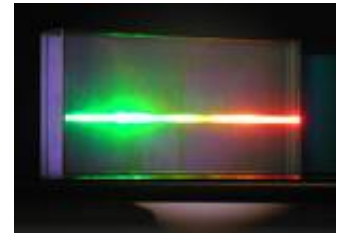


Multi-layer Dielectric Gratings for Pulse Compression

The rapid development of ultrafast lasers has prompted the need for new ultra-high performance, high damage threshold, diffraction gratings for pulse compression. HORIBA Jobin Yvon has been a leading supplier of gold coated pulse compression gratings since the development of the technique. Today HJY is developing unique MLD gratings with higher damage threshold for very high power laser chirped pulse compression.



Traditional diffraction gratings for pulse compression applications are holographically recorded and a gold metallic film. Metalized gratings have many useful features including diffraction efficiencies that can exceed 94% over a broad range of wavelengths. The profile as well as the optical properties of the metal coating determines the properties of the grating.

Features

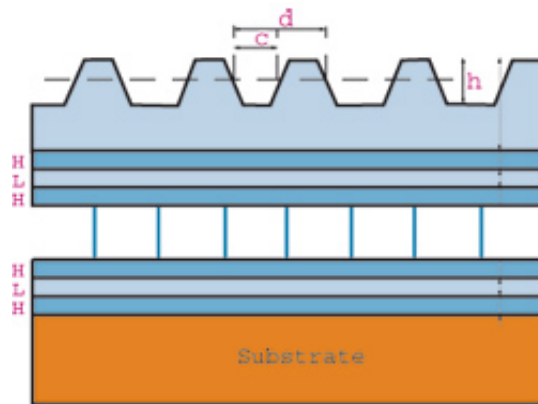
High efficiency: typically from 92% to 95% absolute efficiency on TE polarization,
Spectral domain: centred at 1053 nm with ~30 nm bandpass,
Ideal for high energy lasers: Nd:glass (1053-1057 nm),
Groove density: 1740 gr/mm,
Wavefront quality: $< \lambda/3$ PV at 1053 nm.

As far as laser induced damage threshold is concerned, gold coated gratings typically present the following values:

400 mJ/cm² on the grating surface for nanosecond pulses
250 mJ/cm² on the grating surface for picosecond pulses and lower fluences for shorter pulses or shorter wavelengths.

For many years multi-layer dielectric (MLD) structures composed of alternating high and low index layers have been well known to be highly reflecting. At each interface between a low and high index pair about 4% of the light is reflected. Summing all of the light from the many layers gives an optic that can approach close to complete reflection. Since MLD structures are insulators they lack the conduction electrons that make metals good reflectors and thus can have intrinsically higher damage thresholds.

The manufacture of MLD gratings requires control of the stack of dielectric films, each of a predefined thickness, uniform coating of photoresist and very precise generation of the holographic pattern that defines the groove shape and distribution. The latent image in the photoresist is transferred permanently into the dielectric stack by ion etching.



Multi-layer dielectric grating,
grooves engraved into the low
index MLD upper layer

Grating List

Blank size (nm)	Groove density (l/mm)	Central wavelength (nm)	Reference
165 x 220 x 30	1740	1053	524 40 223
210 x 420 x 50	1740	1053	524 40 525
335 x 485 x 50	1740	1053	524 40 820
420 x 450 x 43	1740	1053	524 40 920

Tutorial