Heraeus Fused Silica Opaque Optical Diffuser Material: HOD500

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Heraeus Quarzglas - What sets us apart?

- More than 100 years of experience in quartz glass
- All 4 production processes in house
- Only material supplier with 3-D homogenisation process
- Precision molding
- R&D team for support and providing technical data
Custom Tailored Products

- Optics for Fusion lasers:
  - NIF, CEA, LLE Omega

- Quartz glass for Space Applications
  - Laser Ranging, Einstein Gravity Probe B, Vista

- Optics for Science
  - VIRGO & LIGO & GEO600

- Defense
  - Air Borne Laser
  - UAV / Directed Energy
Definition: Diffuser

- Optical diffusers are used for uniform dispersion of light in a variety of industrial applications.

- In optics, a diffuser is any device that diffuses, spreads out or scatters light in some manner, to give soft light.
  - Light reflects and diffused from a white surface
  - translucent materials as compact optical diffusers

- Perfect diffuser:
  - Lambertian reflectance (its brightness appears the same from any angle of view)

Juds, Scott M.: Photoelectric sensors and controls: selection and application.*
Current Products

- Ground or Chemically treated Glass
- Flashed Opal glass surfaces
- PTFE plastic (Polytetrafluoroethylene)
- OM-100 from Heraeus, designed for Semi-Conductor applications
Disadvantages

Ground, Chemically or Flash Glass
- Almost Lambertian diffuser
- Depending on base material different working wavelength ranges

PTFE plastic (Polytetrafluoroethylene)
- for >400 °C loss of stability
- Change of reflection behavior over time → recalibration
  - Reflectivity loss below 250nm
  - Potential UV degradation
  - Low density of 1.25 – 1.5 g/cm³ leads to bad mechanical stability

Opaque natural quartz, e.g. OM-100 from Heraeus
- Improvement for a lot of parameters, but still:
  - Marbel effect → no homogeneous density
  - Transmission and reflection loss in UV due to metallic impurities

Porous properties
HOD Motivation

- Product improvement over OM-100
- Maximum reflectivity/transmission from UV, VIS to NIR
- Longterm stable behavior
- Machineable
- Homogenous density distribution
- Low level of metallic impurities
- Low fluorescence
- Lambertian behavior
About HOD

- Heraeus Optical Diffusers are uniform opaque (white) sintered fused silica and fused quartz materials molded into shape.

- The material is produced by molding & high-temperature sintering of high purity fused silica or fused quartz powder into a bulk material with uniform micro-bubbles. The starting powders and controlled bubble content produce the desired optical characteristics.

- This results in bulk material & components that produce the optimized performance.

- Currently Heraeus Optical Diffuser materials & components are available in two grades:
  - HOD-300: fused quartz
  - HOD-500: fused silica (enhanced UV, purity)
Heraeus Optical Diffuser – HOD-500

- Base material: fused silica
- Scattering centers: bubbles Ø<25µm
  - Keyence light microscopy, 100x and 1000x magnification

Can be used in **reflective** and **transmissive** mode
→ performance depends on thickness
Heraeus Optical Diffuser – HOD-500

- Density: 2.155 g/cm$^3$ ± 0.25%
- Typical metallic impurities: < 0.36 ppm
- OH content: ~455 ppm ± 5%
- Typical transmission / reflection for a 5mm thick fire polished diffuser*:

*depends on thickness, surface finish and measurement setup

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Applications

- Radiation hard regime
  - Diffuser in space bound spectroscopy, e.g. satellites for solar or atmospheric measurement/analysis

- Diffuser application in IR and UV
  - Spectroscopy

- Laser Calibration standards
  - Spectroscopy

- Uniform radiation cavity
  - Laser cavities
  - Integrating sphere

- Attenuator / filter
  - Beam dump
Summary

- Heraeus Optical Diffuser HOD-500
- Customer tailored diffuser product initially developed for space applications
- Opaque fused silica
  - Small enclosed air bubbles
  - Maximum reflectivity/transmissivity from UV to NIR
  - Closed porous
  - Strong and machinable
  - Long term stability
  - Homogeneous density
  - Low metallic impurities and low fluorescence
  - Lambertian behaviour

- A product for more than just space !!!!