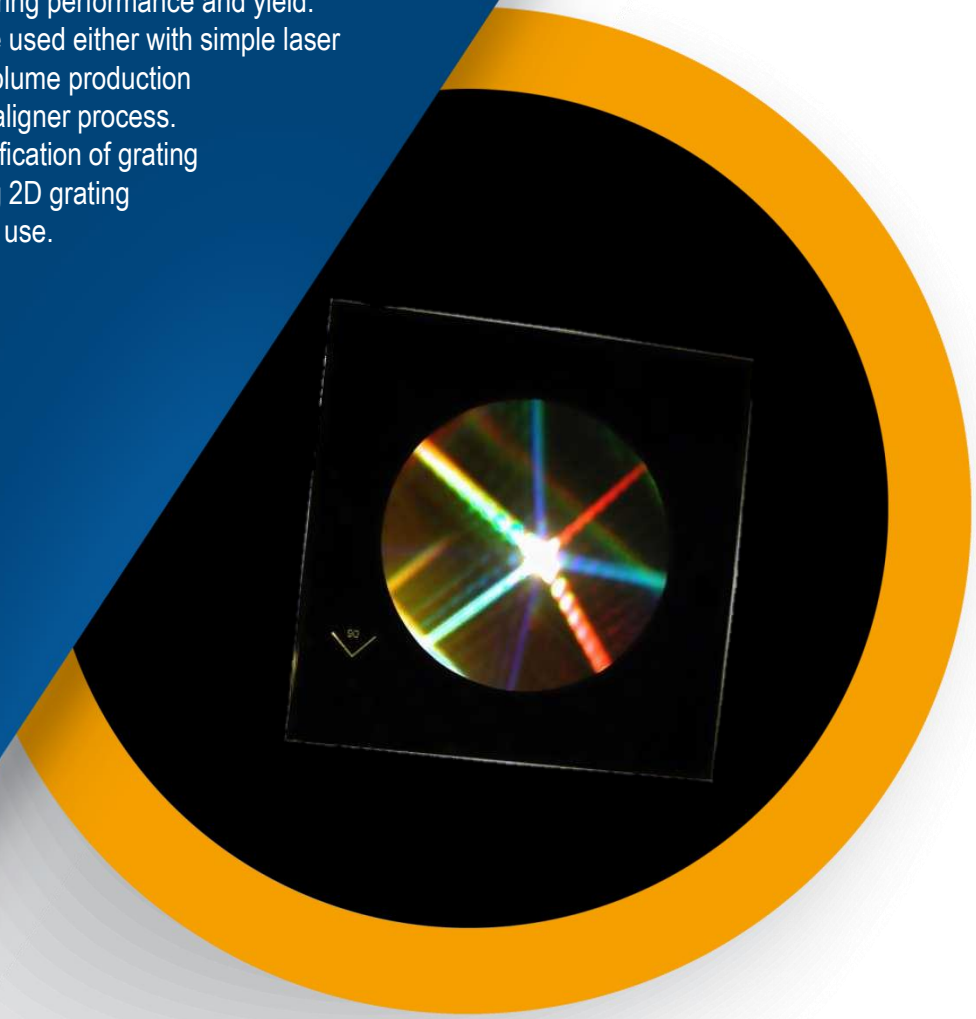
*Enabling volume manufacturing of 2D gratings on planar wafers in a 1-step, large grating area, high accuracy process*

Ibsen photonics

Holographically produced 2D Phase masks allow production-friendly 1-step exposure of 2D grating structures over large grating areas. Ibsen's +/-0.01 nm period accuracy further enhances customer manufacturing performance and yield. Phase masks can be used either with simple laser illumination or in a volume production oriented NFH mask aligner process. Clear on-mask identification of grating parameters including 2D grating orientation facilitates use.



# 2D Phase Mask

## Square Lattice Pattern Generation

# 2D Phase Mask

## Square Lattice Pattern Generation

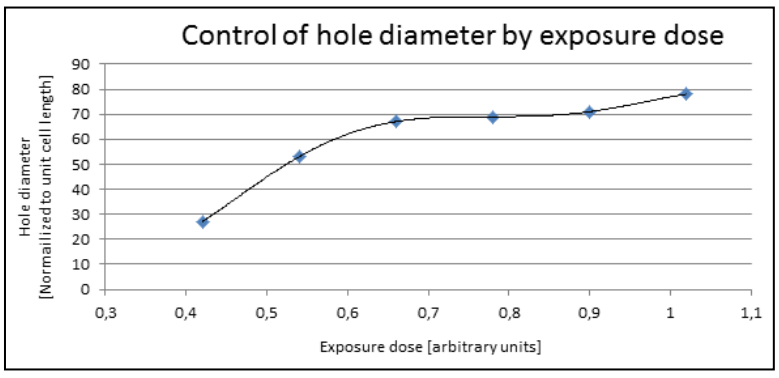
| Features |
|---|
| Single exposure for 2D square lattice grating structures |
| Square lattice periodicity possible down to 260 nm |
| Period accuracy and uniformity of +/-0.01 nm |
| Hole diameter is controlled by exposure time |
| High contrast in interference pattern |
| Inherently free of stiching errors |
| Optimized to illumination wavelengths from 193 – 800 nm |
| 2D Phase masks can be optimized to any polarization – including unpolarized |
| Phase mask parameters are specified on each Phase mask |

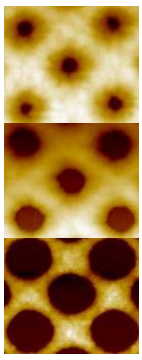
| Product range and specifications | |
|---|---|
| Grating periods | 260 nm – 1260 nm |
| Illumination | 193 nm – 800 nm |
| Materials | Fused silica |
| Period accuracy | +/-0.01 nm |

| Grating and substrate sizes | |
|---|---|
| Grating size | Substrate size |
| Ø2” | 3” x 3” x 2 mm |
| Custom area possible | |

## The priciple

The 2D square lattice Phase mask is illuminated at the Bragg angle, similar to the well known 0/-1 order 1D Phase mask principle. The 2D Phase mask diffracts this illumination into multiple orders; the coherent interference pattern between these accurately creates the 2D periodicity. Our innovative production techniques allow us to manufacture 2D Phase masks with periodicities down to 200 nm, while the 2D Phase mask principle of operation limits the upper lattice periodicity to 687 nm (435 nm illumination).



| Sample Applications |
|---|
| Display technology |
| Semiconductor applications |
| Solar cells |
| Photonic crystals |
| Biochip matrices |

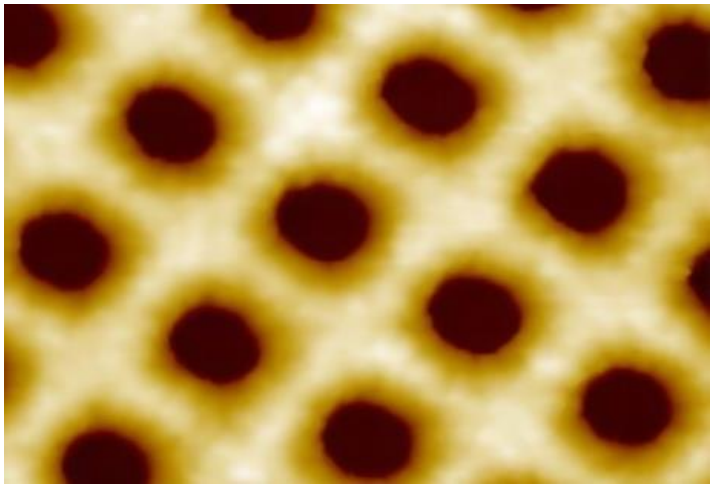

Ibsen photonics

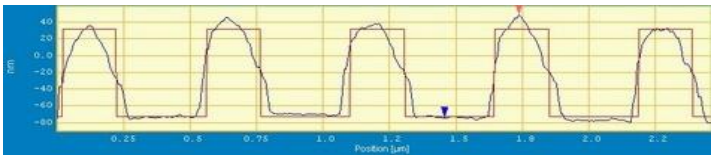
For further information you can contact us directly at:

Ibsen Photonics A/S Ryttermarken 15-21 DK-3520 Farum Denmark
Phone +45 4434 7000 Fax +45 4434 7001 www.ibsen.com E-mail inquiry@ibsen.com

# 2D Phase Mask

## Square Lattice Pattern Generation





### Criteria of suitability

The 2D Phase mask principle requires a certain relationship between the illumination wavelength and grating period. In other words, a given illumination λ can be used to expose a calculable range of grating periods Λ via the following equation:

$$\frac{2}{\sqrt{10}} \leq \frac{\lambda}{\Lambda} \leq \sqrt{2}$$

### Calculation of Bragg ancle

The Phase mask is optimized for illumination at the 2D Bragg angle, which can be calculated using the followoing equation:

$$\sin(\theta_n) = \frac{\lambda}{\sqrt{2} \cdot \Lambda}$$

* Not applicable to all configurations across the product range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Ibsen Photonics A/S Ryttermarken 15-21 DK-3520 Farum Denmark
Phone +45 4434 7000 Fax +45 4434 7001 www.ibsen.com E-mail inquiry@ibsen.com