

# Redistribution Layers on Glass Wafers

**CNF Project Number: 3018-22**

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*Primary CNF Tools Used: ABM Mask Aligner, CHA Mark 50 E-beam Evaporator, Class 1 Photolithography Spinners, Class 2 Photolithography Spinners, GCA AS200 Stepper, Glen 1000 Resist Strip, Hamatech Wafer Processor(s), Heidelberg MLA 150 Maskless Aligner, Oxford 82 RIE, Oxford PECVD, PT 720-740 RIE, YES Asher*

## Abstract:

Glass substrates have excellent electrical and mechanical properties which have led to an increasing interest for their use in advanced microelectronic and photonic packaging applications. Glass substrates offer a very low loss tangent at GHz frequencies, while being moisture insensitive and dimensionally stable. This work outlines a novel approach for fabrication of interposers using thin glass (200 micron and below), normally difficult to handle in standard processes. The process yields void-free, hermetic, copper-filled precision through glass vias (TGVs), along with redistribution layer (RDL) fabrication with up to three metal redistribution layers per side. Furthermore, Mosaic Microsystems is developing various methods to integrate photonic waveguides with thin glass interposers to match high-speed electronics packaging with high-speed photonic communication.

## Conclusions and Future Steps:

We have successfully built upon our previous processes to fabricate multi-layer RDL thin glass interposers by incorporating precision thin film resistors, optical waveguides, and microfluidic channels. Future work will continue to improve upon our processes at CNF to deliver upon our customer's needs.

## Summary of Research:

Processing thin glass wafers 100 mm, 150 mm, and 200 mm in diameter using the conventional silicon processing equipment at the CNF is made possible through Mosaic's patented Viafirm® bonding technology. This has allowed Mosaic to complete multiple RDL fabrication projects that leverage a lift-off processing method using the photoresist spinners and the ABM Mask Aligner for contact alignment. Or using the GCA AS200 Stepper for features that require near micron resolution.

Furthermore, our team has successfully developed and characterized processes for the fabrication of highly precise thin film resistors, optical waveguides, and incorporating microfluidic channels into the thin glass interposer.

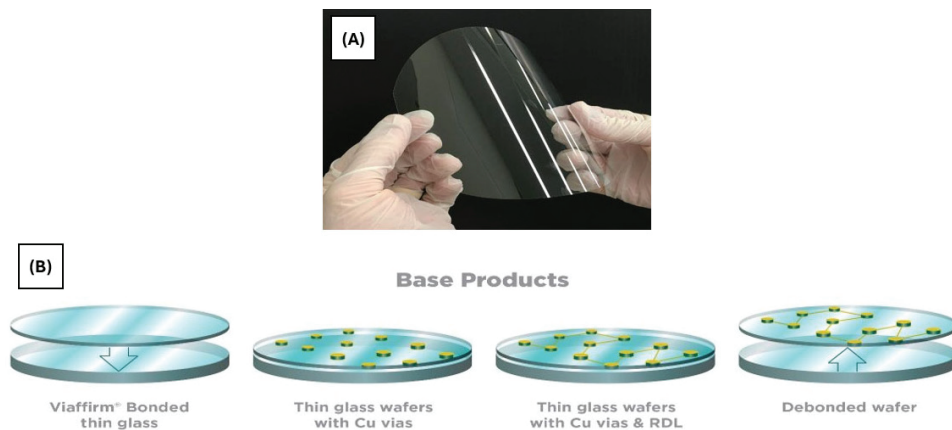


Figure 1: (A) Demonstration of the flexibility of thin glass. (B) Schematic outlining Mosaic's robust Viafirm® bonding process.

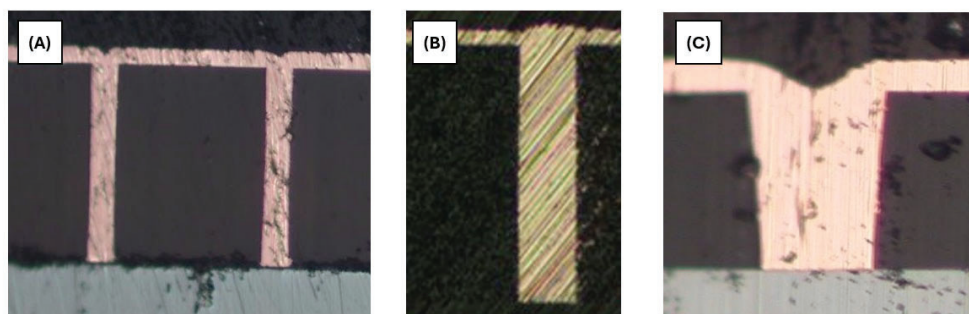


Figure 2: Cross-sections of fully filled copper vias with varying shapes and diameters. (A) 15  $\mu\text{m}$  columnar via, (B) 25  $\mu\text{m}$  columnar via, and (C) 35  $\mu\text{m}$  tapered via.

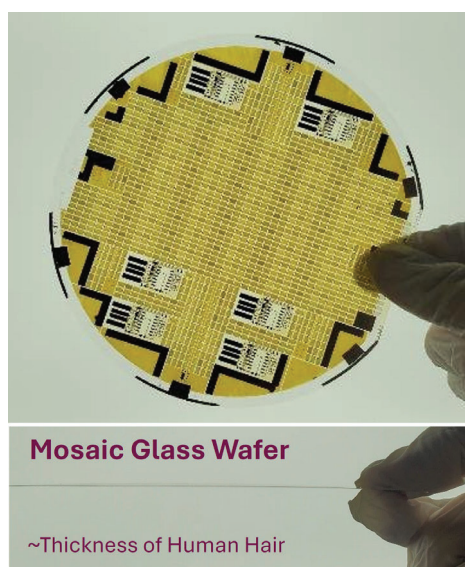


Figure 3: (Top) Example of a fully fabricated thin glass interposer with through glass vias and multiple redistribution layers. (Bottom) Side view of interposer showing the thickness of the thin glass interposer.

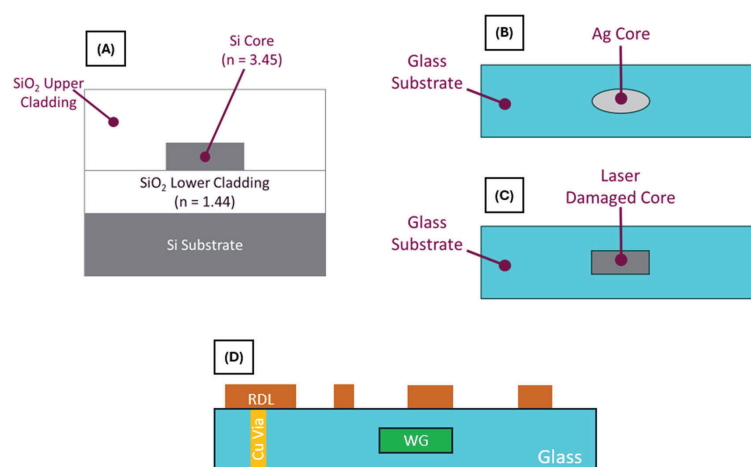


Figure 4: Schematic of various photonic waveguides. (A) Traditional silicon waveguide, (B) Ion-exchange waveguide, (C) Ultrafast laser inscription waveguide, and (D) Integration of electrical and optical communication.