Rockley Photonics Manufacturing Ecosystem

200mm SOI process:
RP proprietary process

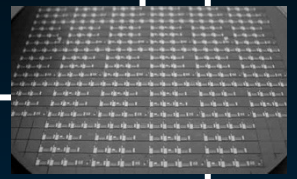
Key BOM purchased items
Substrate, LEDs, Si PDs, Other ICs, Housing

Si PIC Wafers

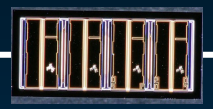
III-V KGD bonding to Si PIC wafers

PCB Assembly

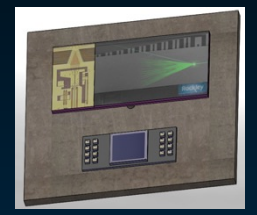
PIC Integration

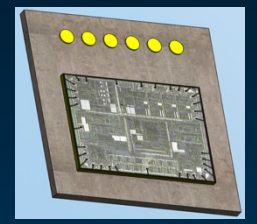


III-V Actives

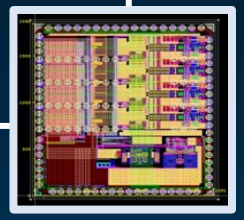


Module Integration





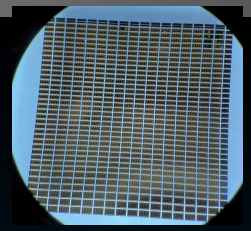
Electronic ICs



100mm InP wafers: device design and process custom to Rockley

- **Strategic Partner Relationships**
- **Internal Assembly and Test Development**
- **100% outsourced HVM supply chain**

Developing Full Wafer Level Back-End

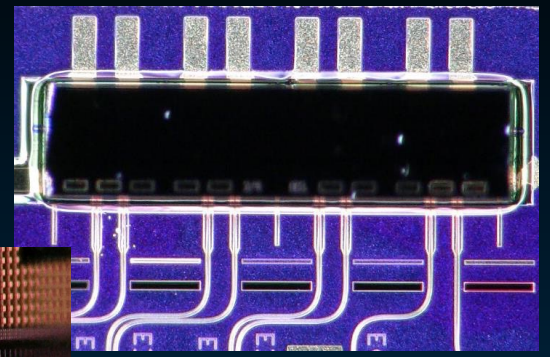


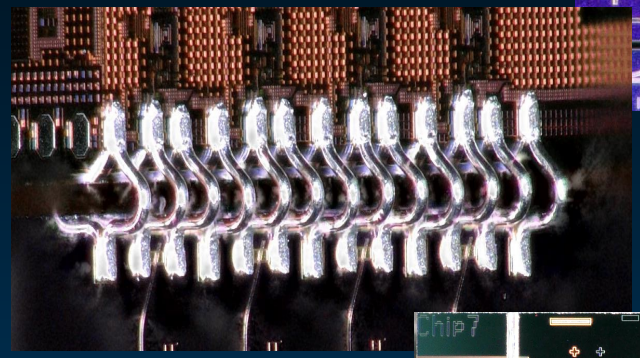
- Convert from Die-to-Die (D2D) to Die-to-Wafer (D2W) AuSn bonding
- Eliminates die touching
- Major reduction in time to locate next bond position
- Die location improved (lithography vs fixture)
- Eliminates expensive die level fixturing

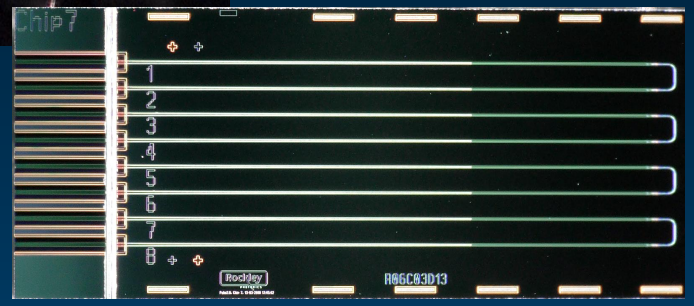
- Enables rest of back end to be automated at wafer level
- Wafer level underfill dispense
- Enables wafer level burn-in with precise contact alignment
- Enables high speed electrical-optical test
- Stealth dicing: Clean, no particulate; close facet proximity without damage; High yield; Consistent stretch for automated PnP; Qualified

Critical Assembly Processes and Capabilities

- High accuracy AuSn bonding (XY)
- Height/tilt control (Z)
- Index matching underfill gel for light coupling and reduced back reflection
- Reliable, short, low-loop wire bonds for high-speed performance
- Low-loss, long-life, passive fiber attach for ease of assembly
- Back-end automation



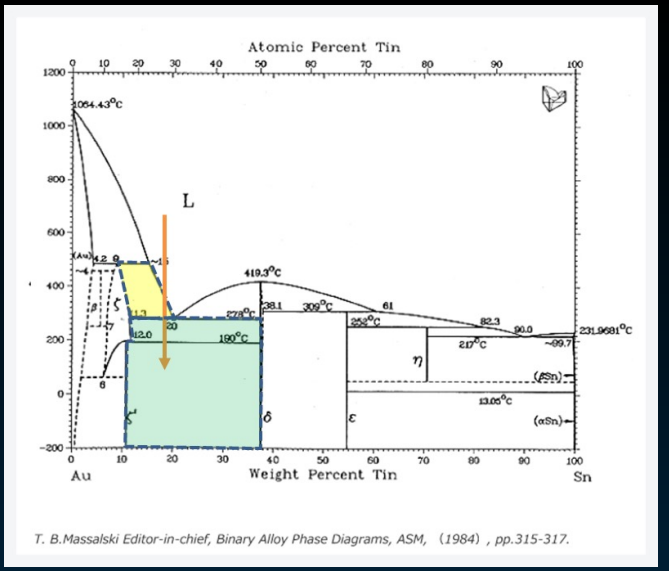


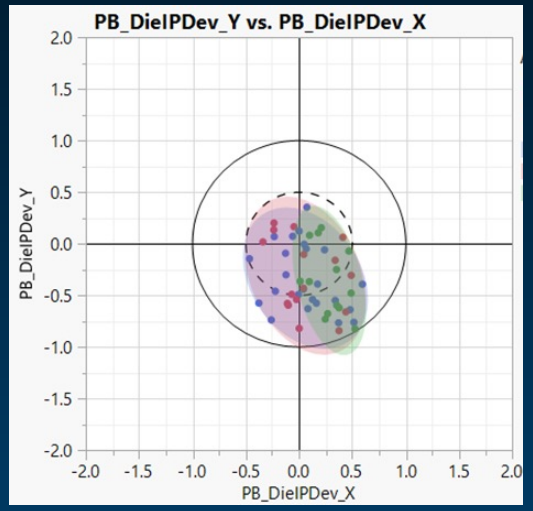


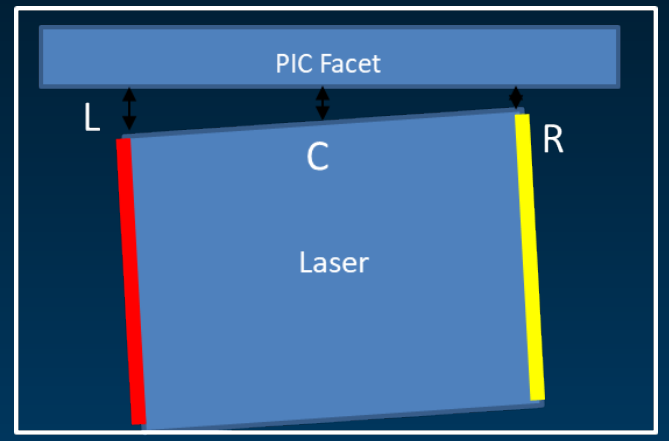

Rockley®
PHOTONICS

AuSn Bonding

- Metal alloy control pre and post bonding
- X/Y post bond location accuracy +/-0.5um
- Requires fiducials with consistent appearance to bonder and in fab layers of feature that require alignment
- Vertical alignment control by passive design with structure



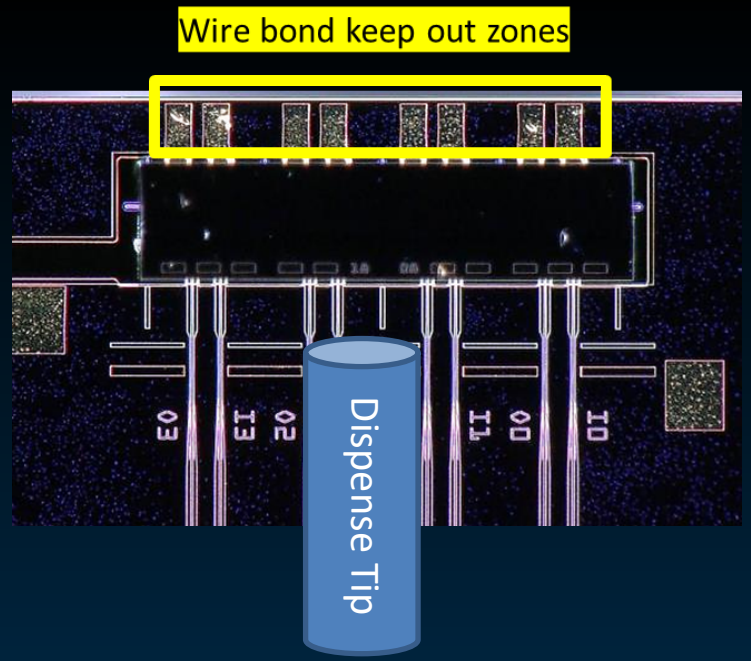




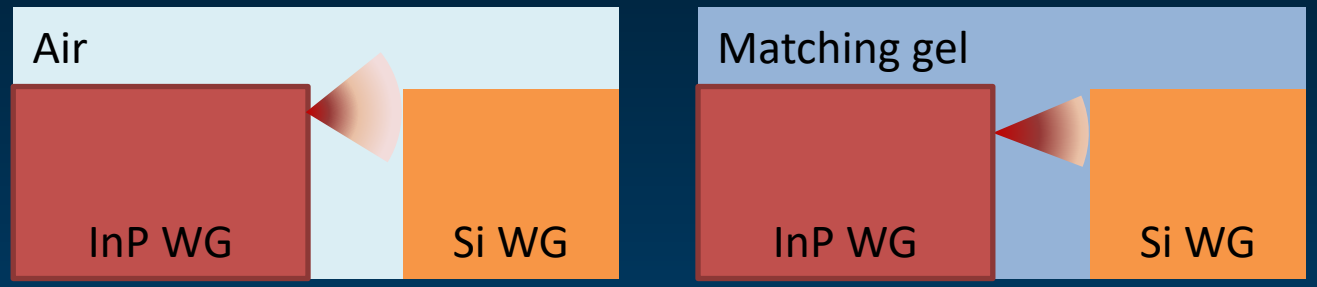
X/Y plane view of optical “gap”

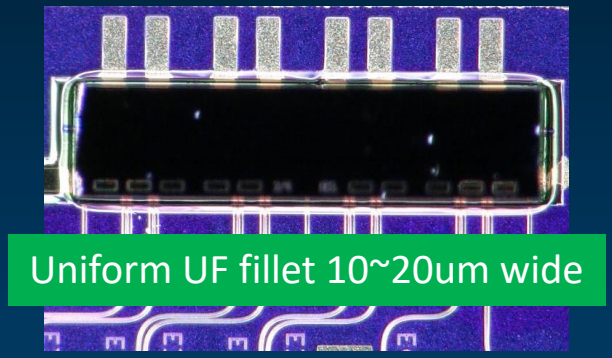
Index Matching Gel to improve Light Coupling and Reduce Back Reflection

- **Challenges:**
  - **Small die size → 2nL dispense**
  - **100um die thickness**
  - **No material on die backside**
  - **Fill significant topology in between III-V and Si**
  - **No voids allowable in optical gap**



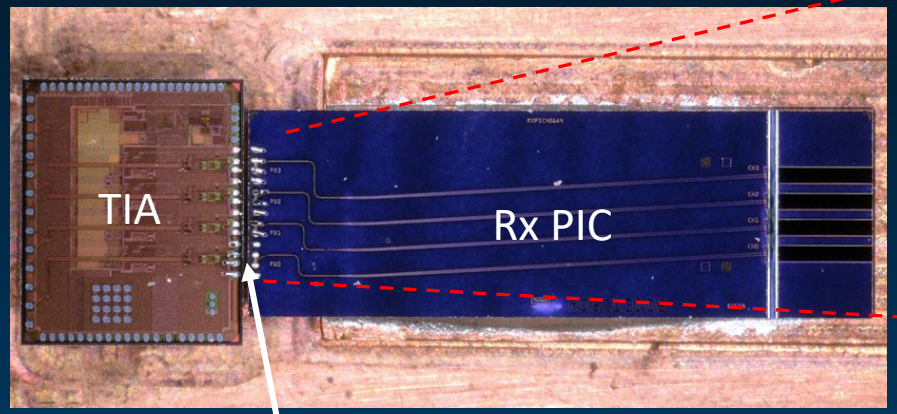
Beam divergence is reduced with use of higher-index matching fluid

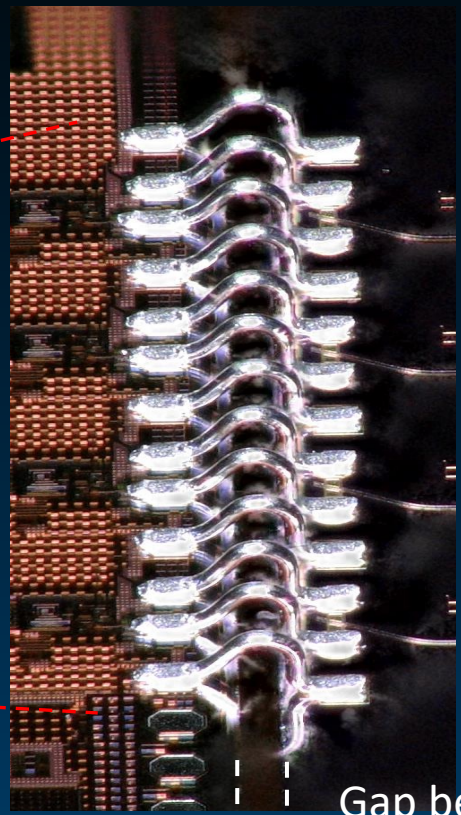




Wirebond

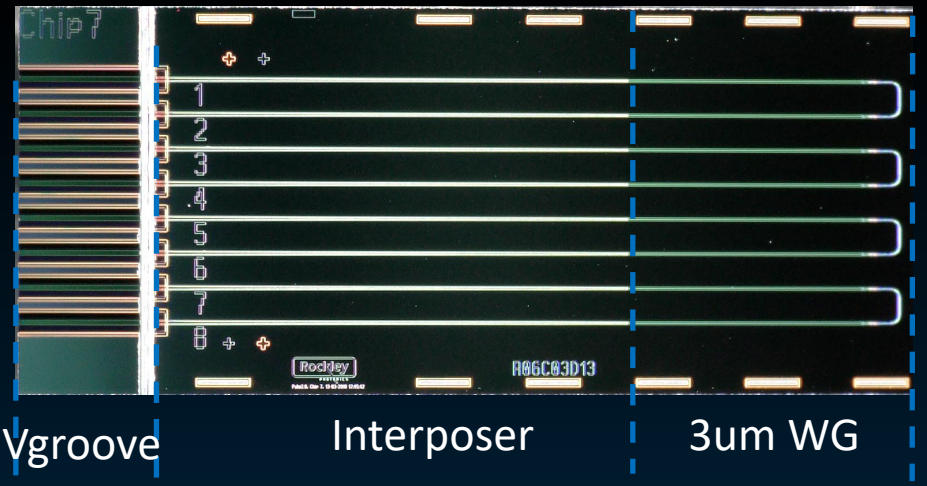
- Short length for optimum RF performance
- Loop necessary to compensate for height difference between TIA and PIC in QSFP-DD module
- Matched pitch between ICs to eliminate added length from fan-out
- Small bond pad sizes

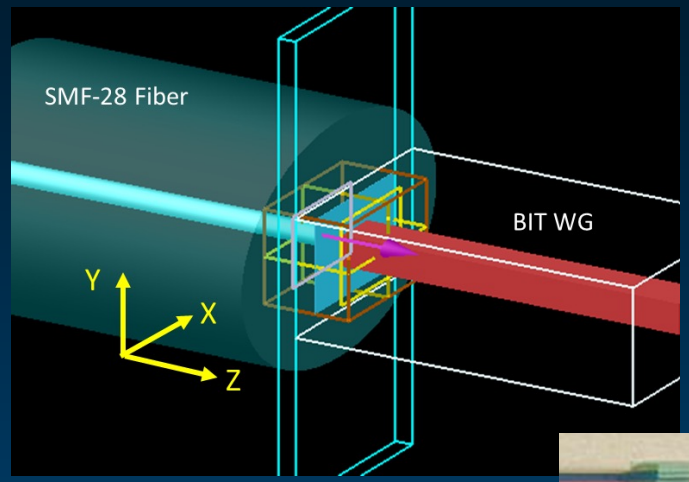


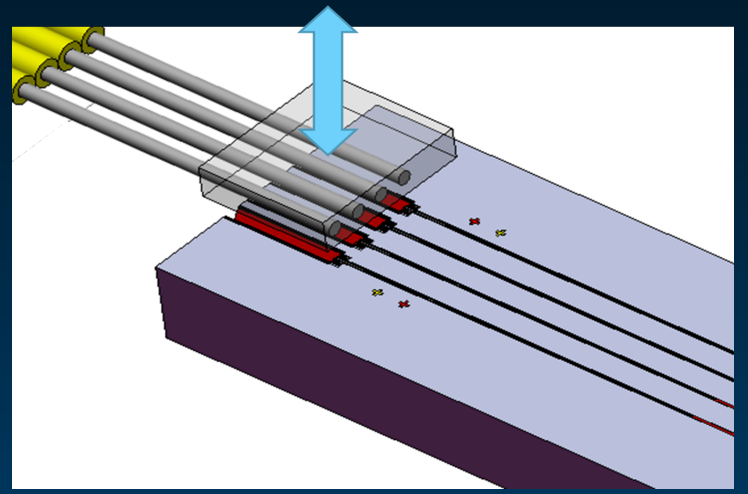


Fiber Attach

- Passive fiber attach
- Narrow mode matching converter to fiber interface to optimize coupling
- <0.5 dB coupling loss
- 2,000 hours 85/85 plus temp cycle and 2 cycles of solder reflow







Rockley Photonics Health Sensors

- Unique sensing platform targeting applications in consumer health and wellness → driving an exponential increase in application capabilities for non-invasive, multi-modal biomarker monitoring
- Built on Rockley's integrated silicon photonics technology
- Internally designed lasers generate numerous wavelengths of light: Visible and IR spectrum
- Light is directed into/reflected from the skin
- Reflected light is gathered by photo detectors and spectral absorption analyzed

Target Consumer Healthcare Applications				
	Lactate	Alcohol	CGM (Glucose)	Hydration
	Core Body Temperature	Blood Pressure	Blood Oxygen (O_2)	Heart Rate

Unique Spectrometer Chip

Mobile LED technology:

- An effective light source for resolving blood components with strong absorbance signatures in the visible and near IR range
- Falls short in power efficiency, signal strength, and spectral range and resolution for targeted biomolecule quantification, in blood, tissue, and skin

"Clinic-on-the-Wrist"

***Condensing technology the size of clinical machines onto a wearable chip**