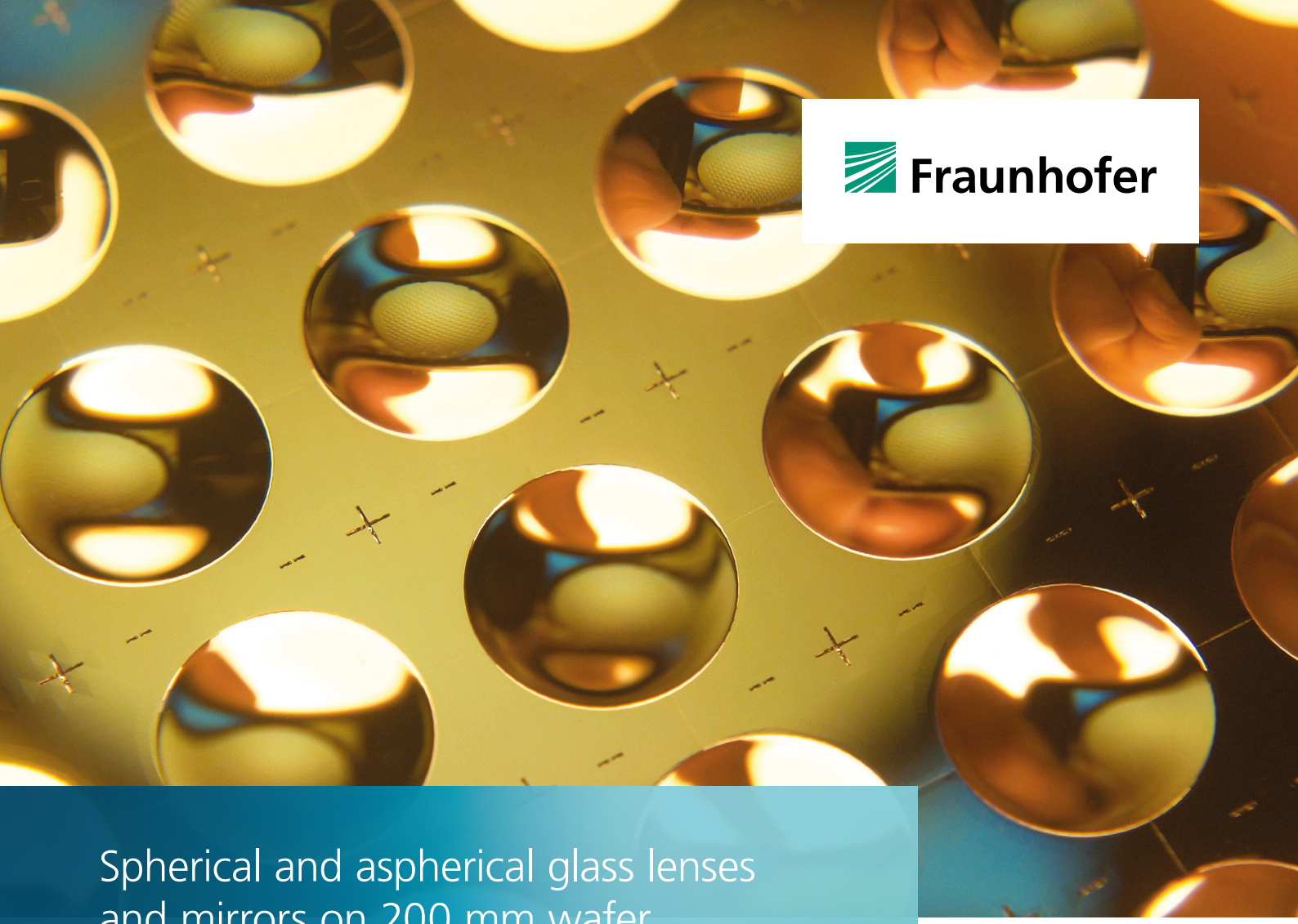

Fraunhofer

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 λ/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 µm RMS.

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

Fraunhofer ISIT
is participant of

Forschungsfabrik Mikroelektronik
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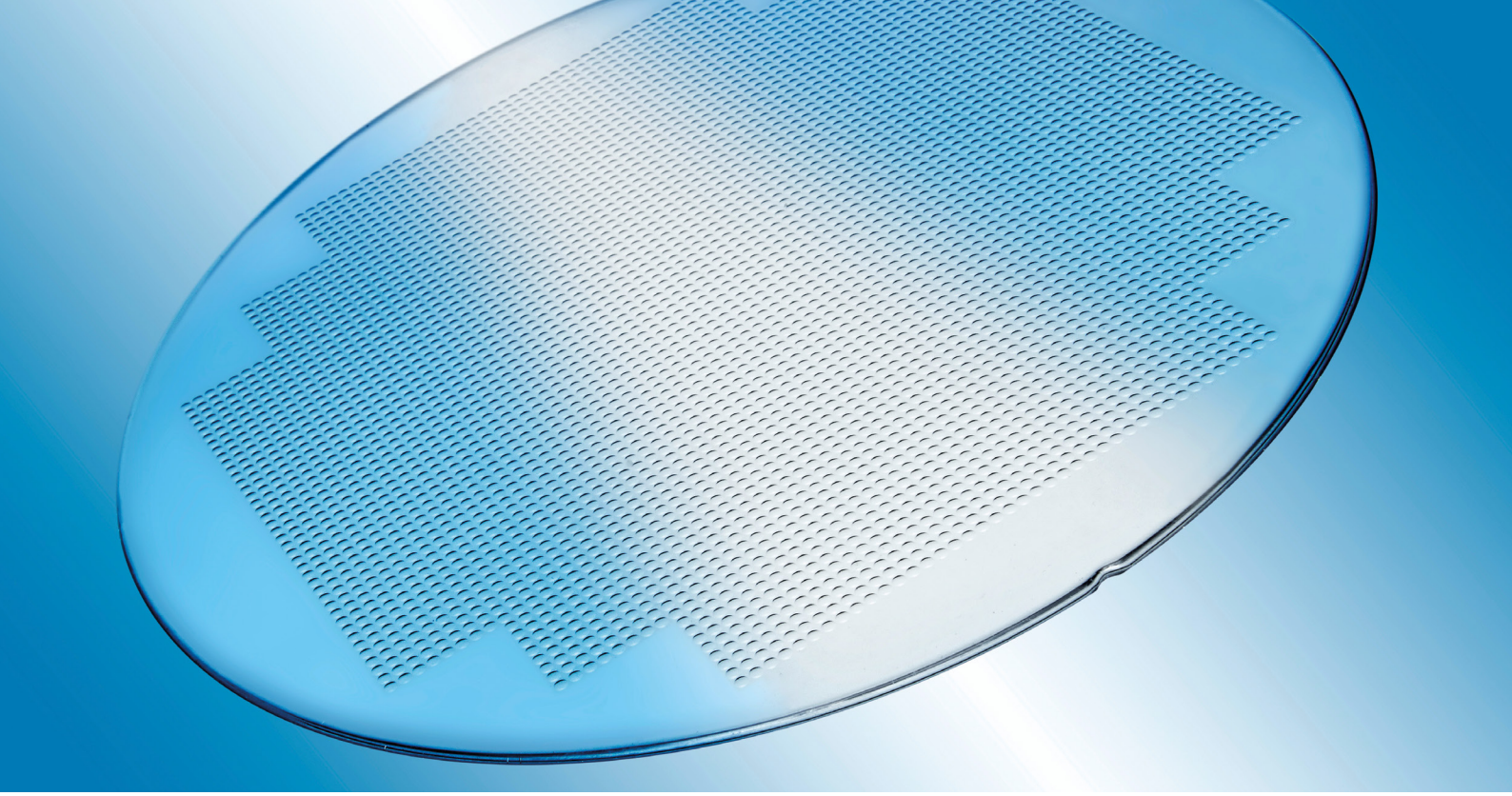
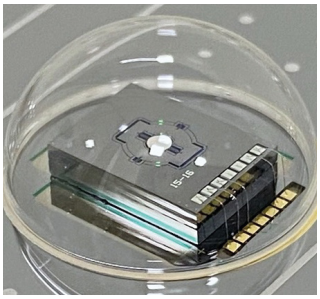
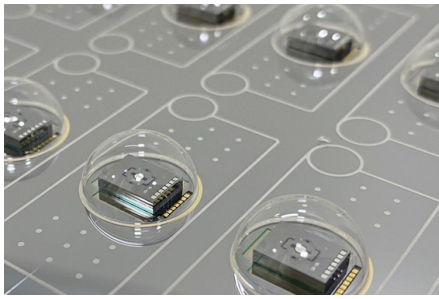


Micro lens array made of
glass on 200 mm wafer

Optical glass dome used
for vacuum encapsulation
of a MEMS mirror





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
- Sagital heigth: max. 0.8 mm
- ROC: 0.25 mm – 20 mm

Mirrors:

- ø: 0.5 mm – 14 mm
- Sagittal heigth: 0.2 mm – 4.0 mm
- Accuracy < λ/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
- Heigth : 2.0 mm – 8.0 mm
- Wavefront deformation: < λ/5 rms

GLASS FORMING TECHNOLOGY

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