M E T A L  O P T I C S  O V E R V I E W

O P T I C S
OUR MISSION

We are proud to make contributions to some of the big scientific developments of the new millennium.

We develop components for experiments with a diameter of 26,695 meters on an energy level of 50 TeV on a distance of 14 billion light years ... or just a few nanometers.

Projects and products for our customers in industry and science benefit from our experience.

OUR PROFESSION IS PRECISION
An extensive range of sophisticated diamond-cutting technologies is available, for single piece as well as for series production.

**Technical data:**

- **Typical dimensions**
  - 50 mm x 50 mm or 500 mm x 500 mm
  - 50 mm up to 500 mm dia.

- **Surface figure**
  - Approx. 0.1 μm over 100 mm

- **Surface roughness**
  - Ra approx. 1 nm - 5 nm

- Optionally coatings available.
- Other specifications available on special order.
- Custom dimensions available on special order.

*Vary with the material involved and its structural rigidity.

**Materials**

- Oxygen-free copper (OFHC.CU)
- Aluminum
- Aluminum alloys (6082 and 6061 preferred)
- Brass
- Plastics (usually PMMA)
- Crystalline materials
- All nonferrous metals
An extensive range of sophisticated diamond-cutting technologies is available, for single piece as well as for series production.

**Technical data:**

**Radii ranges**
- from approx. 5 mm to infinite (concave or convex surfaces)

**Typical dimensions**
- 50 mm x 50 mm or 500 mm x 500 mm
- 50 mm up to 500 mm dia.

**Surface figure**
- Approx. 0.1 μm over 100 mm*

**Surface roughness**
- Ra approx. 1 - 5 nm*

Other specifications available on special order. Optionally coatings available.

*Vary with the material involved and its structural rigidity.

**Materials**
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- Brass
- Plastics (usually PMMA)
- Crystalline materials
- All nonferrous metals
Three-axes turning technology

Our advanced, three-axes turning technology allows us to turn optics having any symmetric geometric shape.

Technical data:

- Typical dimensions
  - on-axis Ø 50 mm up to Ø 500 mm
- Surface figure
  - Approx. 0.5 µm over 100 mm*
- Surface roughness
  - Ra approx. 2 - 15 nm*

- Optionally coatings available.
- Other specifications available on special order.
- Custom dimensions available on special order.

*Very with the material involved and its structural rigidity.

Materials

- Oxygen-free copper (OFHC-CU)
- Aluminum
- Aluminum alloys (6082 and 6061 preferred)
- Brass
- Plastics (usually PMMA)
- Crystalline materials
- All nonferrous metals
**Technical data:**

- **Widths across flats**
  - Approx. 10 mm to 500 mm

- **Surface figure**
  - Approx. \( \lambda/10 \) in the visible spectral region

- **Machining tolerances**
  - Indexing error, approx. 5 arcsec
  - Pyramidal error, approx. 5 arcsec

- **Surface roughness**
  - Ra approx. 1 - 5 nm*

- Optionally coatings available.
- Other specifications available on special order.
- Custom dimensions available on special order.

*Vary with the material involved and its structural rigidity.

**Materials**

- Oxygen-free copper (OFHC-CU)
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- Aluminum alloys (6082 and 6061 preferred)
- Brass
- Plastics (usually PMMA)
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**Raster-scanning polygons**

We manufacture polygons having arbitrary pyramidal angles. We can also machine varying pyramidal angles on individual polygons.
**Pyramidal mirrors**

**Ellipsoids**

**Masters**

**Toroids of all types**

**Roof mirrors**

**Conical mirrors**

**Bifocal paraboloidal mirrors**

**Waxicons/axicons**

**Stepped mirrors**

**Chopper blades**

**Scraper mirrors**

**Cylindrical mirrors**

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**NEW!**

Optical surfaces out of steel without polishing. Ultrasonic assisted diamond-turning on steel parts.

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**Other special shapes are available on special order.**

We look forward to receiving your inquiry.

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**Figuring accuracy and surface roughness varies with:**

- reflective-surface dimensions
- the types of surface figures specified
- the materials employed

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**Materials**

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- Aluminum
- Aluminum alloys (6082 and 6061 preferred)
- Brass
- Plastics (usually PMMA)
- Crystalline materials
- All nonferrous metals
Technical data:

- Axes stroke
  - X 900 mm / Y 350 mm / Z 200 mm
- Surface figure and roughness
depending on design and dimension

Materials

- Oxygen-free copper (OFHC-CU)
- Aluminum
- Aluminum alloys (6082 and 6061 preferred)
- Brass
- Plastics (usually PMMA)
- Crystalline materials
- All nonferrous metals
Freeform surfaces

With the dynamic-axis technology even non-rotation symmetric geometries are possible.

An extensive range of sophisticated diamond-cutting technologies is available, for single piece as well as for series production.

Materials
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- Aluminum alloys (6082 and 6061 preferred)
- Brass
- Plastics (usually PMMA)
- Crystalline materials
- All nonferrous metals
Different types:
- Microlenses
- Grids
- Fresnel- optics
- ...

Manufacturing technologies:
- Diamond- turning
- Diamond- milling
- Diamond- planing
- Structure size down to submicron area

Materials
- Oxygen-free copper (OFHC-CU)
- Aluminum
- Aluminum alloys (6082 and 6061 preferred)
- Brass
- Plastics (usually PMMA)
- Crystalline materials
- All nonferrous metals
## Coatings for CO₂-laser optics

<table>
<thead>
<tr>
<th>Coating type</th>
<th>Code</th>
<th>Reflectivity [%]</th>
<th>Phase Retardation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>λ = 10.6 μm</td>
<td>45° (S)</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>MO</td>
<td>97,7</td>
<td>98,2</td>
</tr>
<tr>
<td>Protected Gold</td>
<td>PG</td>
<td>99,0</td>
<td>99,2</td>
</tr>
<tr>
<td>Unprotected Gold</td>
<td>AU</td>
<td>99,2</td>
<td>99,4</td>
</tr>
<tr>
<td>Hard Gold</td>
<td>HG</td>
<td>98,8</td>
<td>98,7</td>
</tr>
<tr>
<td>Enhanced Coating</td>
<td>EC</td>
<td>99,6</td>
<td>99,2</td>
</tr>
<tr>
<td>Super-Enhanced Coating</td>
<td>SEC</td>
<td>99,8</td>
<td>99,9</td>
</tr>
<tr>
<td>Phase-Retarding Coating</td>
<td>PRC</td>
<td>99,5</td>
<td>99,1</td>
</tr>
<tr>
<td>Zero-Phase-Shift Coating</td>
<td>ZPC</td>
<td>99,8</td>
<td>99,9</td>
</tr>
</tbody>
</table>

## Other coatings

<table>
<thead>
<tr>
<th>Coating Type</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Coating (YAG)</td>
<td>ECY</td>
<td>High-reflecting coating for use with Nd: YAG-lasers (1.064 μm)</td>
</tr>
<tr>
<td>Protected Aluminum</td>
<td>PAL</td>
<td>Protected Aluminum coating primarily for use in the VIS and IR spectral regions*</td>
</tr>
<tr>
<td>Unprotected Aluminum</td>
<td>AL</td>
<td>Unprotected, pure-aluminum coating</td>
</tr>
<tr>
<td>Enhanced Aluminum</td>
<td>EAL</td>
<td>Provides enhanced reflectivity in the UV / VIS due to ist multi-layer dielectric overcoating*</td>
</tr>
<tr>
<td>Protected Silver</td>
<td>PAG</td>
<td>Silver with a protective dielectric overcoating*</td>
</tr>
<tr>
<td>SiO₂</td>
<td>SiO2</td>
<td>Protective SiO₂-overcoating</td>
</tr>
<tr>
<td>Yttrium Oxide</td>
<td>YO</td>
<td>Protective Yttrium Oxide overcoating</td>
</tr>
</tbody>
</table>

* These coatings may be optimized for a specified wavelength range.
METAL OPTICS OVERVIEW

FLAT MIRRORS

SPHERICAL MIRRORS

ASPHERICAL MIRRORS

POLYGON MIRRORS & SCANNERS

SPECIAL OPTICS

UP-MILLING PARTS

DYNAMIC-AXIS-TECHNOLOGY

STRUCTURED OPTICS

COATINGS