Plymouth Grating
LABORATORY

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# Diffraction Gratings

## Benefits

- Exceptional Diffracted Wavefront Error
- High Uniformity over the full aperture
- Robust etched structures
- Excellent feature positioning accuracy
- Spatially varying periods in both dimensions possible

## Typical Applications

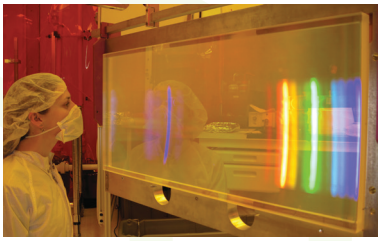
- Chirped pulse amplification
- Spectral beam combining
- Precision positioning and metrology
- Spherical and cylindrical focusing elements for high-intensity lasers

## Features

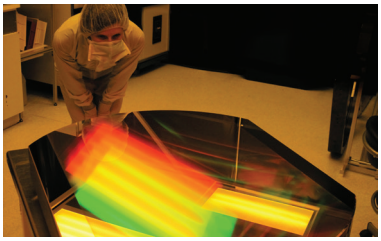
| | |
|---|---|
| Size | Up to 920 mm × 600 mm |
| Period / Frequency | 200 nm – 20 µm / 50 – 5,000 lines/mm |
| Depth | 10 – 5,000 nm (depends on Pd/Freq) |
| Diffracted Wavefront Error | < λ/4 PV (typ. RMS < 1 nm/inch!) |
| Substrate Materials | Variety (fused silica preferred) |
| Coating Materials | Large variety (metals & dielectrics) |

PGL first commercialized Scanning Beam Interference Lithography (SBIL) originally pioneered at MIT to enable production of meter-class multilayer dielectric (MLD) diffraction gratings with exceptional uniformity, high laser damage threshold, and low stress in vacuum. PGL then expanded its technology to include metallic reflection gratings, transmission gratings, two-dimensional gratings, and even focusing gratings that comprise curved lines. Our focus is on gratings for lasers and laser systems with applications in the scientific research, industrial, medical, defense, and semiconductor markets. PGL has developed special expertise not only in grating writing, but also in optical coatings, reactive-ion etching, optical metrology, and precision cleaning, inspection, and handling of large optics.

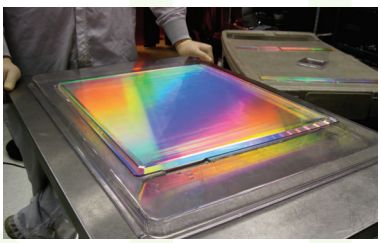
**Multilayer Dielectric (MLD) Gratings**



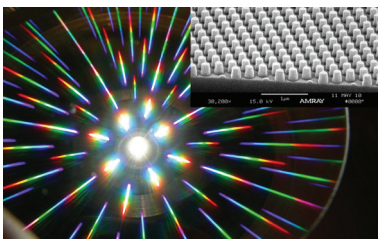
**Gold Gratings**



**Transmission Gratings**

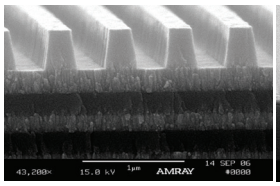
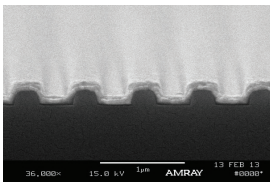
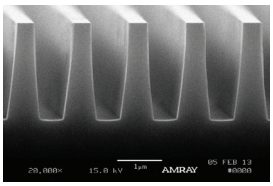
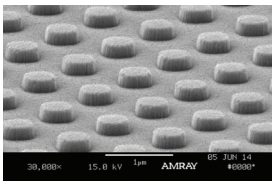


**Two-dimensional Gratings**



## Product Details

The following table illustrates specification typical values and limits for the most popular types of PGL gratings. PGL's unique capabilities allow us to manufacture gratings with variable periods and groove orientations with the same efficiency, uniformity, and repeatability of our standard, straight-line gratings, thus enabling chirped and focusing gratings. Tell us about your application today.

| | MLD | Gold | Transmission | 2D |
|---|---|---|---|---|
| |  |  |  |  |
| Grating Type | Reflecting | Reflecting | Transmitting | Reflecting or Transmitting |
| Diffraction Efficiency | Typ. 95 – 98% | Typ. 91 – 94% | Typ. 93 – 96% | Multi-order |
| Wavefront Error [1] | < λ/3 | < λ/4 | < λ/4 | < λ/4 |
| Laser Damage Threshold | High (2.5 J/cm² 1054 nm 10 ps) | Medium (0.25 J/cm² 800 nm 100 fs) | High (15 J/cm² 1054 nm 10 ns) | Medium – High (depends on type) |
| Bandwidth | Medium (typ. 30 – 40 nm) | High (up to ~ 200 nm) | Medium – High (10's to > 100 nm) | Low (typ. single λ) |
| Maximum Size [2] | 920 mm × 600 mm | 920 mm × 600 mm | 470 mm × 470 mm | 920 mm × 600 mm |

*[1] Depends on substrate size and aspect ratio*
*[2] Primarily limited by current Nanoruler configuration, except deeper Transmission gratings which are limited by etching equipment*

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**Plymouth Grating Laboratory** is dedicated to making the highest-quality diffraction gratings available today. Our focus is on lasers and laser systems. PGL gratings offer exceptionally high diffraction efficiency and laser damage threshold, combined with superior wavefront error and uniformity over large areas. This performance is made possible by PGL's exclusive use of the Nanoruler, based on the proprietary Scanning Beam Interference Lithography technology developed at MIT, and PGL's industry-leading process expertise. The company occupies 20,000 sq. ft. of dedicated manufacturing, engineering, and office space in Carver, MA, just outside of Plymouth, and about 45 miles south of Boston. For more information see plymouthgrating.com.