Plymouth Grating
LABORATORY

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Hybrid Metal-Dielectric Diffraction Gratings

Benefits

- Higher Diffraction Efficiency than gold gratings
- Wide Bandwidth for very short pulses
- High Laser Damage Threshold
- Low Diffracted Wavefront Error
- High Uniformity over the full aperture

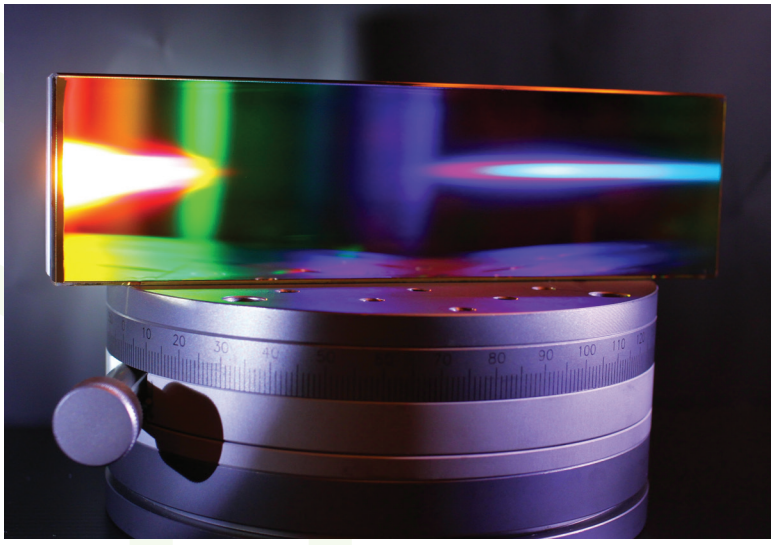
Typical Applications

- Pulse compression in high-intensity laser systems with very short pulses (as short as 10's of fs), especially those based on Ti:Sapphire and optical parametric (OP) amplification

Features

Grating Type	Reflecting
Diffraction Efficiency	Typ. 93 – 96%
Wavefront Error	< λ/3 (depends on size)
Laser Damage Threshold	TBD*
Bandwidth	Up to ~ 200 nm

Hybrid gratings are a cross between multilayer dielectric (MLD) and gold gratings. Like MLD gratings, they comprise an all-dielectric, partial transmission grating over a highly reflecting mirror; however, hybrid gratings utilize a metallic mirror instead of a dielectric one. As a result, this type of grating can in principle realize the best performance characteristics of both MLD and gold gratings. The broad bandwidth and phase properties of the metallic mirror enable hybrid gratings to achieve very broad spectral widths – equivalent to or even broader than gold gratings – with even higher diffraction efficiency. And with the all-dielectric grating region, the laser-induced damage threshold (LIDT) of hybrid gratings may be higher than that of gold gratings*.



A 195 mm × 55 mm hybrid pulse compression grating

**Hybrid gratings are still under development and thus some specifications are as yet undetermined. In particular LIDT has yet to be tested with high confidence.*

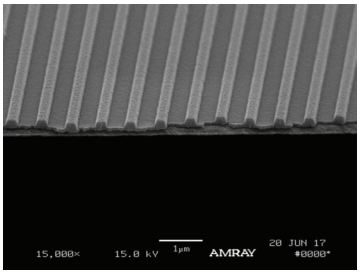
Product Details

PGL's gold gratings have established the state-of-the-art in diffraction efficiency, LIDT, and high-average-power handling with their exclusive "metal-over-glass" construction (see figure at left, top). Likewise PGL's hybrid gratings use only robust dielectric and metal layers, comprising typically one or more high-index dielectric layers over a gold coating on a glass substrate (figure at left, bottom and below). The result is even higher diffraction efficiency than gold gratings and the potential for higher LIDT under certain conditions.

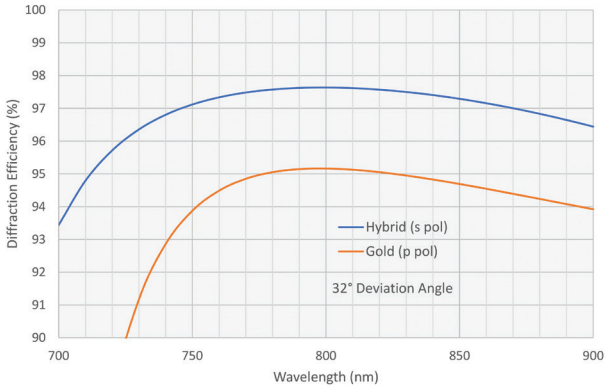
Lamellar gold over etched fused silica

2-layer dielectric hybrid

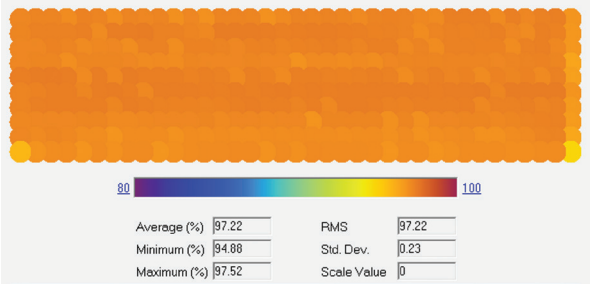
Gold Substrate Higher-index Dielectrics



Hybrid gratings can also exhibit equivalent or even broader spectral and angular bandwidths than gold gratings, as shown in the graph at the upper right. In this example the calculated efficiency for a 1480 lines/mm hybrid grating at 54º angle of incidence is compared to that of a typical gold grating, where each design has been optimized for a laser wavelength of 800 nm and a 32º total deviation angle. The example shows that the hybrid grating efficiency can be more than 2% higher than that of a similar gold grating.



The measured diffraction efficiency of a 195 mm x 55 mm hybrid grating is shown below, demonstrating the high degree of uniformity achievable over the full clear aperture.



As of the date of publication of this sheet there has been insufficient testing of hybrid grating LIDT values to specify performance. As this data becomes available it will be reported.

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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.