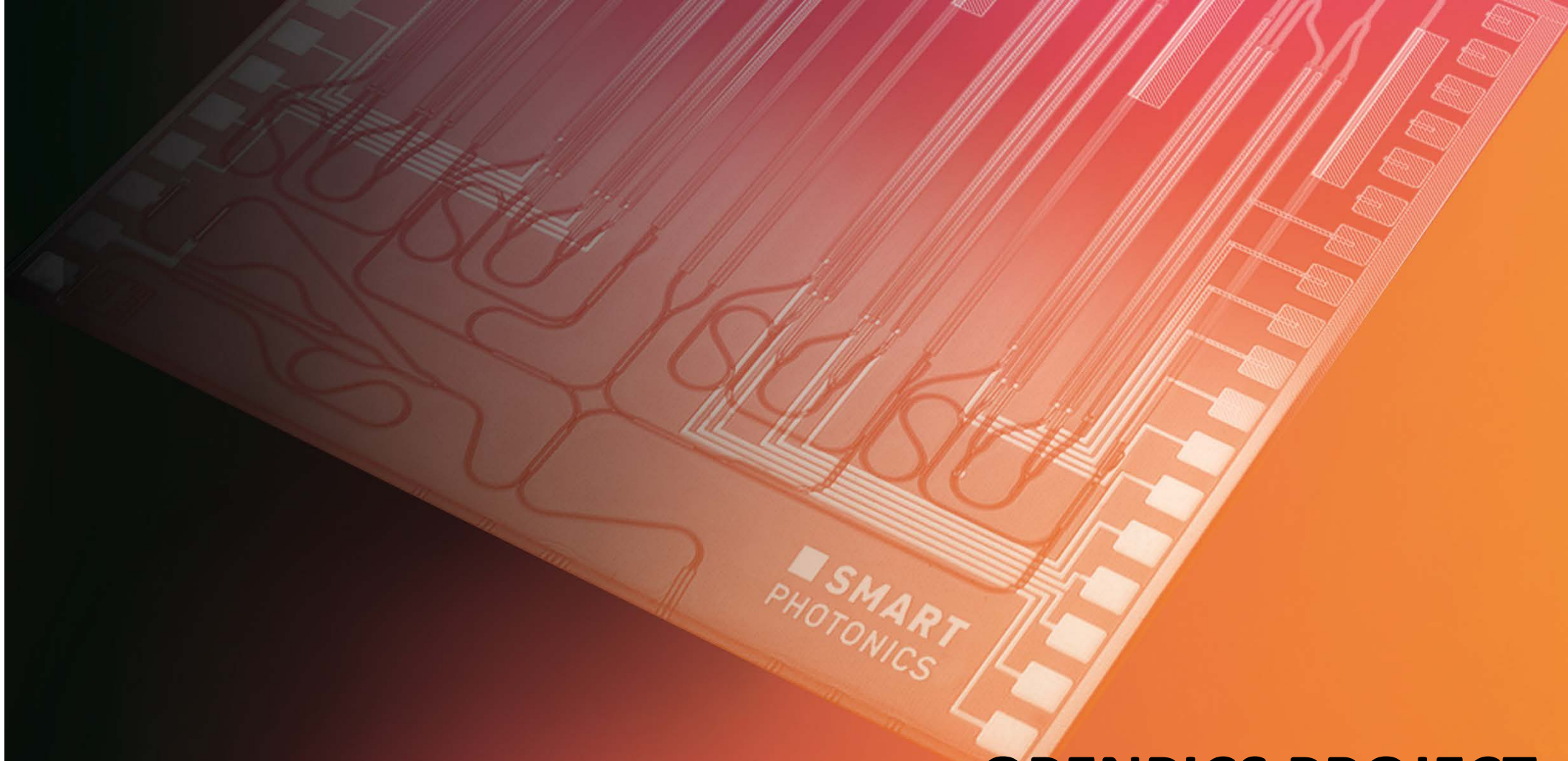

OPENPICS PROJECT

WP2 – REVIEW MEETING

R. DAAMEN, 29TH AUGUST 2017

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OUTLINE

WP2 General

- M0.1 WP2 Charter/Goals
- M0.2 WP2 Milestone Planning

WP2.1 – MPW Generic BB *Data & Characterisation*

- M1.1 List of Tracking Parameters
- M1.2 Generic MPW Update (up to SP19)

WP2.2 MPW Generic BB *Process Improvements*

- General Improvements
  - M1.1 Metallization
- Laser Threshold & Passivation Improvements
  - M2.1 Dielectric Material Improvements
  - M2.2 Integration Improvements

WP2 Summary

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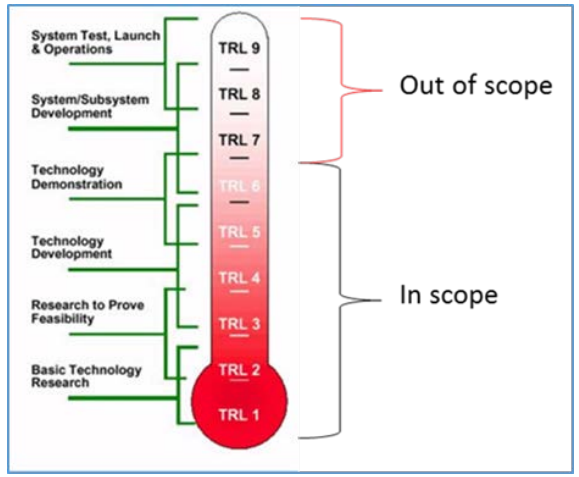
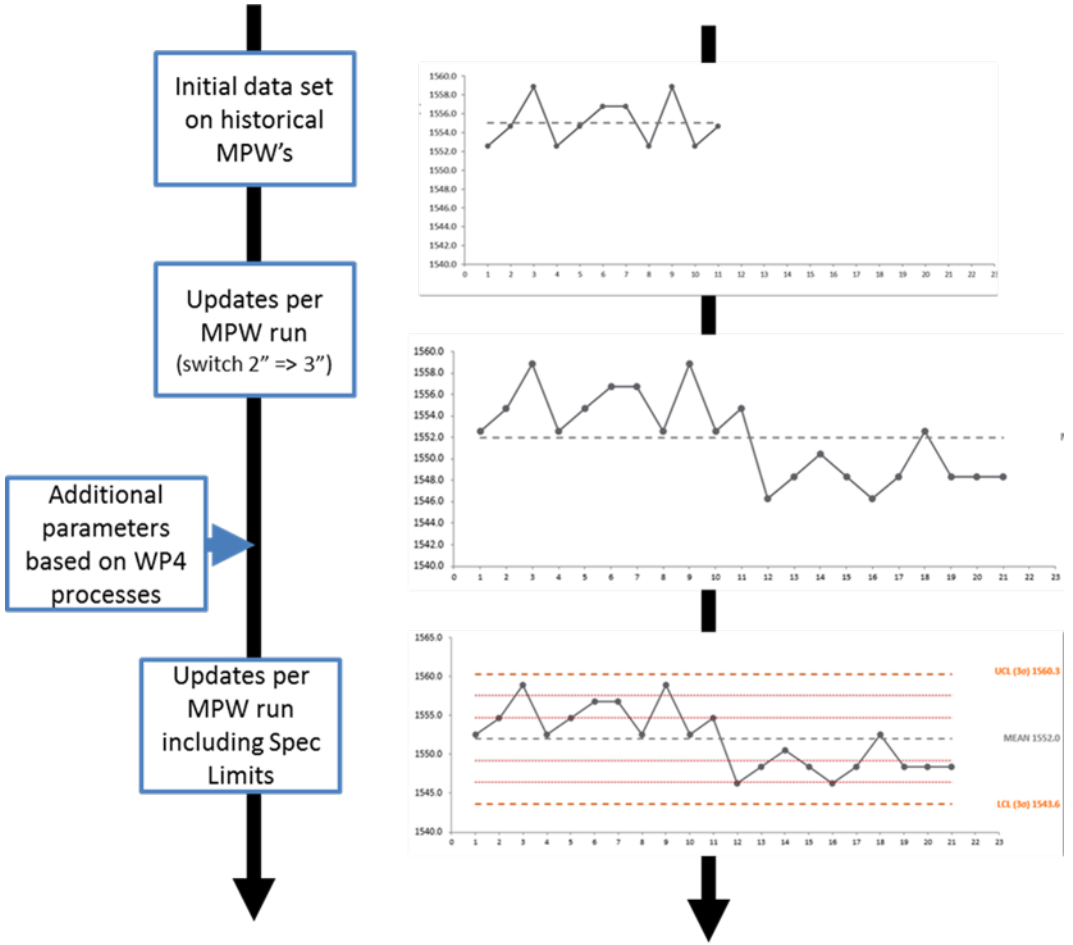
WP2 – MPW PROCESS IMPROVEMENTS & BB CHARACTERIZATION

- WP2 Overall Goal
  - Tracking and Process Improvement of Existing MPW Building Blocks *& Introduction of New BB's*
- WP2 Work Packages
  - WP2.1 Track BB parameters in available BB's
  - WP2.2 Improve quality and reduce variation in available BB's
  - WP2.3 Introduce new BB's in the MPW (& PDK)
    - Link to WP3/WP4 – parallel MPW runs until Fit-for-Release





Planning WP2 (June 2017 update)		Milestone Description	SP19	SP20	SP21 / Review	SP22	SP23	SP24	SP25 / Review?
		Design Submission Date	Dec-16	Mar-17	Jun-17	Sep-17	Dec-17	Mar-18	Jun-18
		Remarks	*2months delay*	*1month delay*					
Description	Milestone #	Expected MPW Delivery Date	June '17	Aug'17	Oct'17	Jan'18	Apr'18	TBD	TBD
WP2 General	WP2-M0.1	WP2 Project Charter			WP2-M0.1				
	WP2-M0.2	WP2 Milestone Planning			WP2-M0.2				
WP2.1 MPW Generic BB Data & Characterisation	MPW Characterisation & Monitoring								
	WP2.1-M1.1	List of Generic MPW parameters for data monitoring & MPW cadence			WP2.1_M1.1				
	WP2.1-M1.2	Generic Update Q3'16 - Q2'17 Data up to and including SP19 (1st 3inch MPW)			WP2.1_M1.2				
	WP2.1-M??	T.B.D.							
WP2.2 MPW Generic BB Process Improvements	General Improvements								
	WP2.2-M1.1	Metallization - Lift-Off improvements			WP2.2_M1.1				
	WP2.2-M1.?	T.B.D.							
	Laser Threshold & Passivation improvements								
	WP2.2-M2.1	Dielectric Material Improvements			WP2.2_M2.1				
	WP2.2-M2.2	Integration Improvements			WP2.2_M2.2				
	WP2.2-M2.3	Passivation Integrity/Integration Improvements update					WP2.2_M2.3		
	Planarisation								
	WP2.2_M3.1	Polyimide Planarisation sequence on SP20				WP2.2_M3.1			
	WP2.2_M3.2	Dummy Structures/Tiling (on SP22)					WP2.2_M3.2		
	WP2.2_M3.?	T.B.D.							
	Waveguide Loss improvements								
	WP2.2_M4.1	T.B.D.							
WP2.3 New Building Block Introduction	New Building Blocks (from WP3) Commercially Avaliable on MPW					Plating & DBR laser	SI substrate	Effect MQW	Spotsize Convertor
	WP2.3-M1.1	DBR laser				WP2.3-M1.1			
	WP2.3-M1.2	SI substrate					WP2.3-M1.2		
	WP2.3-M1.3	Effect MQW						WP2.3-M1.3	
	WP2.3-M1.4	Spotsize Convertor							WP2.3-M1.4
	WP2.3-M1.5	Al MQW							=>SP28

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WP2 Summary

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WP2.1 – MPW GENERIC BB *DATA & CHARACTERISATION*

Initial reported tracking List

Epitaxy Photo Luminescence

- Active Layer PLpeak
- Passive Layer PLpeak
- Other parameters (T.B.D.)

Waveguide Processing

- Shallow WG width
- Deep WG width
- Other parameters (T.B.D.)

Building Block Performance

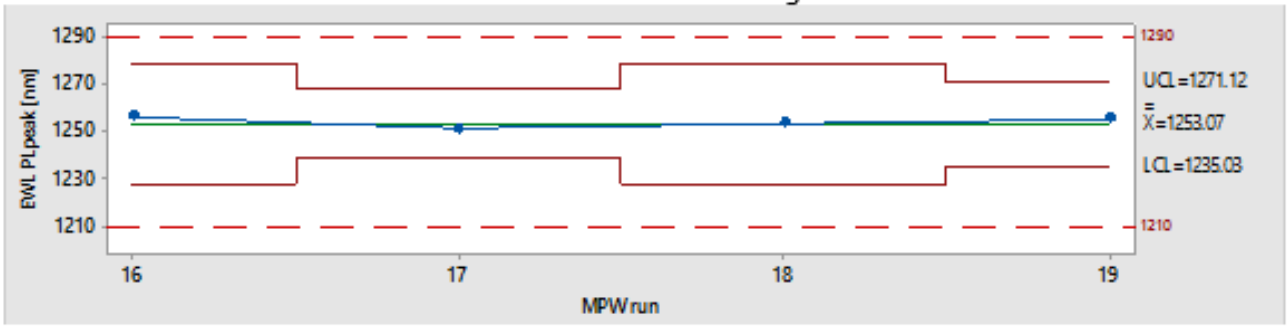
- Passives: Deep WG losses
- Active Laser Threshold
- Other parameters (T.B.D.)

Extend data set with New BB's

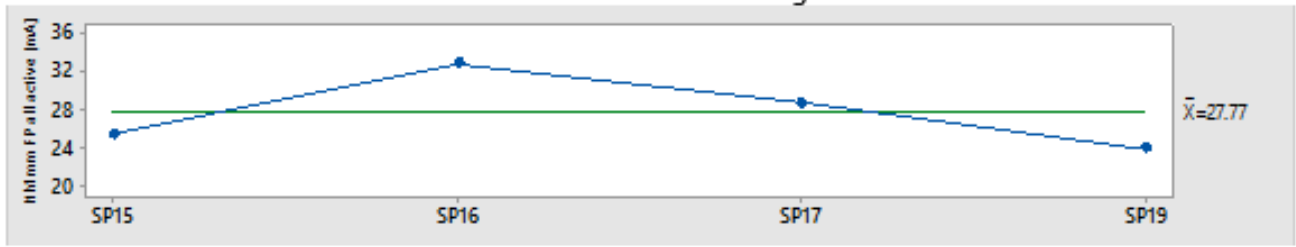
- once available from WP3

Some Examples

- Epitaxy: Passive Layer PLpeak
  - Current Target 1250nm ±40nm
  - SP19 is 1st 3inch wafer MPW run using the L-reactor



- BB performance: Threshold Current 1mm FP All Active
  - Current target – TBD
  - SP19 is 1st 3inch wafer MPW run using the L-reactor



At SP19 MPW switched from 2" to 3" wafer size (incl. new passivation)

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WP2 Summary

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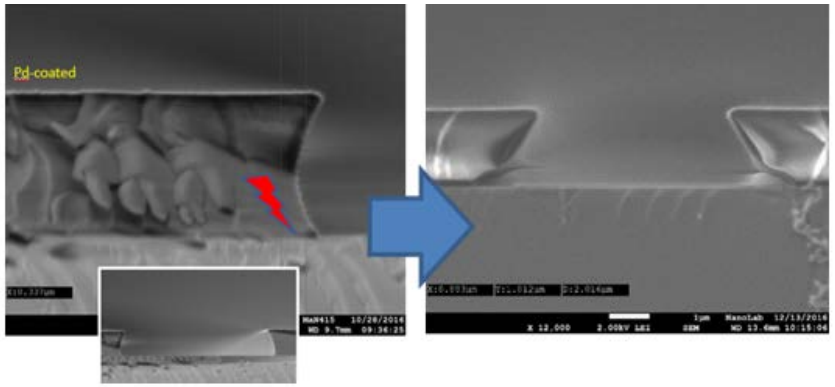
WP2.2 MPW GENERIC BB *PROCESS IMPROVEMENTS*

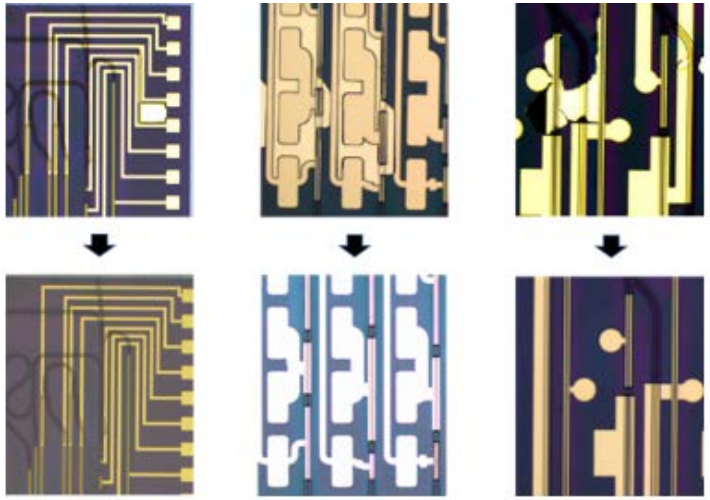
GENERAL IMPROVEMENTS

M1.1 Metal Lift-Off - Achievements

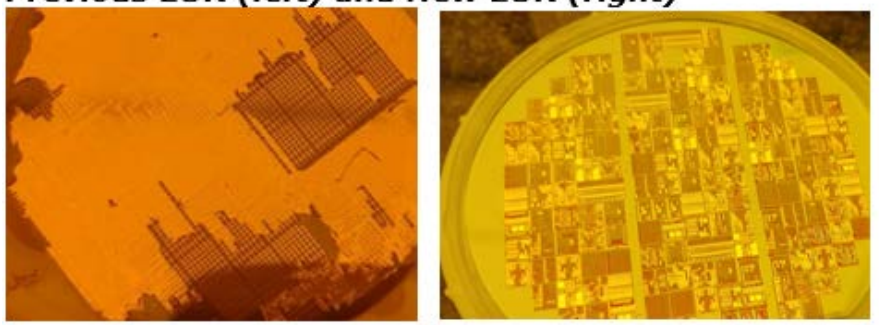
- A process assessment was carried out on the existing Lift-Off Resist (LOR) process (i.e. MaN415)
- A new LOR with better Thermal Properties (higher Tg) was selected (MaN1420)
- The new LOR was successfully applied on InP wafers with Full Topography resulting in a new and improved Lift-Off process with reduced metal residues
- Critical Dimension (CD) performance of the MaN1420 at targeted line widths of 2.5 and 5.0µm has dramatically improved



Example of the Improvements w.r.t. residues



Previous LOR (left) and New LOR (right)



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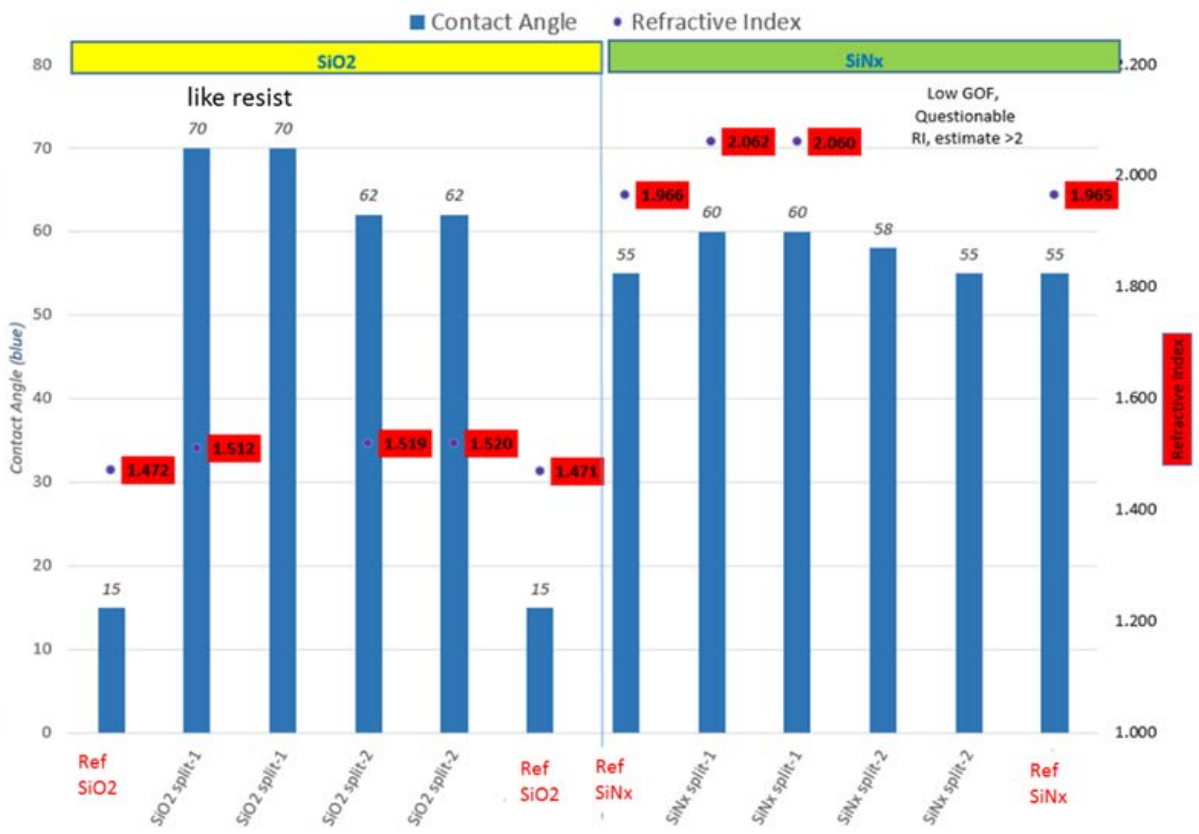
WP2.2 MPW GENERIC BB *PROCESS IMPROVEMENTS*

LASER THRESHOLD & PASSIVATION

M2.1 Dielectric Material Quality – PECVD updates



Achievements

- Contact Angle improvements
  - SiO_2 Contact Angle of has been improved from hydrophilic 15° to a hydrophobic > 60°. Small SiN_x improvements.
- Breakdown Improvements
  - SiO_2 Split-1 showing no early fails around 85V with consistent breakdown occurring >160V
  - SiN_x Split-2 improving with tight spread

Material	Split	Breakdown Results [0 - 200V]	Contact Angle [°]
SiO2	Reference SiO2	Early fails at 85-100V, wide spread towards 200V	15
	Split-1 SiO2	No early fails, consistent fails between 160-185V	70
	Split-2 SiO2	Early fails around 100V, remaining 170-190V	62
SiNx	Reference SiNx	Consistent ≥ 190V	55
	Split-1 SiNx	≥160V, but wide spread	60
	Split-2 SiNx	Very tight spread 190-200V	55

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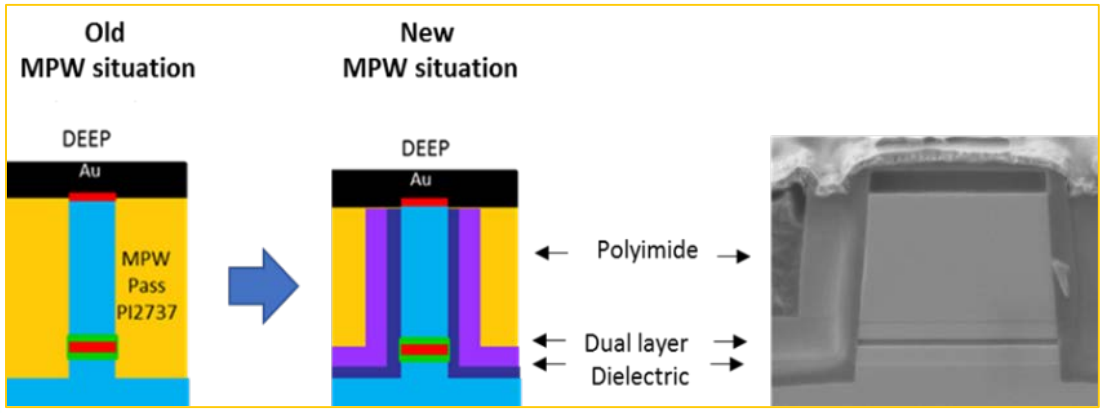
WP2.2 MPW GENERIC BB *PROCESS IMPROVEMENTS*

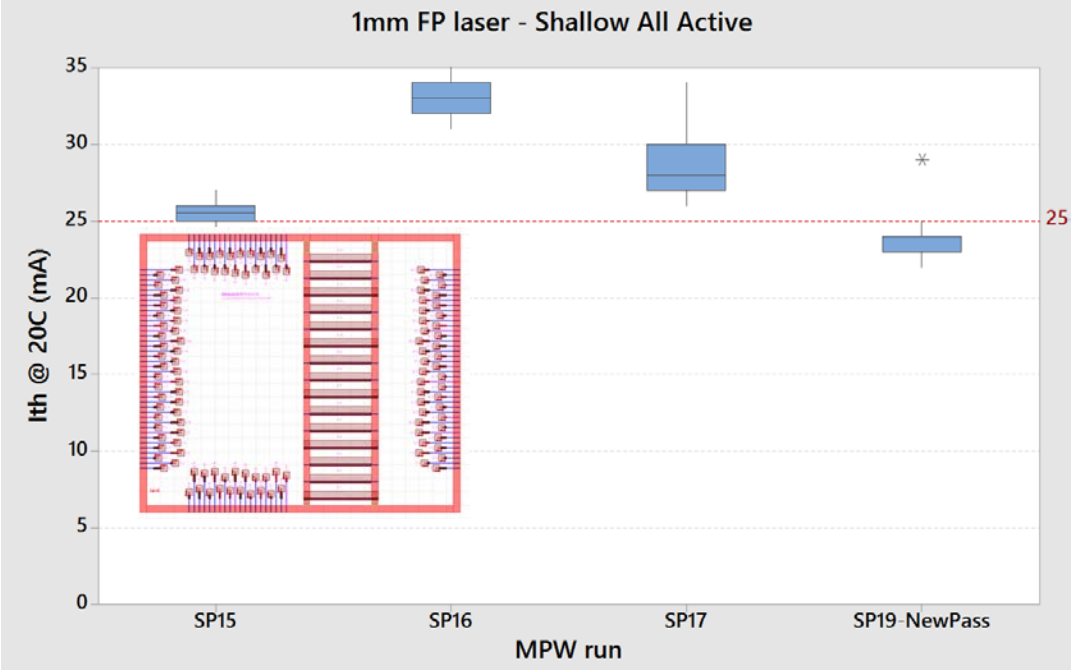
LASER THRESHOLD & PASSIVATION

M2.2 Integration Improvement - Achievements

- New Passivation Integration approach developed using Higher Quality Dielectrics
  - Self-aligned Processing
  - Dry etch recipe updated
  - Excellent Reliability & Life Time results obtained
    - Also for DEEP lasers



- New Passivation implemented on MPW SP19
  - Laser Threshold Currents brought back below 25mA
  - More stable performance observed



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WP2 Summary

WP2 SUMMARY

- WP2 divided into 3 parts
  - WP2.1 Track BB parameters in available BB's
  - WP2.2 Improve quality and reduce variation in available BB's
  - WP2.3 Introduce new BB's in the MPW (& PDK)
    - Input from WP3/WP4 to run in parallel to MPW before release
      - i.e SP19 Au plating
- 7 Milestone reports created
  - Performance Tracking started using initial selected parameters
  - Several Improvements made to improve quality & stability

- *Other MPW news*
  - *SP20 almost finished*
  - *SP21 started*

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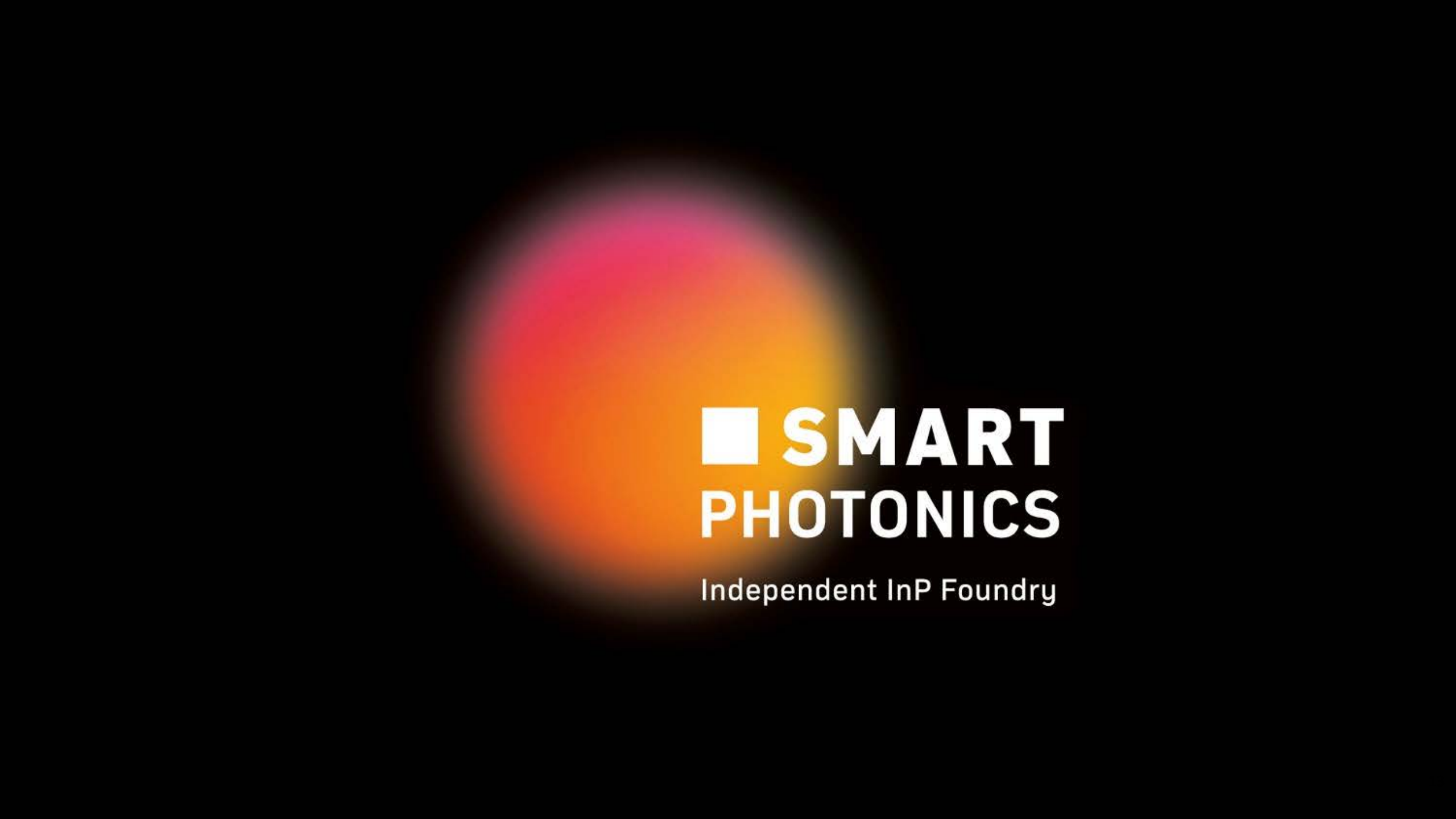
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