

## 3D Glass forming technology

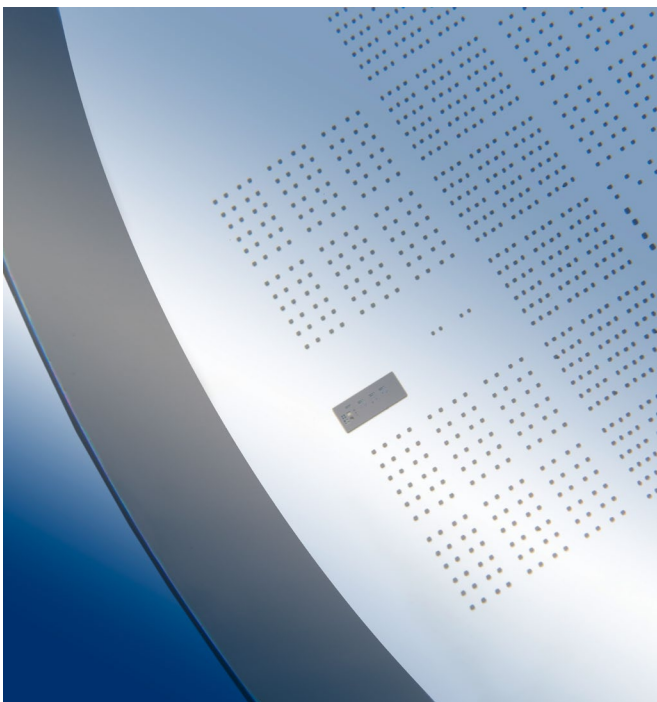
**Glass Packages / Inclined Windows /  
Optical Domes / Lenses / Mirrors**

Different structured  
glass wafer with  
caps and lenses

### Motivation

Fraunhofer ISIT has a wide portfolio of qualified single process technologies available, which were combined to different specific technology process platforms. They form a kind of tool box to realize various applications. One of these process platforms is glass micromachining. Fraunhofer ISIT developed a process based on hot temperature viscous glass micromachining. It is mainly used for the production of micro-lenses and glass packages with inclined window surfaces. Using this process, it is possible to structure glass wafers with high aspect ratios on wafer level. A structured silicon wafer is chosen as so-called primitive form, so glasses must be used whose softening temperature is well below that of silicon. This has the

advantage that the standardized methods to structured silicon wafers of a clean room can be used. The etched structures or cavities correspond later the molded areas in the glass. The structured silicon wafer is then anodically bonded to a glass wafer. In this case, a defined pressure within the cavities is enclosed. When a relative vacuum is enclosed the cavities and the heat treatment takes place under atmospheric pressure, the glass is pressed into the cavities. If an atmospheric pressure is enclosed and the heat treatment takes place under vacuum then the glass is forced out of the cavities. Depending on the application, the glass may now be further processed by grinding and polishing.



Detail view of  
a glass wafer  
with silicon vias

**Fraunhofer Institute for  
Silicon Technology ISIT**

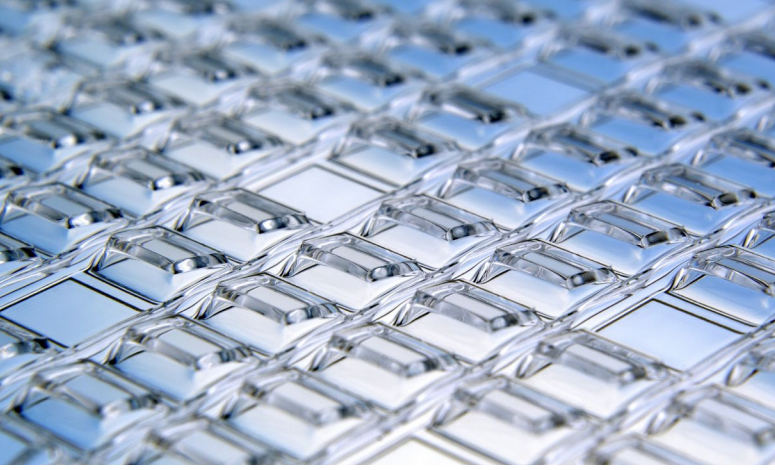
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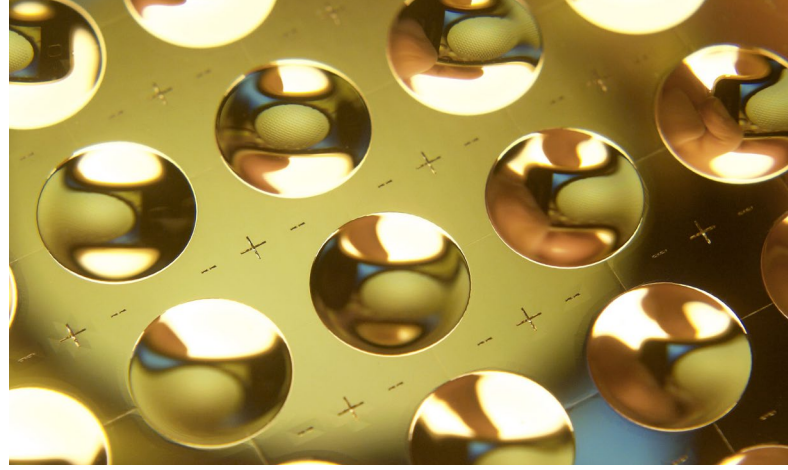
[www.isit.fraunhofer.de](http://www.isit.fraunhofer.de)

Fraunhofer ISIT  
is participant of the

 **Forschungsfabrik  
Mikroelektronik**  
Deutschland



Inclined windows on a 8" glass wafer



Spherical micro mirrors coated with a thin gold layer

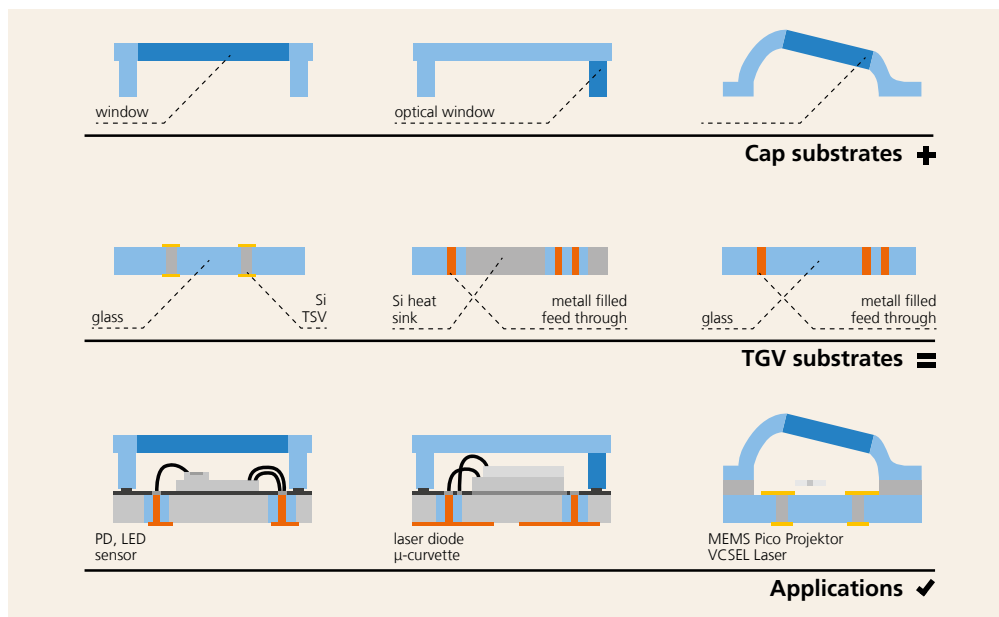
### Technical data for optical packages

- Packages with planar windows
- Packages with inclined windows with angles up to 15°
- Cavity sizes 1mm up to 10 mm
- Cavity depth 0.1mm up to 4 mm
- Roughness < 1 nm (Ra)
- Window deformation < 100 nm (3.5 mm window size)
- Hermetic sealing

### Technology

- Proprietary glass forming process
- Anodic wafer bonding
- Material: borosilicate glasses
- CTE match to silicon
- Fabrication on 8" wafer

Schematic of different optical housing constructions supported by the modular packaging system



### Technical data for lenses

- Plano convex, plano concave lenses
- Lens arrays
- Lens diameter: 100 μm – 8 mm
- Sag. height: max: 800 μm
- ROC: 100 μm – 20 mm

### Technical data for Through Glass Vias (TGV)

- Wafer thickness: < 400 μm
- Contact via diameter: < 100 μm
- Contact via pitch: (depending on the aspect ratio): < 90 μm (1:4)
- Via material: Silicon

### Applications

- Wafer Level Opto Packaging
- Hermetic Glass Packages
- Optical Windows
- Lens Arrays
- Micro Optics

### Our Service

- Development and production of optical components (mirrors, lenses) on 8" glass substrates
- Realization of glass caps for housings of optical microsystems according to customer requirements
- Easy transfer to pilot production
- Access to cost-effective production of micro-optical components