

EUV Diffraction Gratings

for Monochromators,
Reflectometers,
Scatterometers and
More



Inprentus manufacturing headquarters in Champaign, Illinois, USA

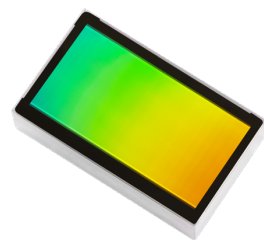
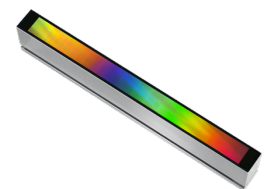
Inprentus offers custom master blazed gratings for EUV applications where optimization of optical efficiency, instrument compactness, and performance are priorities for next-generation processing labs.

A modernized method for mechanical ruling of diffraction gratings

Low manufacturing yield of **master gratings** has traditionally limited the industry, causing poor efficiency and focusing when using stock replica gratings. The Inprentus method has revolutionized the core manufacturing process for blazed grating production, providing the industry with a valuable new source. This new method offers improvements and critical specifications for a variety of optical diffraction applications. These improved specifications include extreme focusing requirements and enhancements of instrument throughput or optical efficiency.

Design to delivery: working with you throughout the process

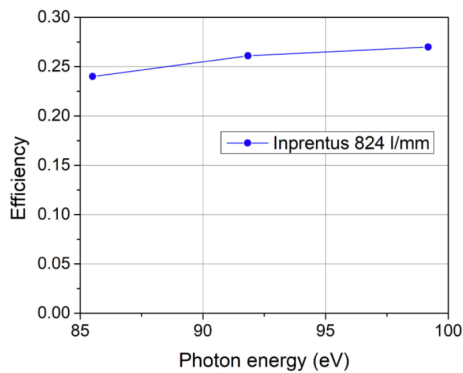
Inprentus will work with you to design and calculate simulated specifications and assist you with your grating design for custom instrument constraints.



Master gratings for EUV applications Inprentus has ability to manufacture diffraction gratings with extreme focusing abilities using high variable line spacing (VLS). This leads to optimization towards reduced spot size and brighter light at operating wavelength. The gratings can be used in and around design wavelengths in a wide variety of sizes and specifications, enabling compact instrument designs and upgrades. Inprentus also works closely with customers to provide custom blaze angles in the grating masters to enable a drop-in replacement in current instrument or next-generation instrument upgrade.

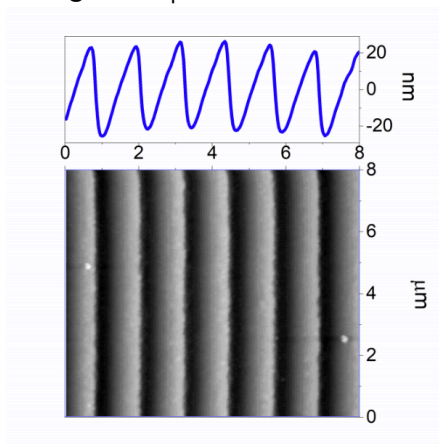
Performance: High Grating Efficiency (figure 1)

Inprentus 824 lpmm custom EUV grating with extreme VLS was verified to provide near-ideal efficiency at design wavelength. Compare to simulated efficiency in figure 4. The measurement was performed at the Center for X-Ray Optics at Lawrence Berkeley National Laboratory.



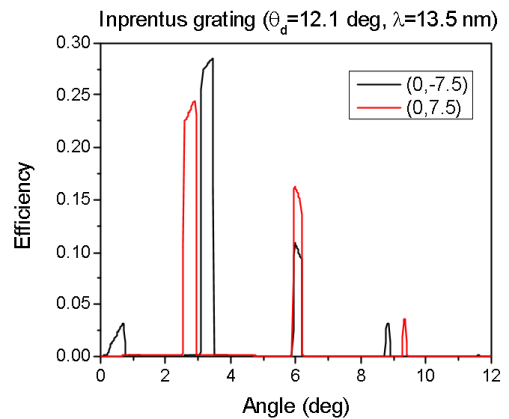
Nanomanufacturing: Precision Blaze Angle (figure 3)

Manufacturing advancements have enabled this EUV VLS grating to have line density extrema ranging from 736 lpmm to 930 lpmm while maintaining a blaze angle of $3.3^\circ \pm 0.04^\circ$. An atomic force microscope (AFM) grayscale height map of manufactured grooves is shown below along with groove profile in blue.



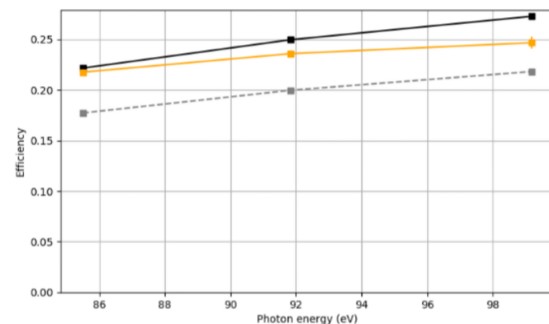
Upgrades: Extreme Focusing (figure 2)

Focused image size can be reduced by around 50x and the instrument made smaller using high VLS gratings. Efficiency measured at different points on a high VLS grating is shown. The differences are consistent with designed high line density variation. Inprentus has experience with manufacturing gratings with line spacing variation of 100% and more.



Support Capabilities: Efficiency Simulation (figure 4)

Proprietary simulation allows manufacturing set-up to be precisely modified until the grating yields efficiency (orange) above 80% (grey) of theoretical (black) efficiency. Simulated efficiency is included in the FAT report and agrees with measured performance (see figure 1).

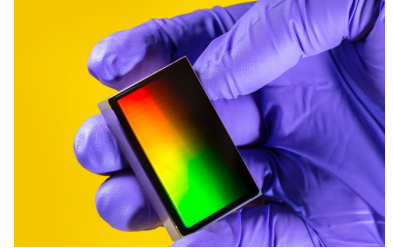


Applications

Typical product applications that would benefit from these improved diffraction grating specifications include optical emissions spectroscopy, x-ray and ultra-violet diffractive optics, and a variety of laser optics applications.

Specifications

- Blaze angles from 0.1° to 80°
- VLS - Variable Line Spacing (VLS)
- Echelle gratings
- Ruling on curved substrates – concave, toroidal, elliptical
- Resolving power above 100,000 (*dependent on other specifications*)
- High damage threshold substrates and overcoatings available
- Dimensions up to 500 x 200mm
- Line densities from 50 to 3000 l/mm
- Gold (Au) coated ruling surface with silicon or fused silica substrates



Quality Control

Each Inprentus diffraction grating undergoes a thorough optical testing procedure to assure conformance to customer specifications. The diffraction grating manufacturing process, testing program, and packaging operations ensure the highest standard of quality to provide gratings that are thoroughly clean and free from any organic low vapor pressure material or organic fluid. Each diffraction grating is measured with a variety of optical metrology instruments, and test results are provided with the delivery of each diffraction grating.



Inprentus

Inprentus has delivered custom blazed gratings to synchrotron & free-electron laser facilities and industrial laser companies around the world. The company's manufacturing operations include a variety of ruling machines that offer both high precision and high throughput, while maintaining the capability to produce a wide range of gratings. Inprentus' manufacturing center is staffed by world leading scientists engaged in the materials science, nanotechnology, and control system software development that is at the center of the company's expertise.



Contact Inprentus to get your diffraction grating project started



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