

Spherical and aspherical glass lenses and mirrors on 200 mm wafer

Development and production of optical components

Glass micro mirrors (gold plated) with diameter of 8 mm on a 200 mm wafer

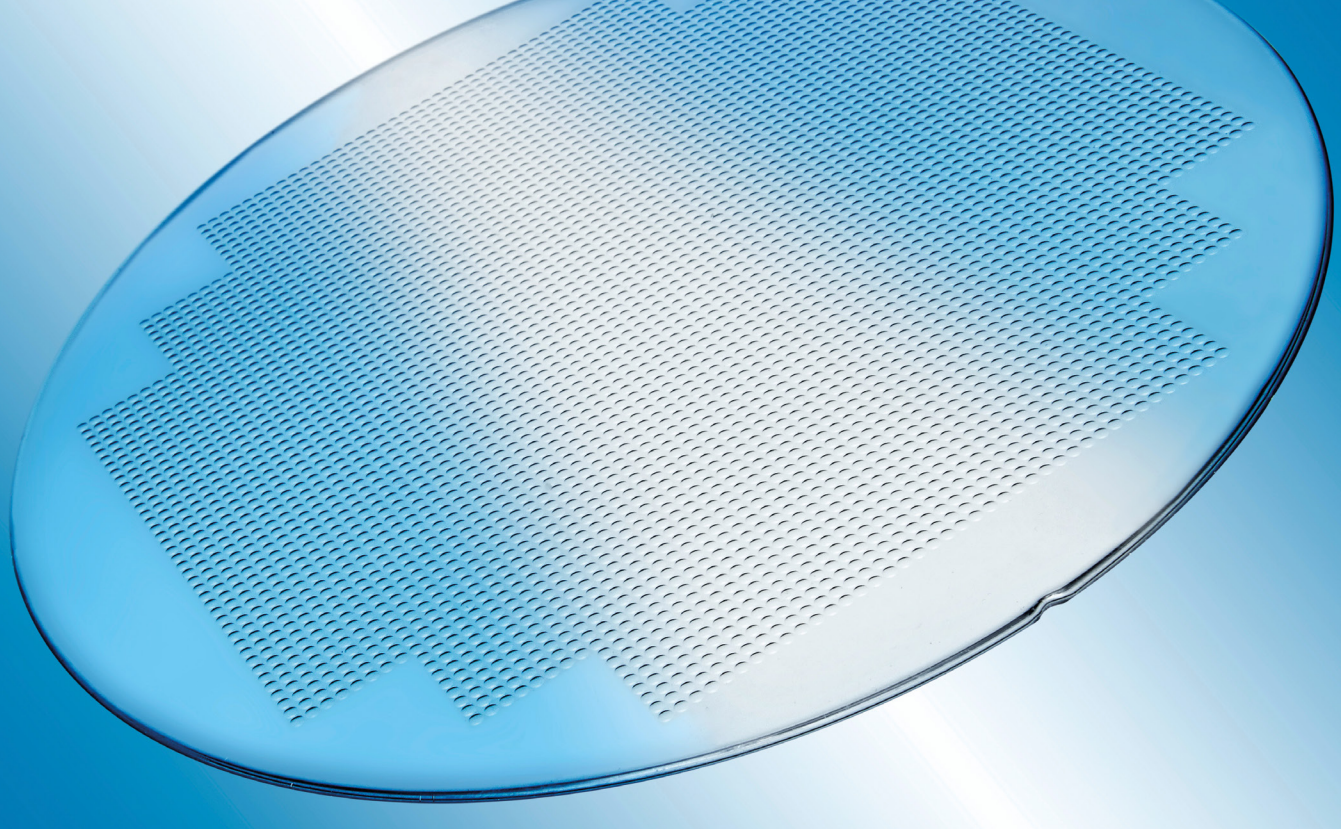
Since several years the Fraunhofer Institute for Silicon Technology develops new production processes for optical components made of glass on complete 200 mm wafers. With the hot-viscous forming process, optical domes, plano-convex lenses, lens arrays and concave mirrors can be manufactured from glass in high quality. The process is particularly suitable for glasses with a coefficient of thermal expansion like silicon, especially Borofloat® 33 glass, but also glass like AF 32 ® and Eagle XG can be used in different thicknesses.

While so far only optical surfaces with a spherical shape could be manufactured, very recent developments of the process also allow the production of aspherical mirrors and

lenses. In general, the process features high uniformity over the entire wafer ($< 0.5\%$ relative to ROC) and very low roughness (a few nm). For lenses up to 3 mm in diameter, a shape accuracy of better than $1/5$ RMS can be achieved, while for large mirrors and lenses (up to 14 mm in diameter) the deviation from the nominal shape is less than $0.5 \mu\text{m}$ RMS.

The reproducibility of the radius-of-curvatures (ROC) could also be improved to deviation of less than $\pm 1\%$ of the ROC from wafer to wafer.

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Micro lens array made of glass on 200 mm wafer

The main features and key figures of the lenses and mirrors are:

- Glass material: Borofloat® 33, AF 32®, Eagle XG (= CTE von Silizium)
- Wafer : 200 mm
- Wafer thickness: 300 µm - 1 mm
- Uniformity < 0.5% of ROC over whole wafer
- Lenses (spherical & aspherical), lens arrays , mirrors (spherical & aspherical), domes

Lens:

- ø: 0.1 – 8.0 mm
- Sagittal height: max. 0.8 mm
- ROC: 0.25 mm – 20 mm

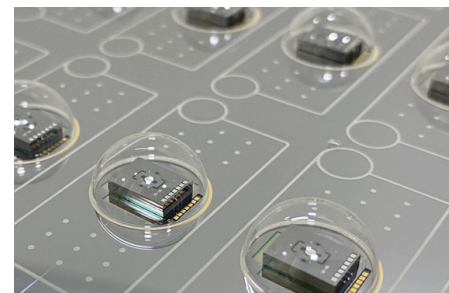
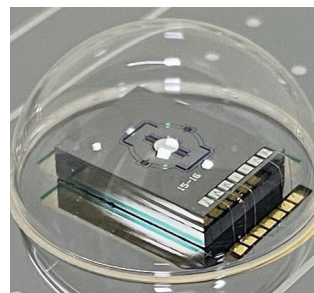
Mirrors:

- ø: 0.5 mm – 14 mm
- Sagittal height: 0.2 mm – 4.0 mm
- Accuracy < 1/5 rms for ø < 3,0 mm
 - <0.5 µm for 3.0 mm < ø < 14 mm
- ROC: 0.5 mm – 30 mm
- k: - 3.0 – +6.0

Optical domes

- ø: 4.0 mm – 16 mm
- Height : 2.0 mm – 8.0 mm
- Wavefront deformation: < 1/5 rms

Optical glass dome used for vacuum encapsulation of a MEMS mirror



GLASS FORMING TECHNOLOGY

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