

A NOVEL PHOTSENSITIVE PERMANENT BONDING MATERIAL FOR POLYMER/METAL HYBRID BONDING

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SPEAKER INFO

Presentation Title: A Novel Photosensitive Permanent Bonding Material for Polymer/Metal Hybrid Bonding

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- **Education:** MS in Chemistry, National Cheng Kung University
- **Experience:** >10 years of experience in research and development of advanced packaging material
~15 papers and patents published



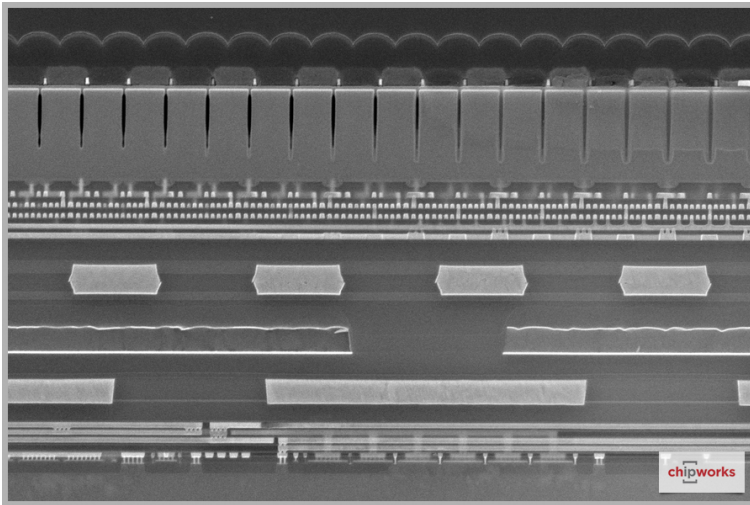
OVERVIEW

- Introduction
- Processing Conditions
- Results and Discussion
- Material Characterization
- Summary

INTRODUCTION

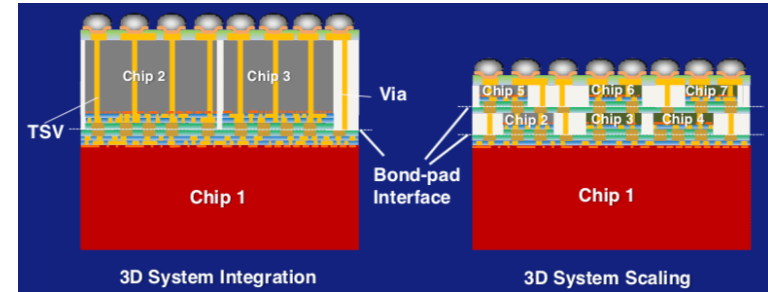
3D INTEGRATION WITH Cu/OXIDE HYBRID BONDING

Direct Bond Interconnect



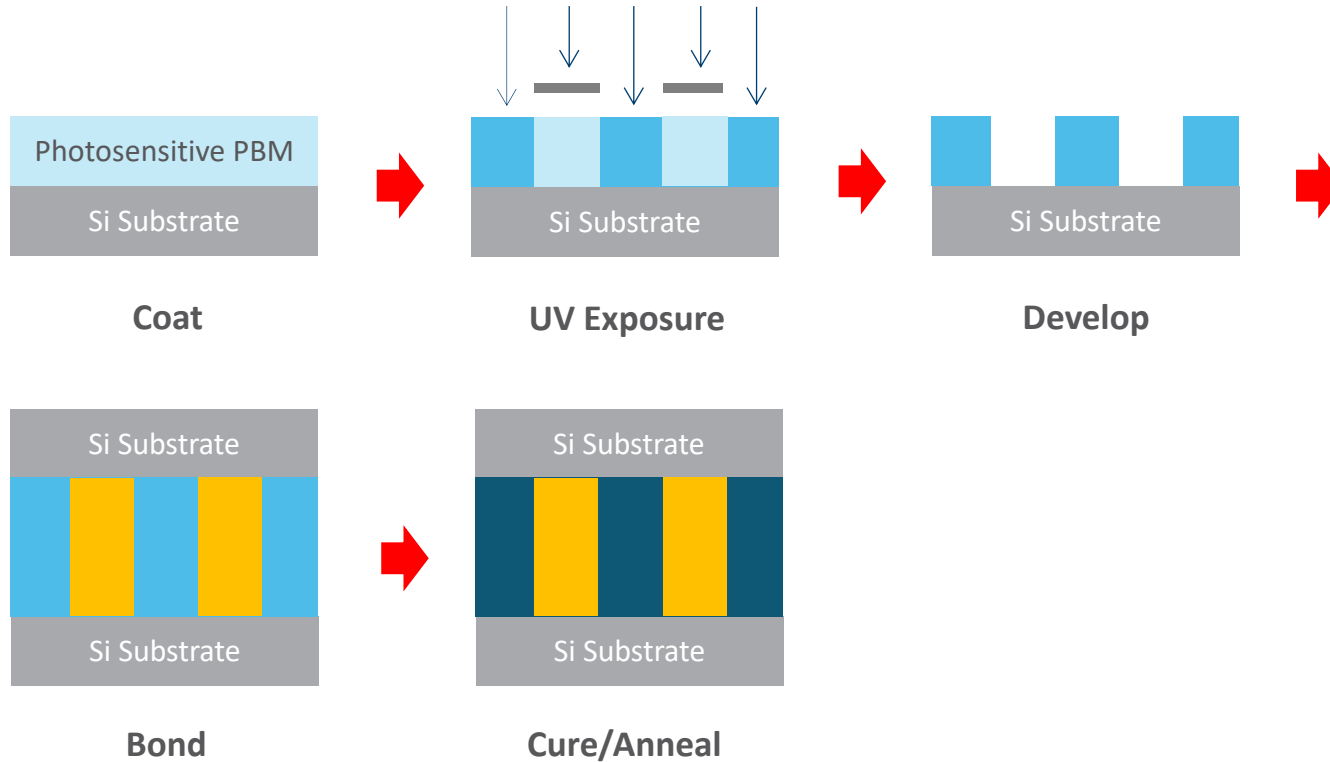
Source: Chipworks

System on Integrated Chips



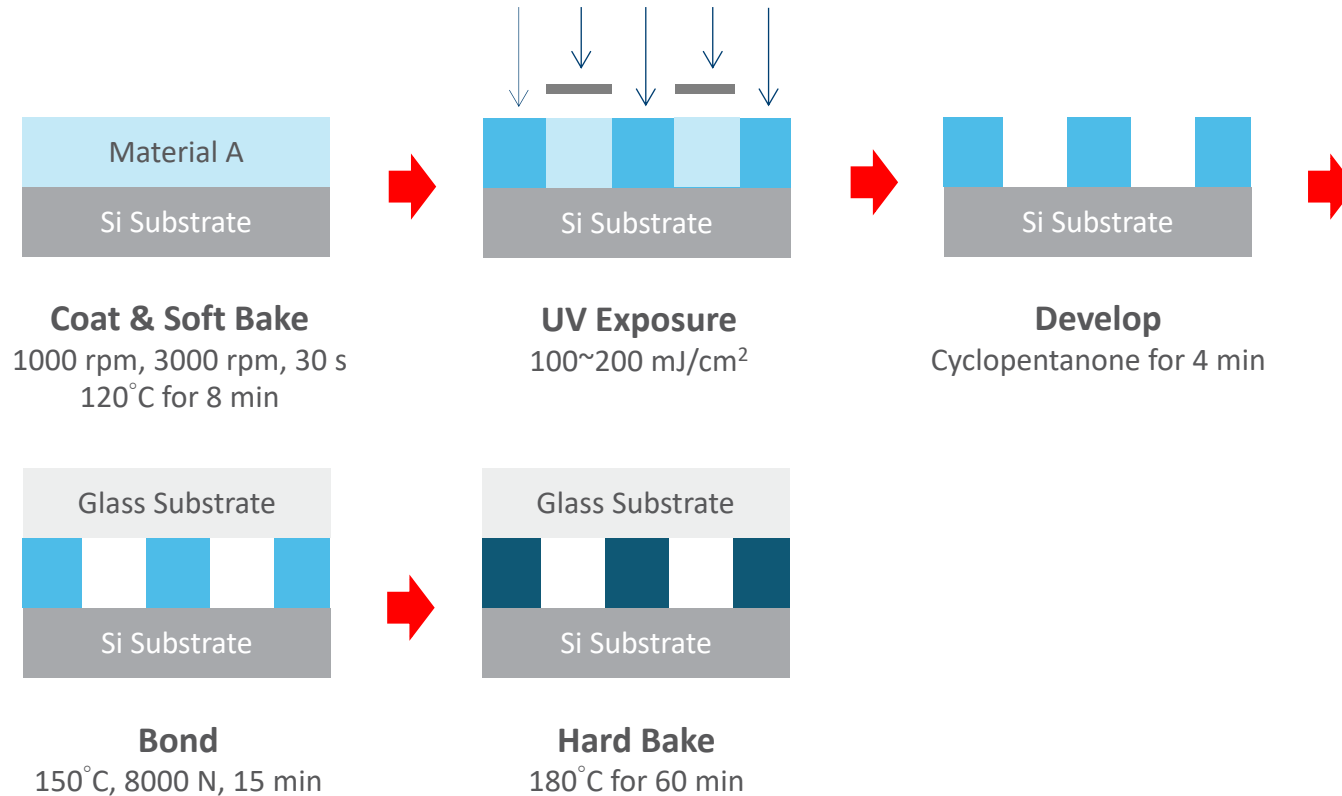
Source: TSMC

PHOTOSENSITIVE MATERIAL FOR Cu/POLYMER HYBRID BONDING



PROCESSING CONDITIONS

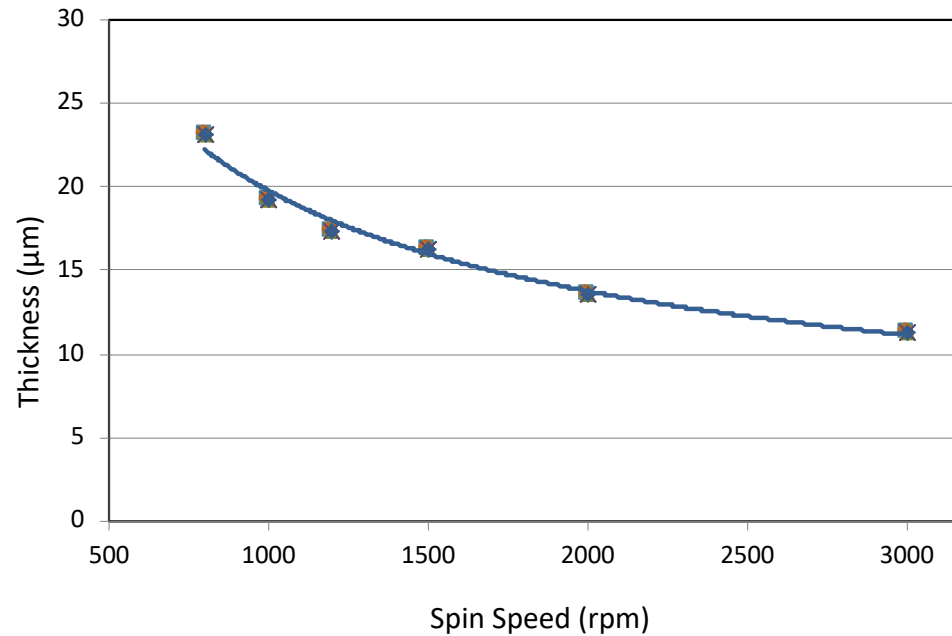
PROCESS FLOW AND CONDITIONS



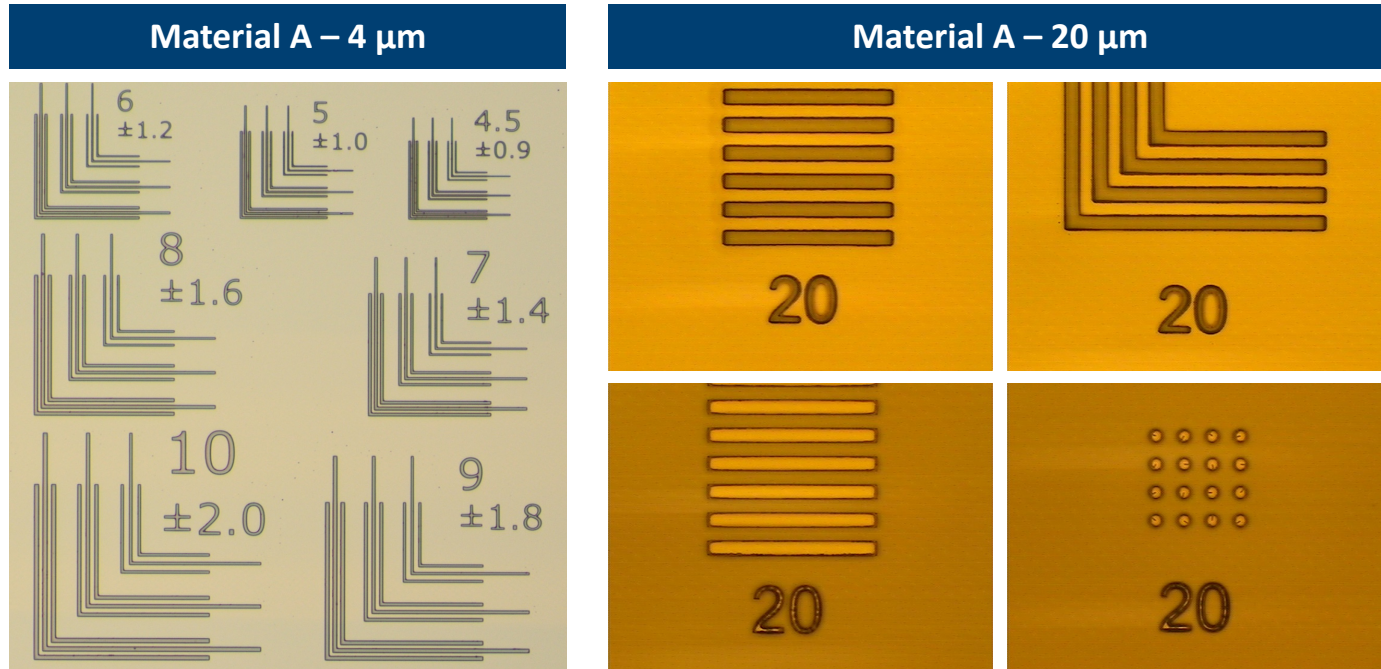
RESULTS AND DISCUSSION

FILM THICKNESS

Speed Spin of Material A



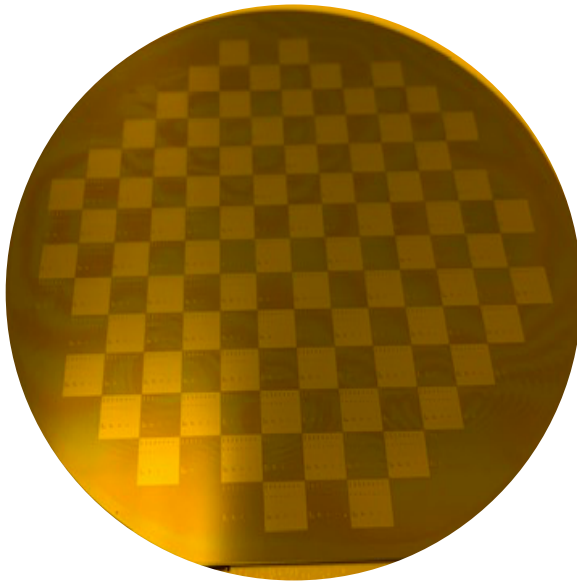
PATTERNING RESULT



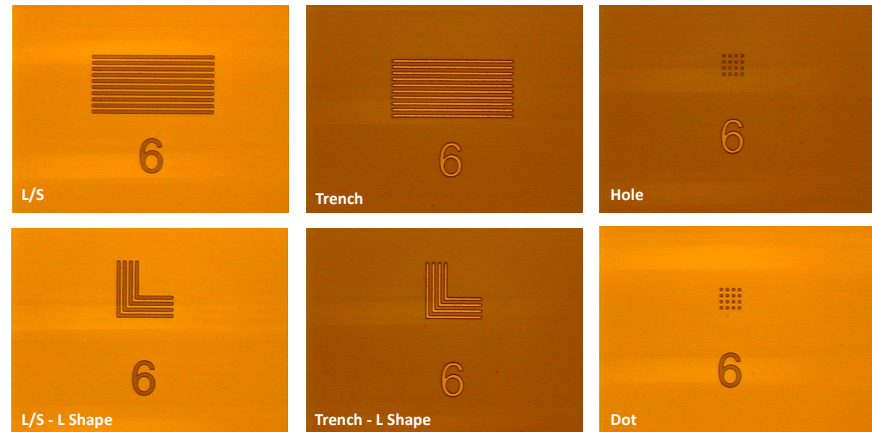
1:1 aspect ratio for imaging

BOND PERFORMANCE

Bond (Si-to-glass)

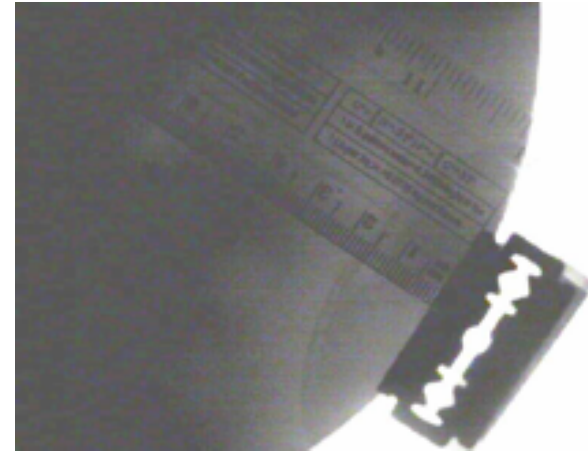
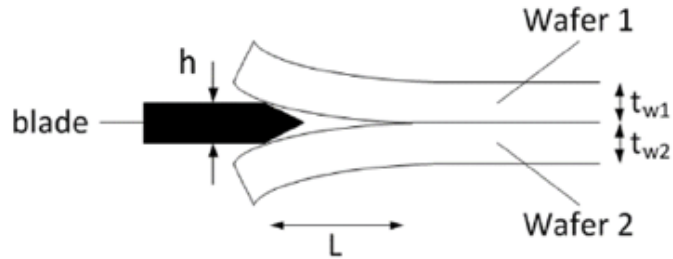


Microscope Inspection



Good bond line on patterned wafer

BOND STRENGTH



$$\text{Bond Energy (mJ/m}^2\text{)} = \frac{3 \times h^2 \times E \times t^3}{32 \times L^4}$$

h: Razor blade thickness

E: Young's modulus of substrate

t: Wafer thickness

L: Crack length

Bond Energy to Si

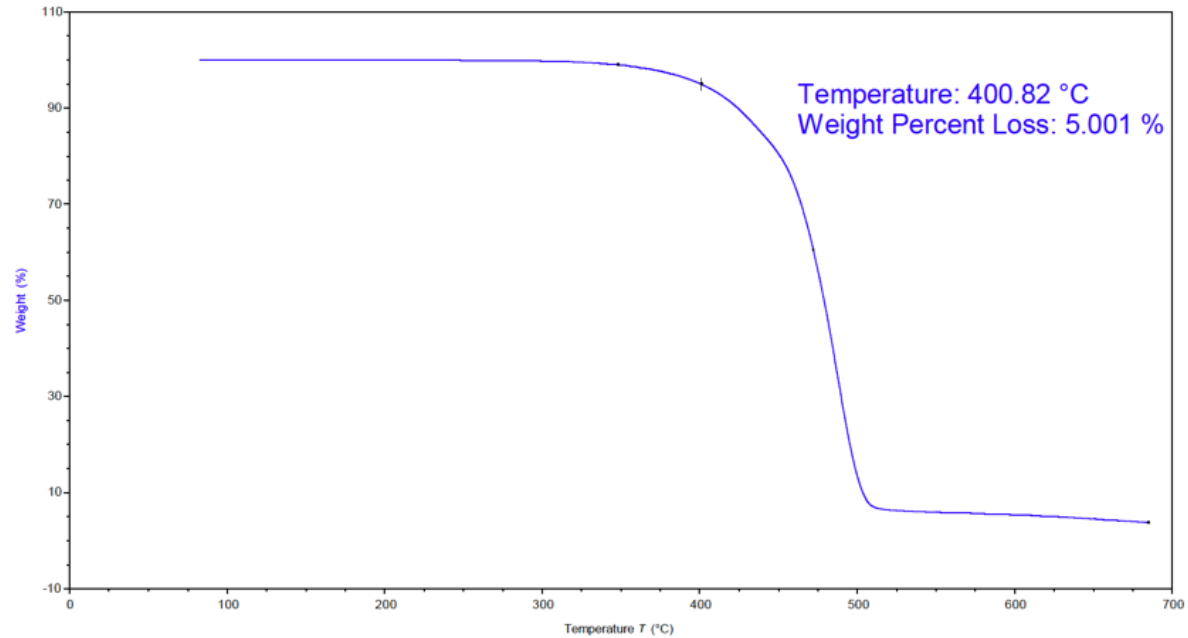
3762 mJ/m²

Bond Energy to Glass

2181 mJ/m²

MATERIAL CHARACTERIZATION

THERMAL DECOMPOSITION



Good thermal stability up to 350°C

OTHER PROPERTIES

- Young's Modulus: **171.4 MPa**
- Tensile Strength: **12.39 MPa**
- Elongation: **112.3%**
- Relative Permittivity (D_k): **2.5** at 10 GHz
- Loss Tangent (D_f): **0.0016** at 10 GHz
- Transmittance: **> 90%** at 600 nm

SUMMARY

SUMMARY

Features of Material A make it an attractive candidate for polymer/metal hybrid bonding

- Negative-tone, photosensitive permanent bonding material
- Film thickness range 3-25 μm
- I-Line sensitive with aspect ratio 1:1
- Good thermal stability ($> 350^{\circ}\text{C}$)
- Low Dk/Df at high frequency (2.5 & 0.0016 at 10 GHz)
- Good bonding strength after patterning ($> 2000 \text{ mJ/m}^2$)
- Low-temperature curing ($< 200^{\circ}\text{C}$)



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