

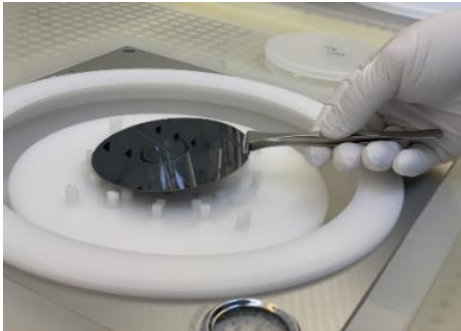
Test Strategy for Mass Transfer Photodiodes

Dr. Hektor Meier

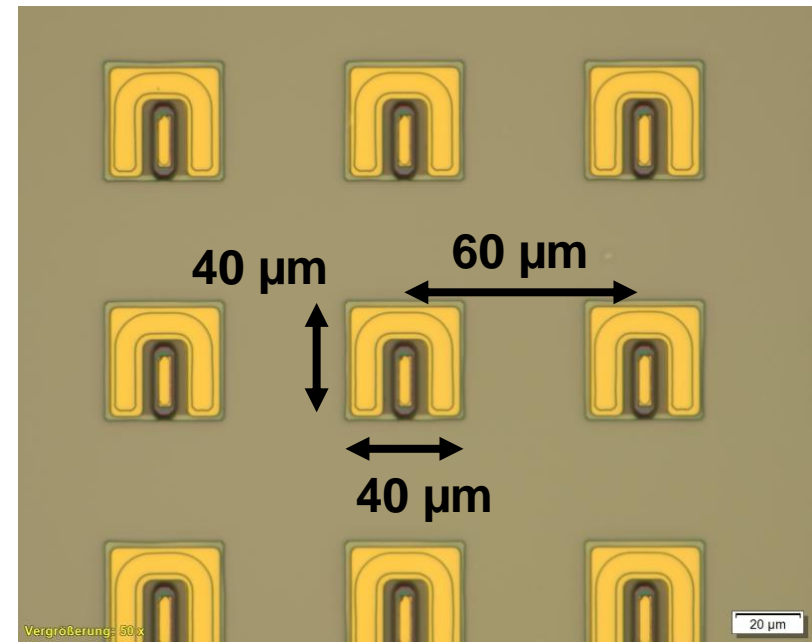
Head of Product Development,
Albis Optoelectronics AG, Switzerland

Albis Optoelectronics – Detecting Solutions

- Designer, developer and manufacturer of high-speed **III-V photodiodes (up to 70 GHz)** and **avalanche photodiodes (up to 25 GHz)** based on InP and GaAs.
- 20 years of excellence in III-V photodiode manufacturing with **over 40 million photodiodes sold to date.**
- Qualified technology and products with long track record of reliability.
- Own **clean room production facilities**
 - In-house front-end to back-end III-V wafer processing and testing.
 - Flip-chip mounting and packaging infrastructure.
- Design and fabrication chips, chip-on-carrier and packaged photodiodes.



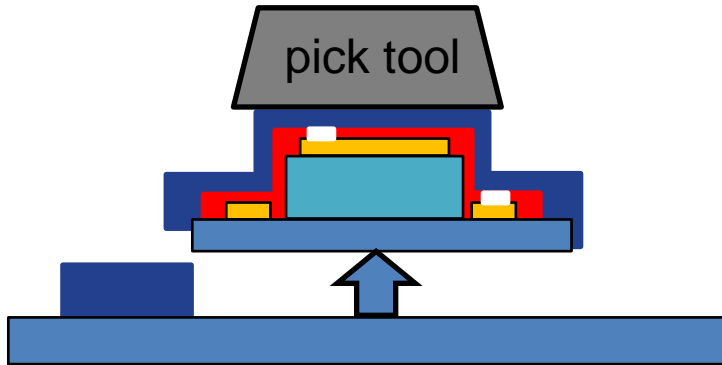
- Mass transfer photodiode concept
- Yield challenge
- Testing strategy
- Conclusion



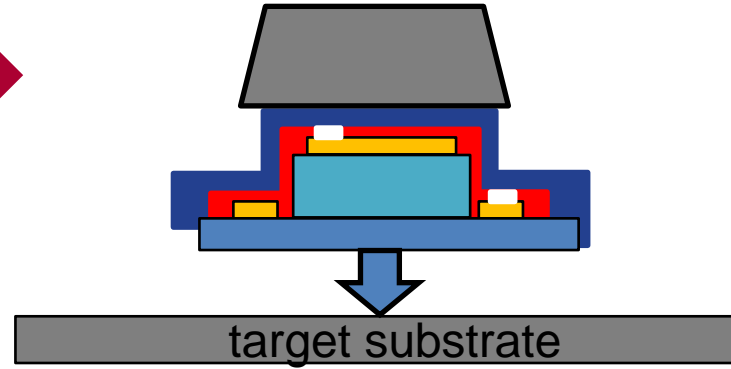
The Albis InP mass transfer PD (MTPD) is a releasable photodiode designed for efficient substrate removal and transfer via pick-and-place on target substrates.

Mass Transfer PD (MTPD) concept

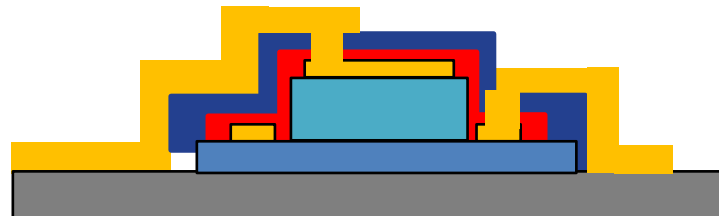
d) pick from source wafer



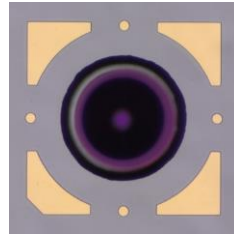
e) place on target substrate



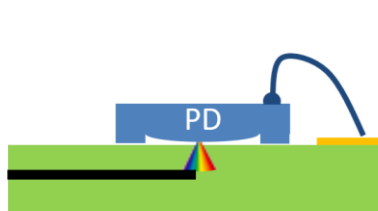
f) electrical interconnect to target substrate



PD on Waveguide



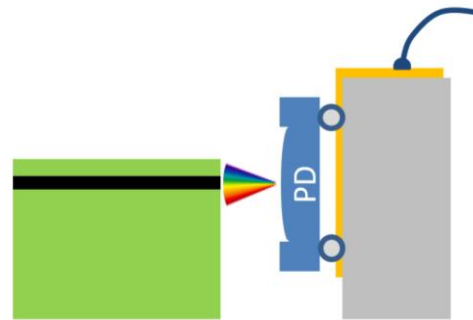
Standard PD



PD on waveguide
w/ mirror or grating

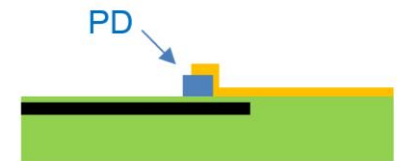


PD on planar substrate



PD on wrap-around carrier
edge illuminated waveguide

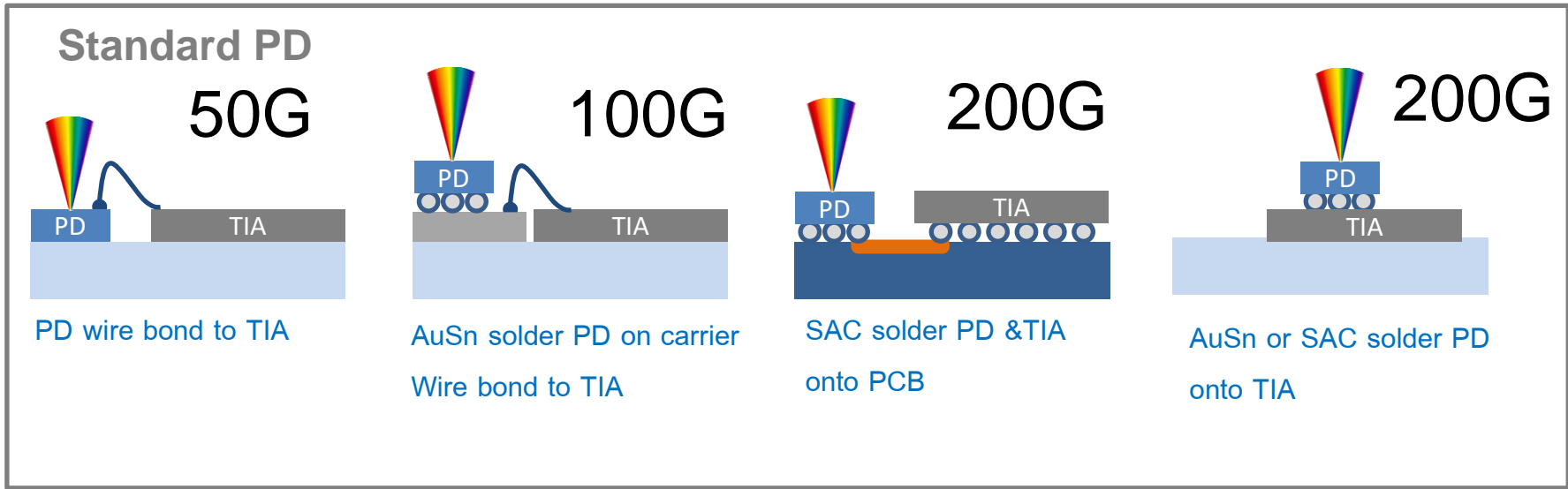
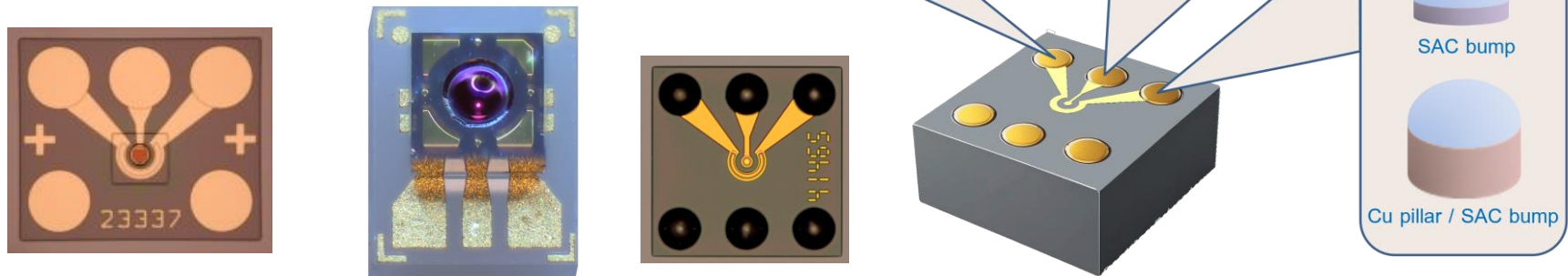
Mass Transfer PD



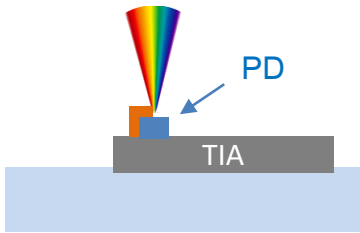
Mass Transfer PD on
waveguide, evanescent,
grating or mirror coupling

- MTPD
 - Enables evanescent / grating coupler.
 - Heterogenous integration of PD on PIC platform (SiN, Glass, Polymer, TFNL).
 - Cost efficient electrical interconnects on wafer level (no wire bond or soldering).
 - Small chip size enables high density integration (many components).

PD on TIA



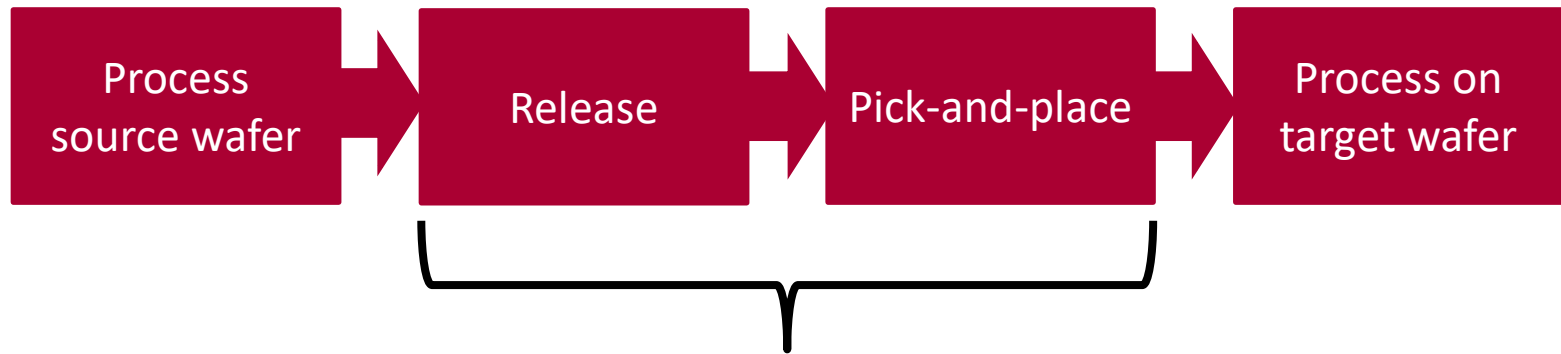
Mass Transfer PD



Mass Transfer PD
onto TIA

- MTPD
 - Enables heterogenous integration of PD on high-speed TIA wafers.
 - Parallel electrical interconnect deposition on full TIA wafer.
 - Low parasitic interconnects / cross-talk.
 - Testability on wafer level.

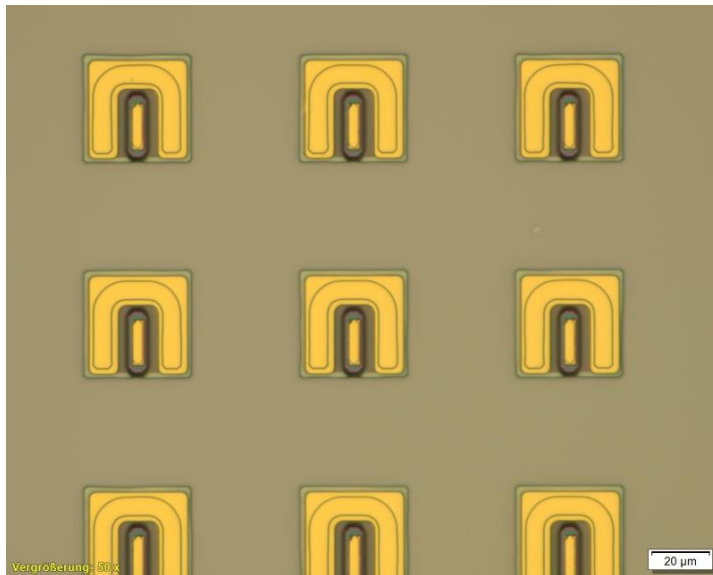
Yield Challenge



$$Y_{swp} = 99 \%$$

$$Y_{mtr} = 99 \%$$

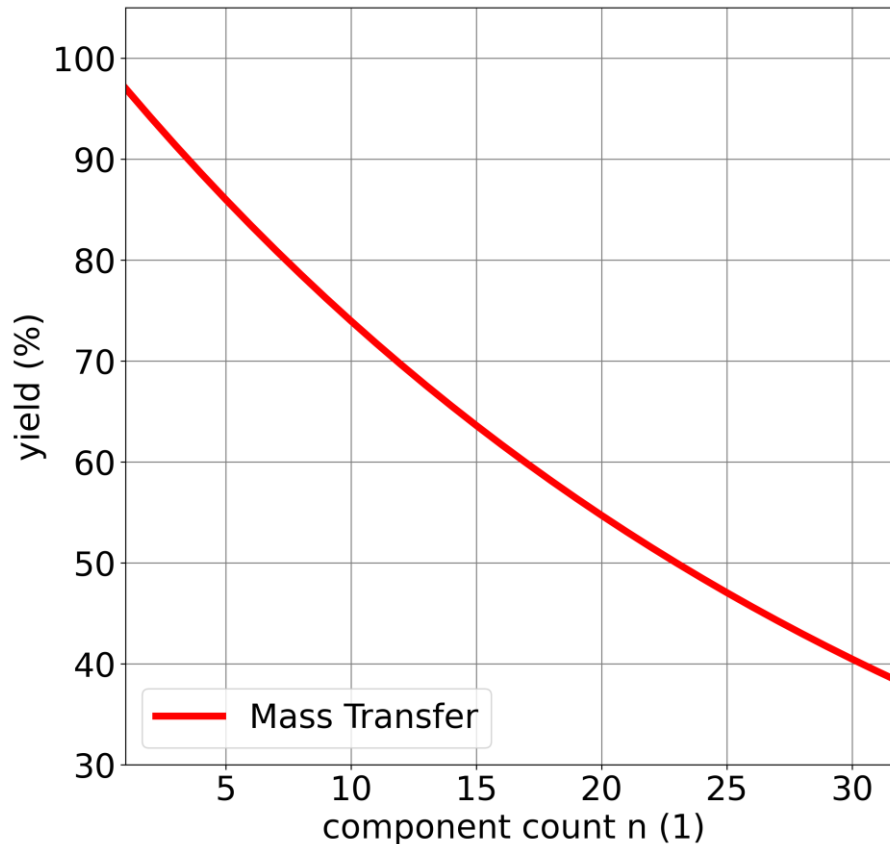
$$Y_{twp} = 99 \%$$



$$Y(n) = (Y_{swp})^n * (Y_{mtr})^n * (Y_{twp})^n$$

Mass Transfer Yield

- Mass transfer of **untested** components.



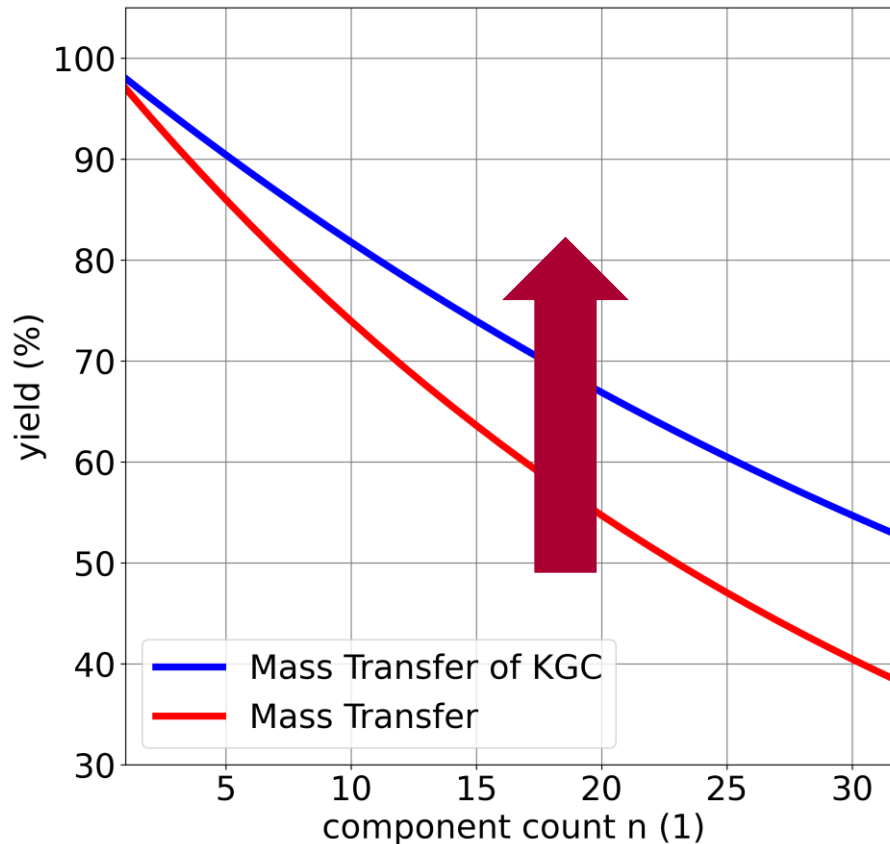
$$(Y_{swp})^n * (Y_{mtr})^n * (Y_{twp})^n$$

$$(99\%)^n * (99\%)^n * (99\%)^n$$

- Low yield of individual steps results in costly **failure of full assembly**.

Mass Transfer Yield

- Mass transfer of **tested** and known-good-chiplet (KGC).



$$100\% * (Y_{mtr})^n * (Y_{twp})^n$$

$$\uparrow$$

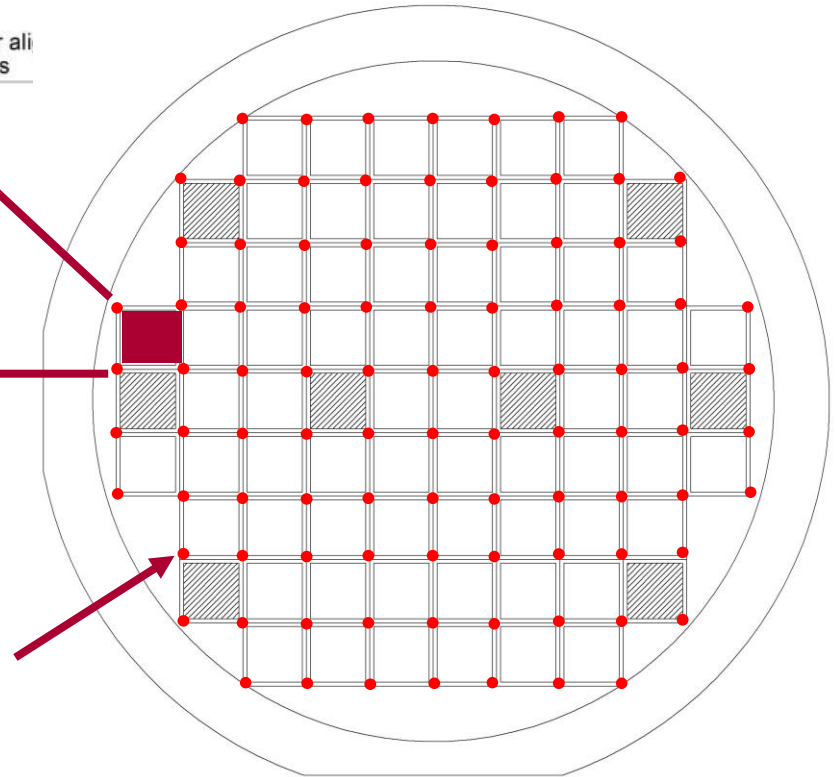
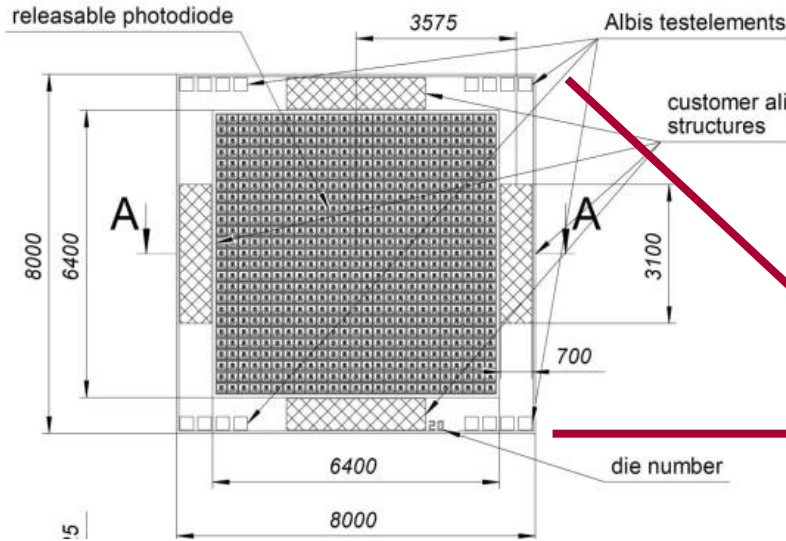
$$(Y_{swp})^n * (Y_{mtr})^n * (Y_{twp})^n$$

- Testing components before assembly improves yield.

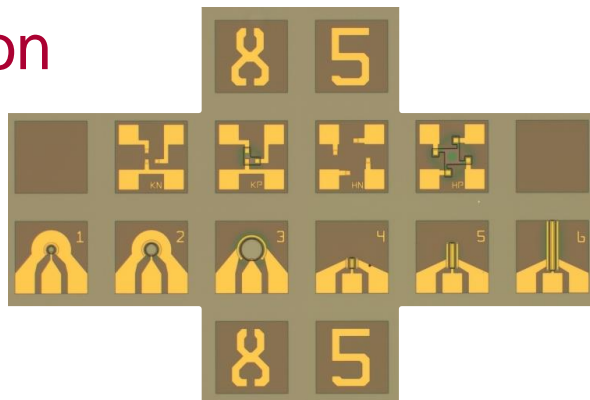
Test Strategy – Die Validation

- Multi-project wafer (MPW) with standardize testing procedure for die and wafer validation.

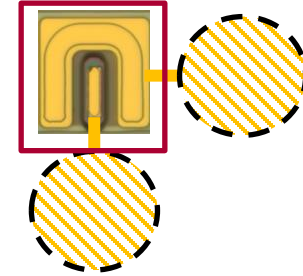
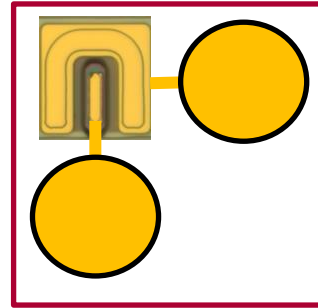
die



die validation
test sites



Test strategy for MTPD



	No probe pad	Probe pad	Sacrificial probe pad
Material consumption	small	large	small
Integration density	high	medium	high
Testability	die validation	100%	100%
Assembly yield	low	high	medium
Cost	lowest	low	medium

- Testing strategy is part of the heterogenous product design.

- **Innovative Photodiode Form Factor:**
 - The Albis mass transfer PD (MTPD) is a releasable photodiode designed for efficient substrate removal and transfer via pick-and-place on target substrates.
 - It enables new heterogenous, high-density integration and new illumination schemes.
- **Quality and Performance Focus:**
 - Tested MTPD technology with high quality, yield, and performance.
- **Active R&D and Prototyping:**
 - Engages in R&D projects and customer-driven prototypes.
 - Promotes MPW runs to showcase the compatibility and feasibility of Albis PD technology with mass transfer approaches and target substrates.

Thank you

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