

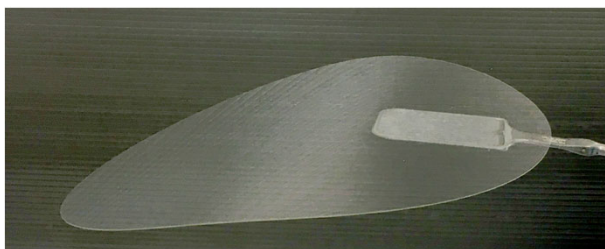


Mosaic Microsystems Ultra-Thin Glass Solutions

Mosaic Microsystems provides ultra-thin glass-based packaging and integration solutions for advanced microelectronics and photonics applications. Mosaic's glass technology leverages the superior material properties of glass with substrate thicknesses down to 70 μm and through-glass via (TGV) diameters of 30 μm . Standard types of glass are alumino-borosilicate glass (ABS) (CTE match to Si), and fused silica (FS) (ultra-low loss). The advantages of glass include superior mechanical and electrical properties, stability over a wide range of environmental conditions, and compatibility with semiconductor processing providing enhanced performance over existing solutions particularly at frequencies above 3 GHz. Applications include 5G wireless, radar, photonics, interposers, MEMS and sensors.

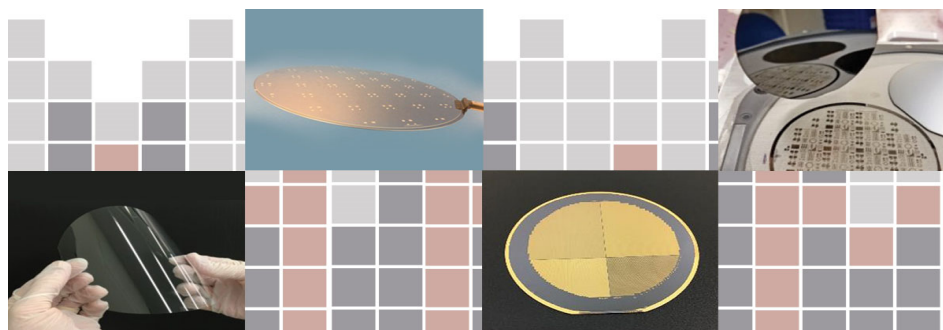
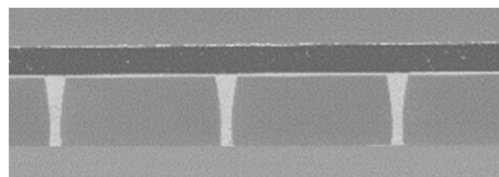
Viafirm™ Bond Technology

Glass thinner than 250 μm is normally difficult to handle in a semiconductor manufacturing facility. Mosaic offers a solution which involves temporarily bonding the glass to a handle wafer, which is typically silicon. Viafirm™ is inorganic, can be processed in high vacuum systems and at temperatures up to 450 °C. It is easily debonded using standard mechanical methods. The result is the ability to leverage semiconductor manufacturing processes to create precision features that include substrate integrated waveguides, passive devices and fine L/S circuitry.



Through-Glass Vias

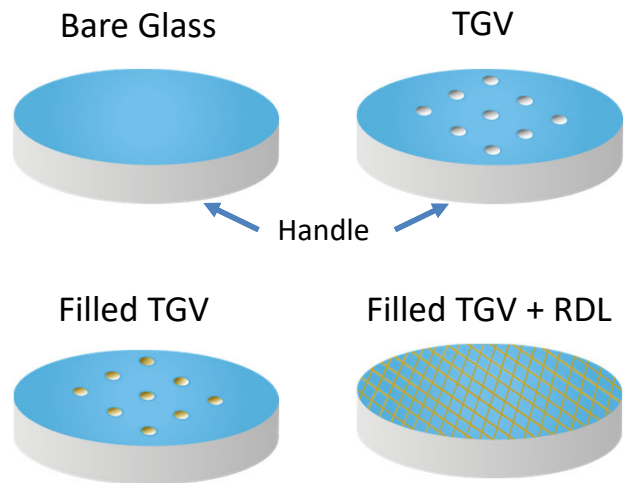
Mosaic's TGV technology allows for the formation of vias 30 μm in diameter. The vias can be filled with metals to enable heterogeneous integration. Multiple metal layers can be formed on either side and semiconductor die can be directly bonded to the glass using BGA or metal compression bonding.



Material properties

| Property | BSG | FS |
|---|---------------------|--|
| Dielectric Constant | 5.25 | 3.79 |
| Loss Tangent @10 GHz | 0.006 | 0.0002 |
| Loss Tangent @ 69 GHz | 0.009 | 0.0004 |
| DC Resistivity ($\text{Log}_{10} \Omega\text{-cm}$ 250 °C) | 12.9 | 15 |
| Refractive Index @ 589 nm | 1.51 | 1.46 |
| CTE (ppm/°C) | 3.2 | 0.5 |
| Thermal Conductivity (W/cm ² °K) | 0.019 | 0.014 |
| Density (g/cm ³) | 2.38 | 2.2 |
| Young's Modulus (GPa) | 73.6 | 73 |
| Poisson's Ratio | 0.23 | 0.16 |
| Hardness | H _v =640 | H _k =522 kg/mm ² |

Wafers provided at four levels of integration



Wafer Specifications

| Property | ABS | | | | FS | | |
|----------------------------------|-------------------|----------|-------|----------|-----------|---------|-------|
| | 99 | 149 | 199 | 299 | 99 | 149 | 199 |
| Wafer Diameter ¹ (mm) | 99 | 149 | 199 | 299 | 99 | 149 | 199 |
| Alignment Features | Flat | Flat | Notch | Notch | Flat | Flat | Notch |
| | 18, 32.5 mm | 57.5 mm | SEMI | SEMI | 32.5 mm | 57.5 mm | SEMI |
| Handle Wafer Material | Si | | | | FS | | |
| Glass Thickness w/o TGV (μm) | 70, 100, 125, 200 | | | | 100 - 200 | | |
| Glass Thickness w/ TGV | 100 | | | | 100 - 150 | | |
| Surface Roughness (nm Ra) | <1 | | | | <1 | | |
| TTV (μm) | < 5 | | | | <10 | | |
| Via Diameter ² (um) | Top | Bottom | | Top | Bottom | | |
| | 30 +/- 3 | 23 +/- 3 | | 30 +/- 3 | 23 +/- 3 | | |
| Viafirm Bond | | | | | | | |
| Bond Energy (mJ/m ²) | Low | Std. | High | | Low | Std. | High |
| | ≤300 | 400 | ≥700 | | ≤300 | 400 | ≥700 |
| Voids (%area) | <1.5% | | | | <1.5% | | |

Notes:

1. Glass wafers are typically undersized by 1mm to accommodate handling, full size glass wafers available upon request.
2. Via diameters 15 – 35 μm and in glass thickness <100 μm and up to 175 μm thick are in development.
3. Edge exclusion of 5 - 10 mm is typical.

Please contact us to discuss your metallization or wafer needs not described above, including 300 mm!

<https://www.mosaicmicro.com/contact-us/>