ADVANCEMENTS OF TEMPORARY BOND AND DEBOND: CREATING PHOTONIC DEBONDING METHODS AND MATERIALS FOR WAFER-LEVEL PACKAGING

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iMAPS Device Packaging Conference

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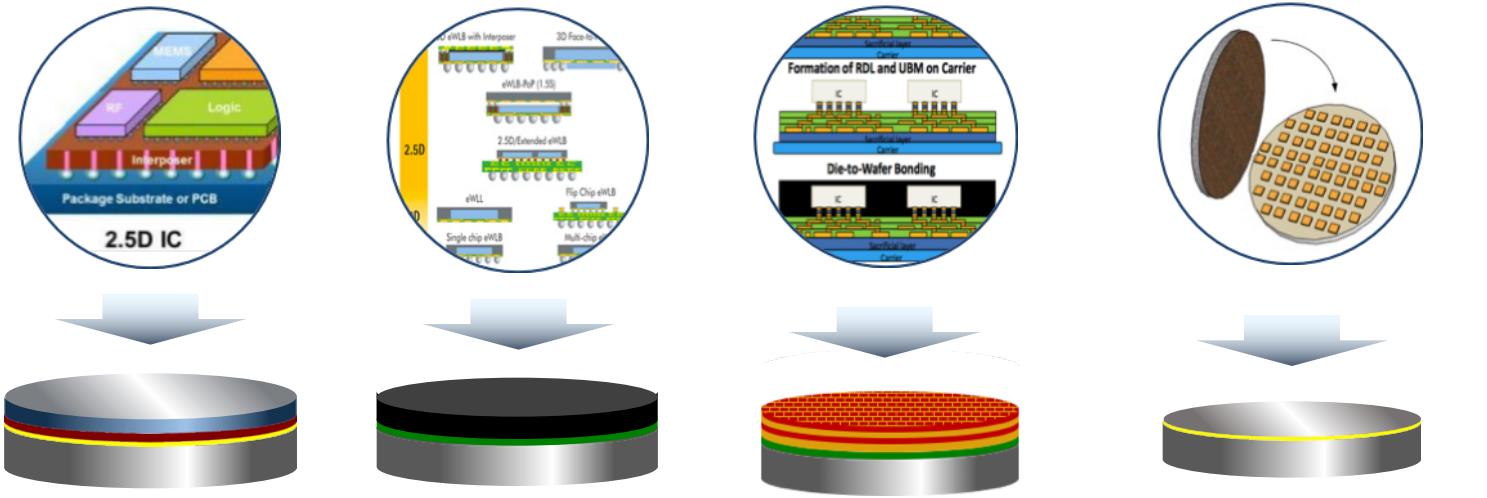
OUTLINE

- Introduction
- Material Characterization
- Results and Discussion
- Conclusion

INTRODUCTION

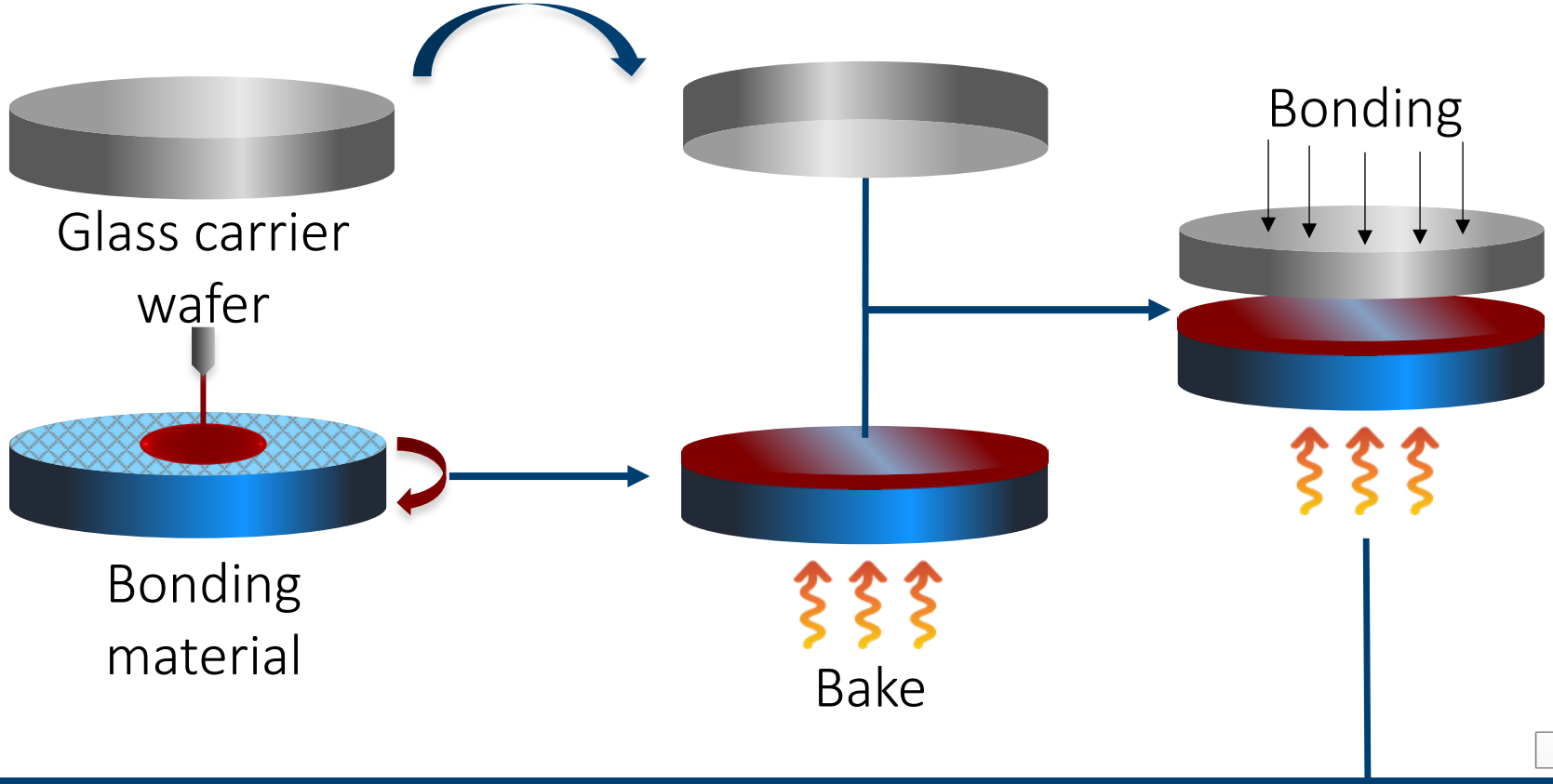
TEMPORARY BOND AND DEBOND IN WLP

Temporary bond and debond technologies have been widely developed and adopted in many technologies for wafer-level packaging (WLP).

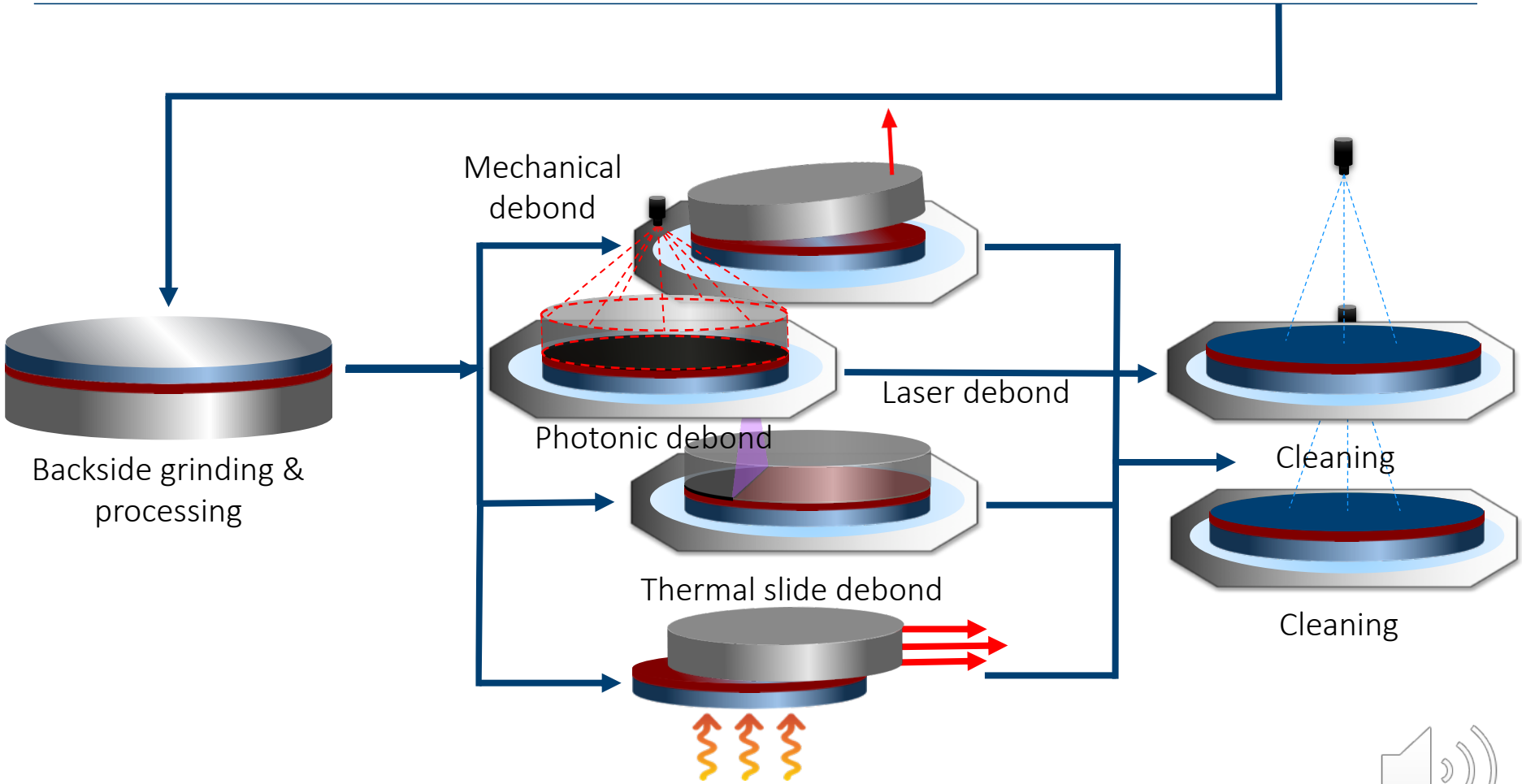


Thin wafer | EMC wafer | RDL build | Substrate transfer

TEMPORARY BOND AND DEBOND PROCESS FLOW

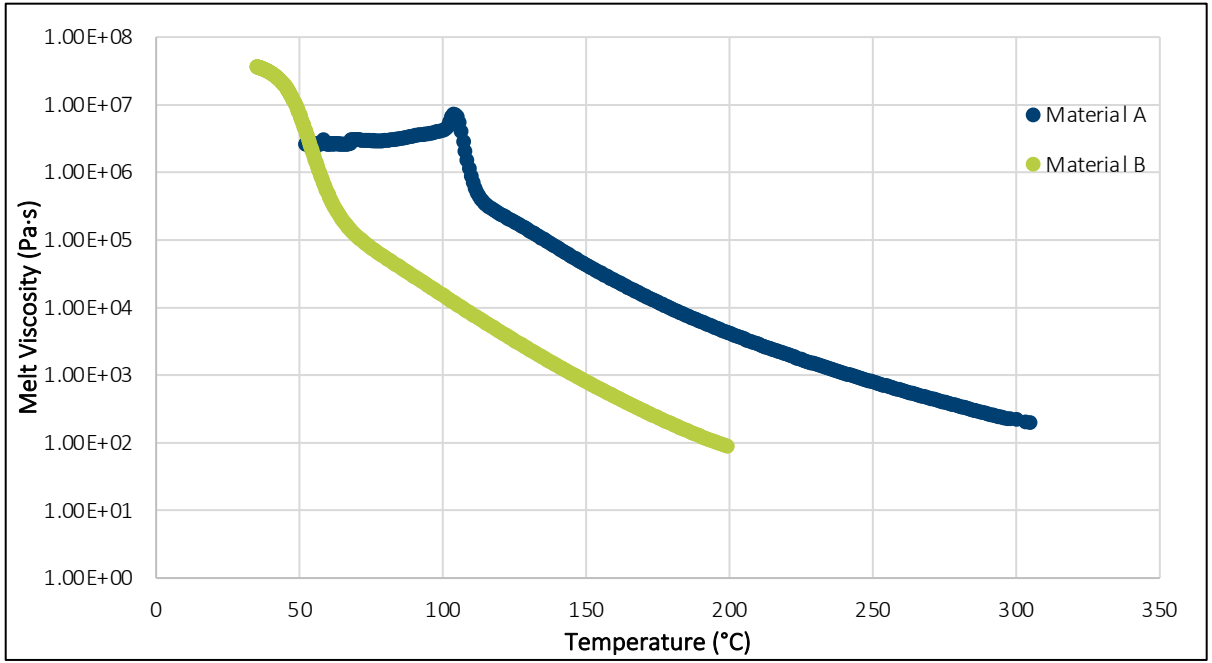


TEMPORARY BOND AND DEBOND PROCESS FLOW



MATERIAL CHARACTERIZATION

MATERIAL CHARACTERIZATION – THERMAL PROPERTIES



	Thermal Decomposition Under N_2 (°C)	Glass Transition Temperature (°C)	Melt Viscosity at 200°C	Thickness (µm)
Material A	397.0	98.3	4161 Pa·s	50
Material B	365.0	40.0	89 Pa·s	50

PHOTONIC DEBOND SYSTEM

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PHOTONIC DEBOND SYSTEM– STANDALONE

- NovaCentrix PulseForge® Invent
- High-intensity flashlamp source
- Sub-millisecond debond duration
- Suitable to debond up to 6” wafer size
- Manual loading and unloading

NOVACENTRIX®

PHOTONIC DEBOND SYSTEM – CUSTOM INTEGRATION

- NovaCentrix PulseForge® 3000 Series
- Modularity of the system allows for customizable illumination area and debond throughput
- Suitable for large sized wafers (> 6”) debonding

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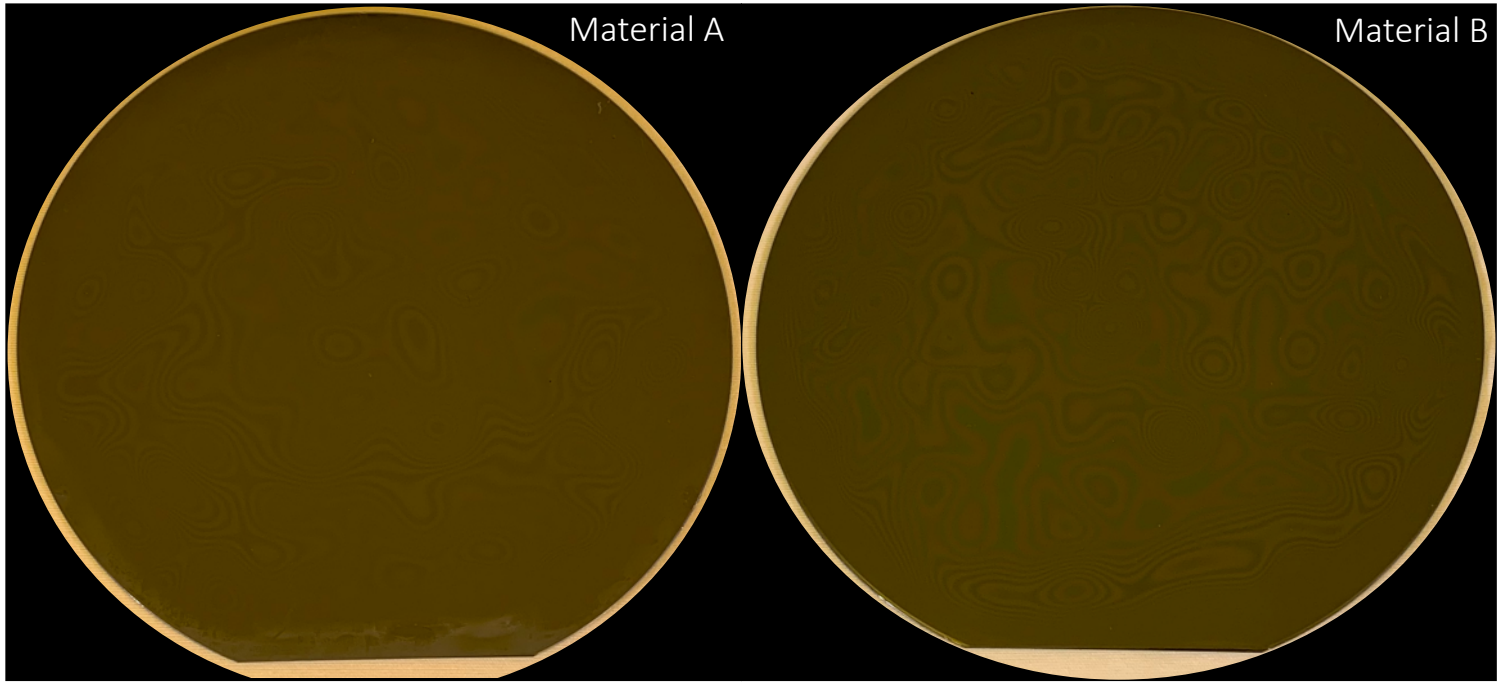
RESULTS AND DISCUSSION

PROCESS CONDITIONS

Material	Spin Conditions	Bake Conditions	Bond Conditions
A	1000 rpm 3000 rpm/s 30 s	60°C, 5 min 160°C, 5 min 220°C, 5 min	220°C 2000 N 3 min
B	650 rpm 500 rpm/s 30 s	80°C, 3 min 160°C, 3 min 200°C, 6 min	140°C 1000 N 3 min

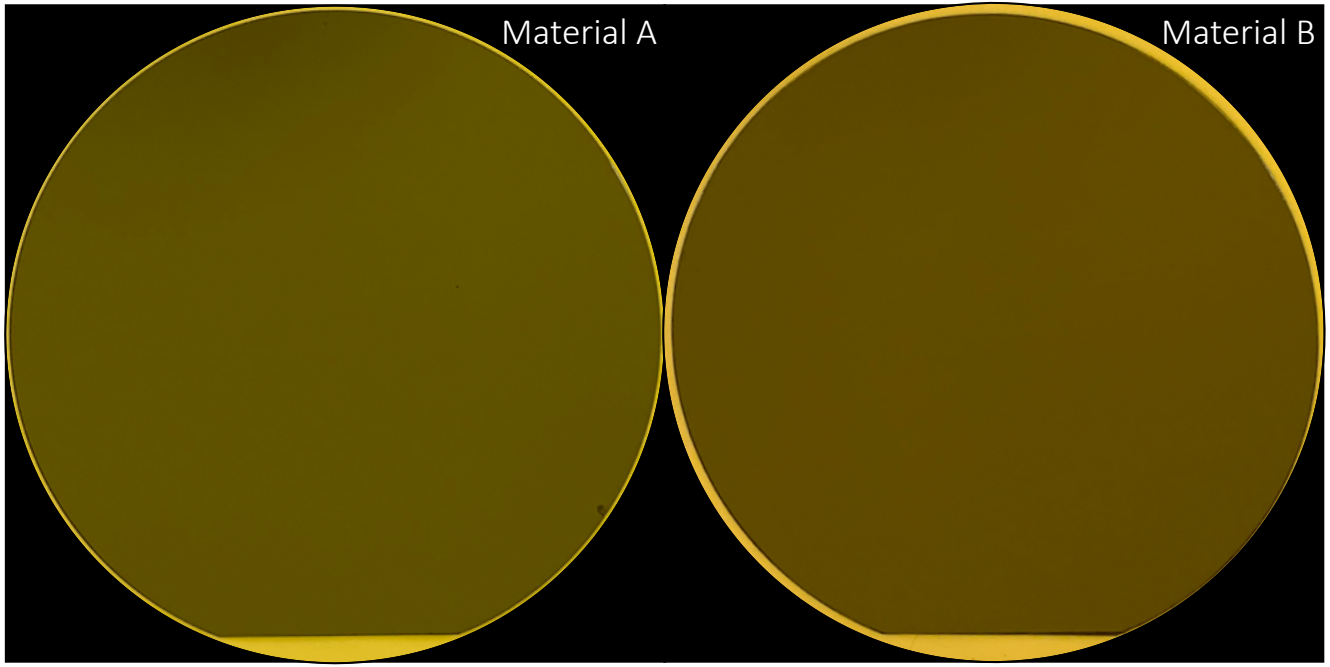
FULL-THICKNESS WAFER STUDY – DEBOND – DEVICE WAFER



Material	Peak Radiant Intensity (kW/cm²)	Fluence (J/cm²)
A	45	5
B	45	6

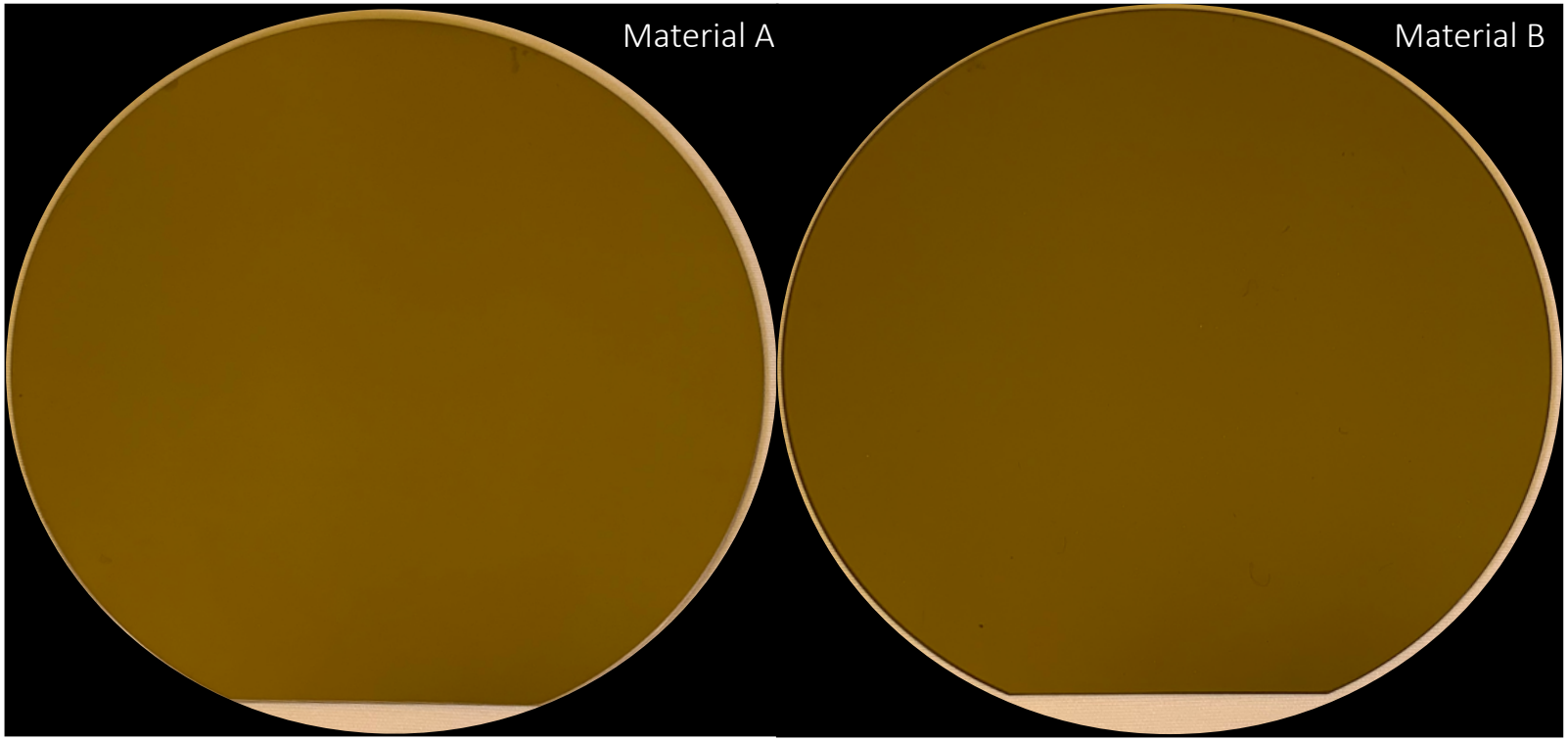
Wafers are able to be separated in under 200 µs

FULL-THICKNESS WAFER STUDY – CLEANING – DEVICE WAFER



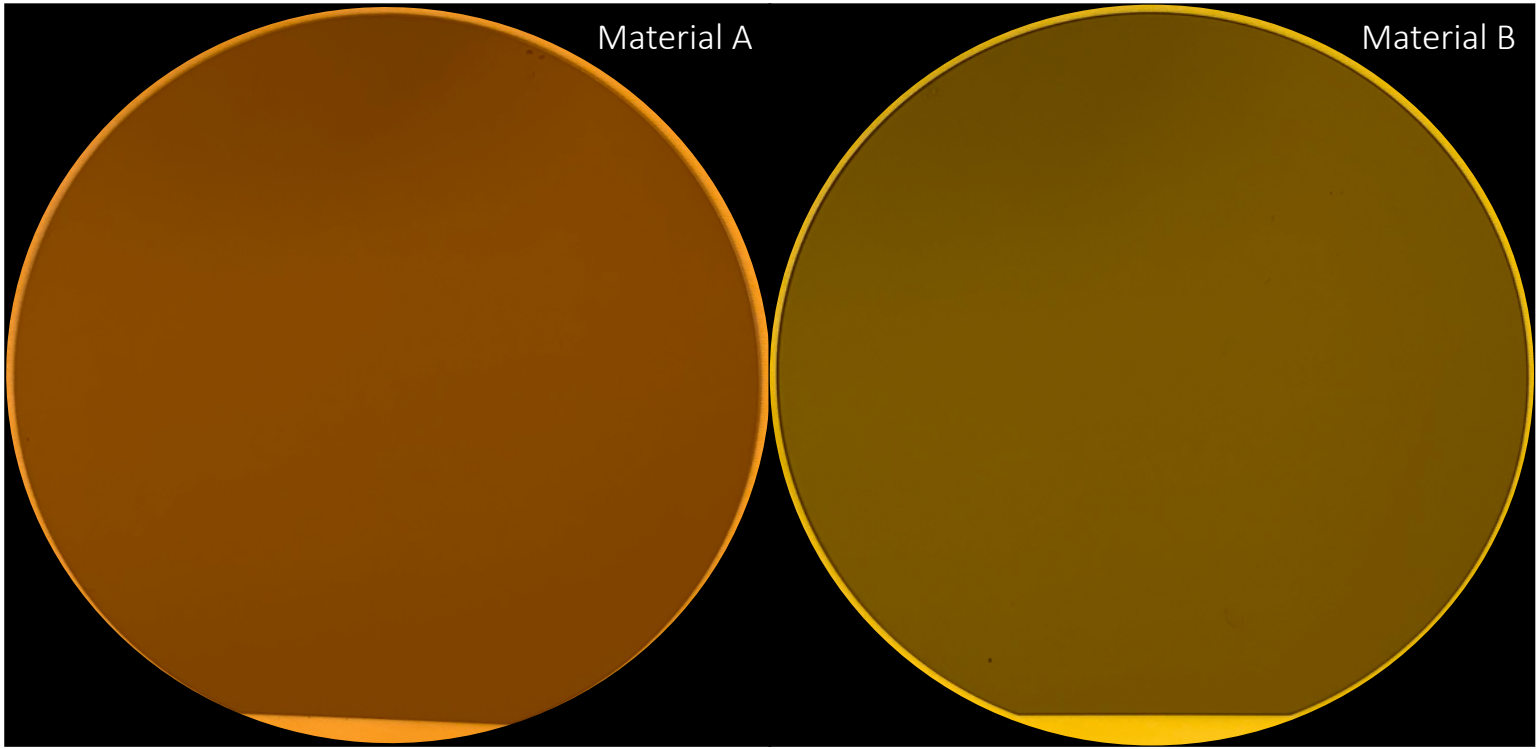
Material	Step	Spin Speed (rpm)	Time (s)	Solvent Dispense
A	1	1000	120	Cyclopentanone
	2	1000	15	Isopropanol (IPA)
	3	1000	15	No Solvent
B	1	1000	60	Cyclopentanone
	2	1000	15	Isopropanol (IPA)
	3	1000	15	No Solvent

FULL-THICKNESS WAFER STUDY – DEBOND – CARRIER WAFER



Carrier Wafer Shows Low Residue Post-Debond

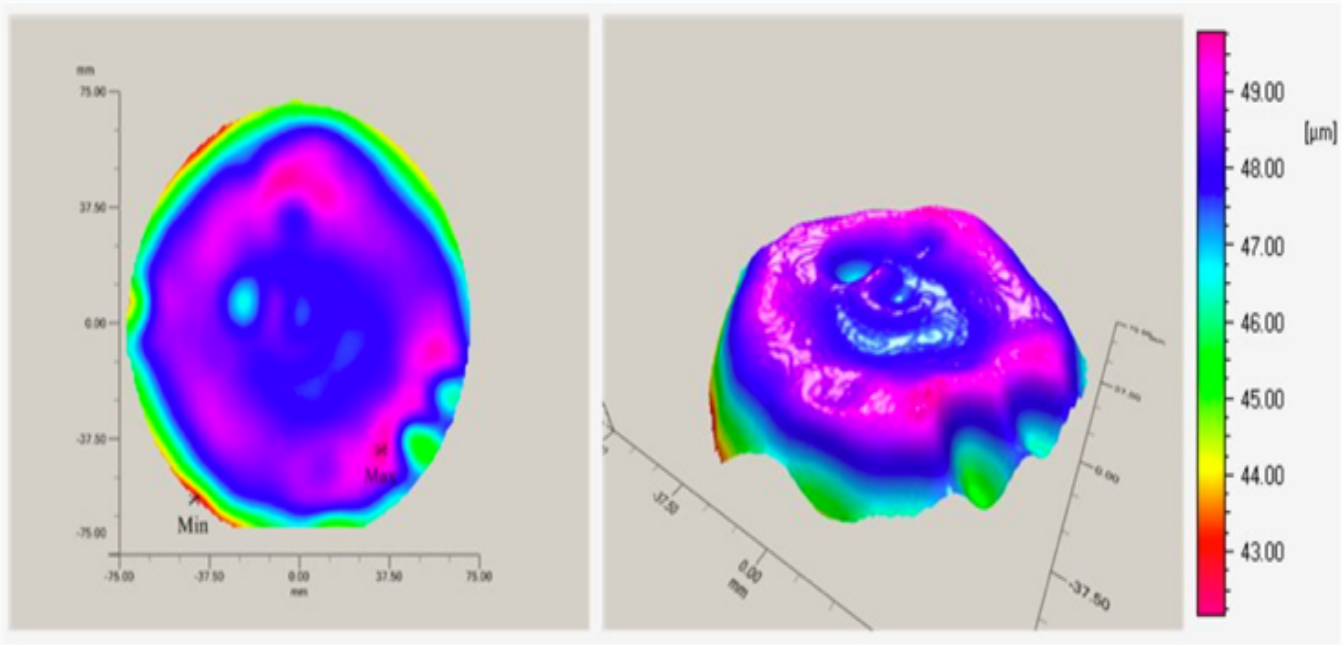
FULL-THICKNESS WAFER STUDY – CLEANING – CARRIER WAFER



Step	Spin Speed (rpm)	Time (s)	Solvent Dispense
3	1000	15	No Solvent

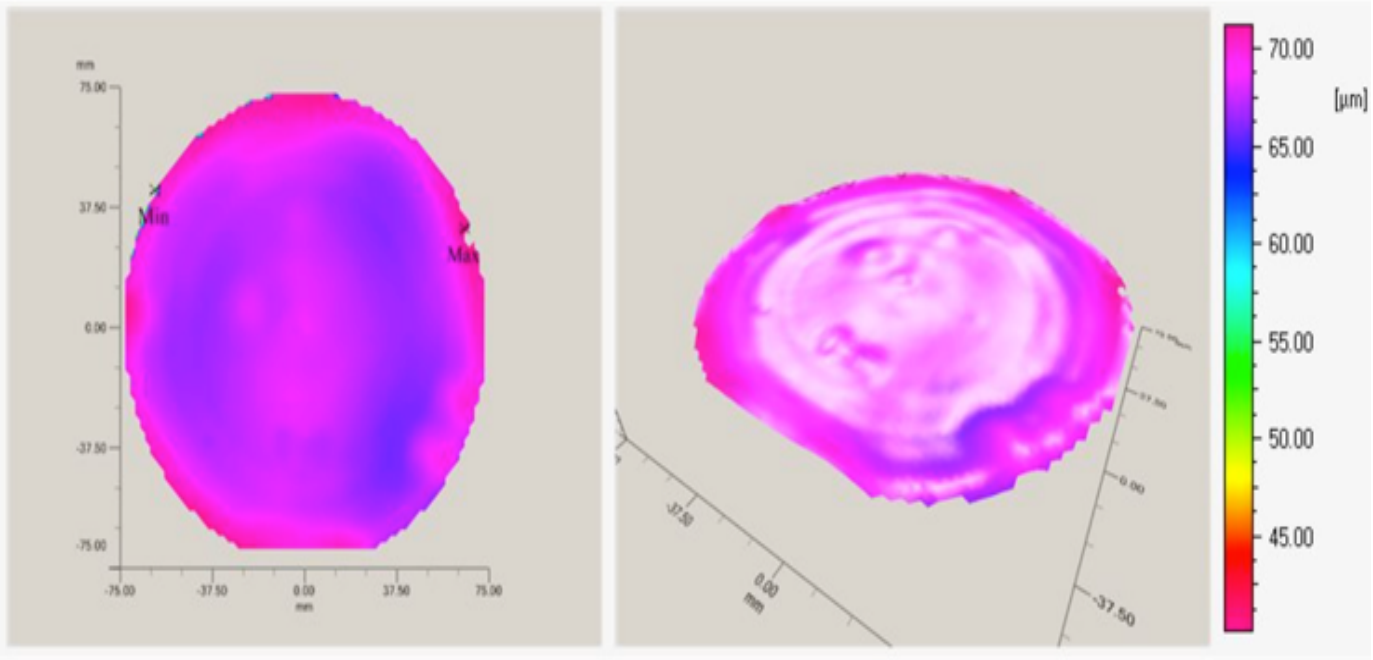
Carrier Wafer was able to be cleaned efficiently by solvent

THIN WAFER STUDY – FILM THICKNESS – MATERIAL B



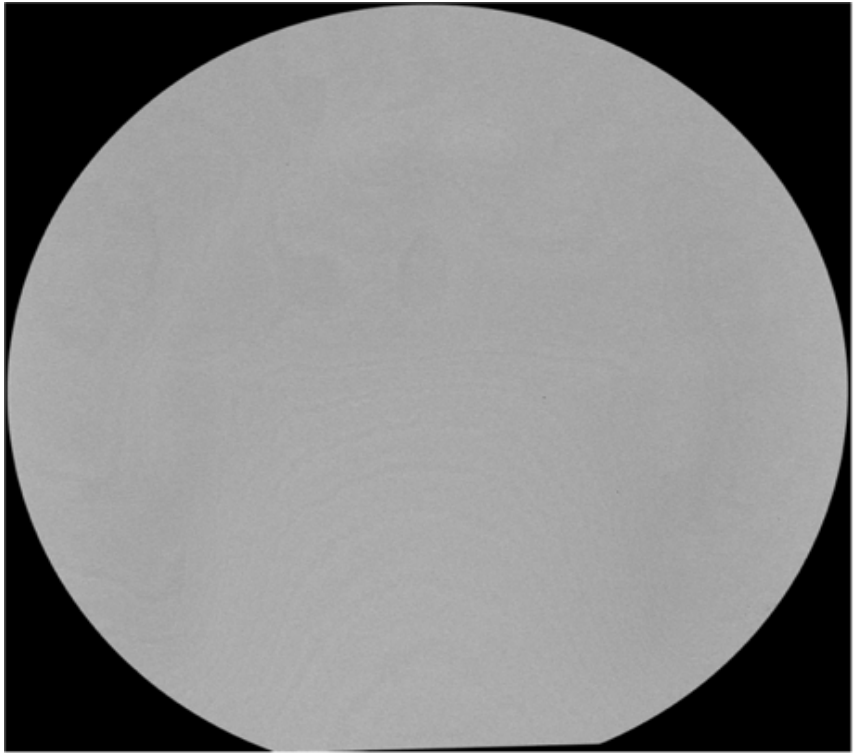
Average Film Thickness – 48.86 µm

THIN WAFER STUDY – THICKNESS OF THIN Si WAFER



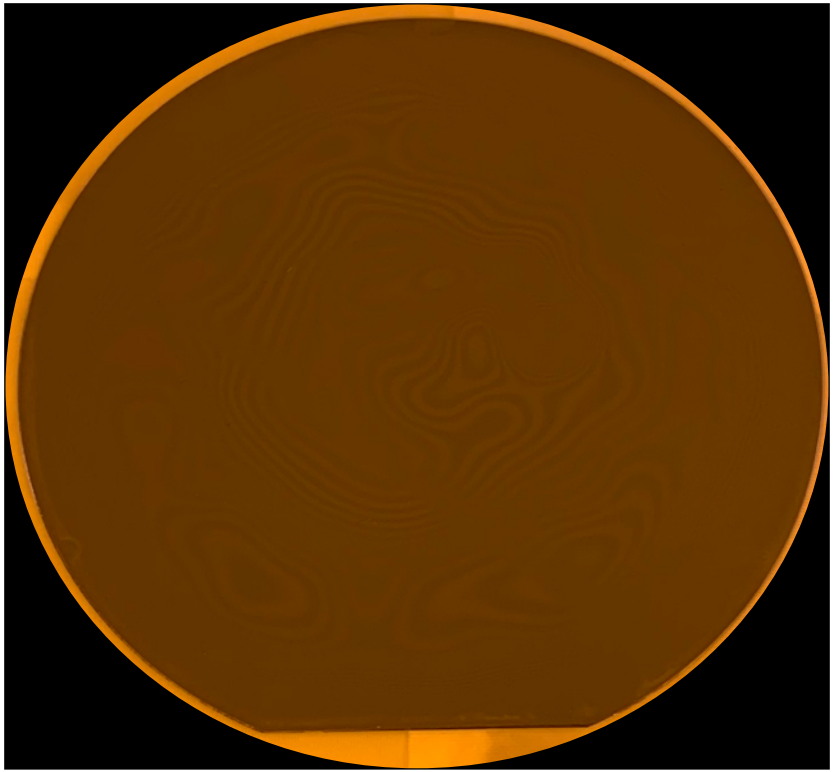
Average Si Thickness – 67.9 µm

THIN WAFER STUDY – BOND LINE CSAM



No voids are observed in the bond line

THIN WAFER STUDY – DEBOND – DEVICE WAFER



No damage was observed in the thin Si post-separation

CONCLUSION

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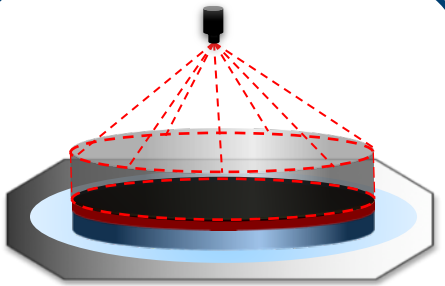
Short wafer separation time

Able to support thin wafer debond



Photonic debonding

Low-residue carrier wafer post-separation

Efficient cleaning of polymer layer on device

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THANK YOU!

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