XRnanotech

Nanostructures and Optics
with Swiss Precision

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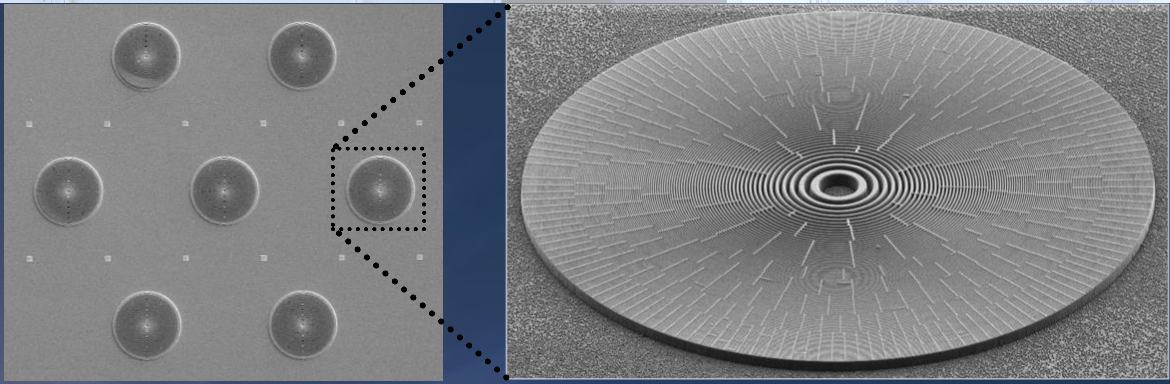
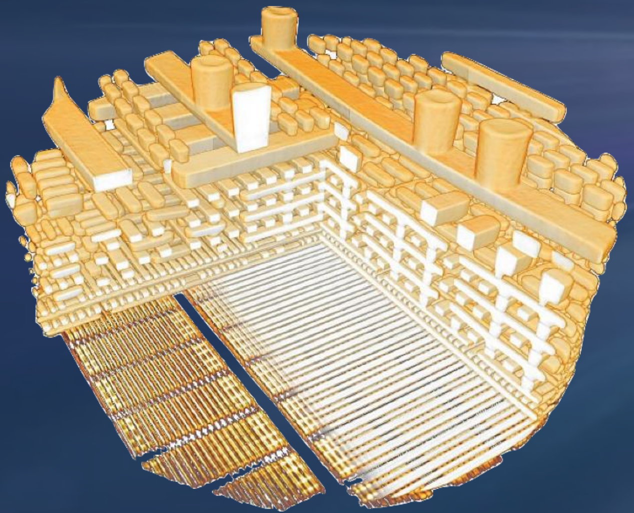
Photo by M. Teller

Award Winning Manufacturing with Swiss Product Excellence

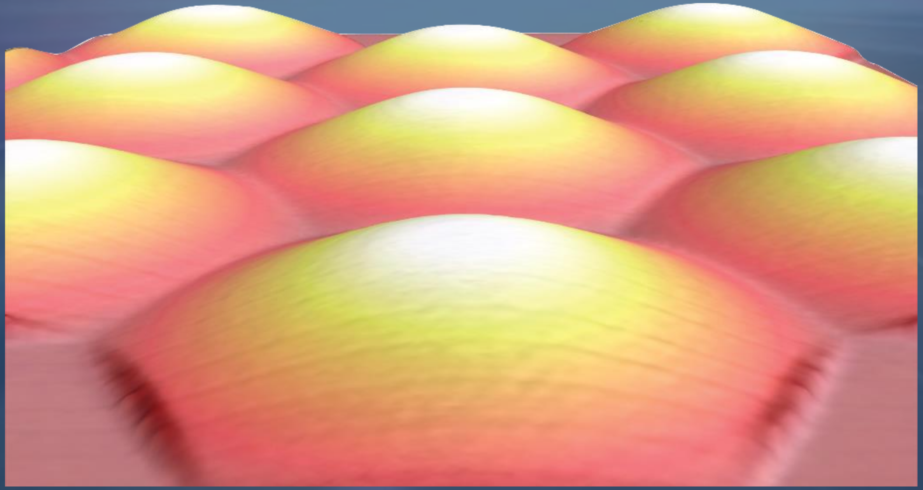
SWISS EXCELLENCE + STIFTUNG



EUV and X-ray Optical
Components & Systems



Nano and micro-
structured Metamaterials



Neutron Optical
Components

Facts/Figures

XRnanotech is the leading Swiss company for nanostructures and X-ray optics, with a proven track record, high customer retention, and successful sales.

XRnanotech
MICROWORKS
› part of XRnanotech group

- Founded February 2020
- Team of 27 people
- Innovative products covering nanostructures and optics
- Flexible Fab for rapid micro and nano prototyping

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MICROWORKS

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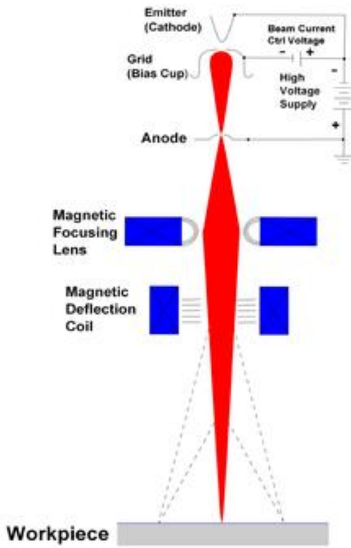
Core Technologies

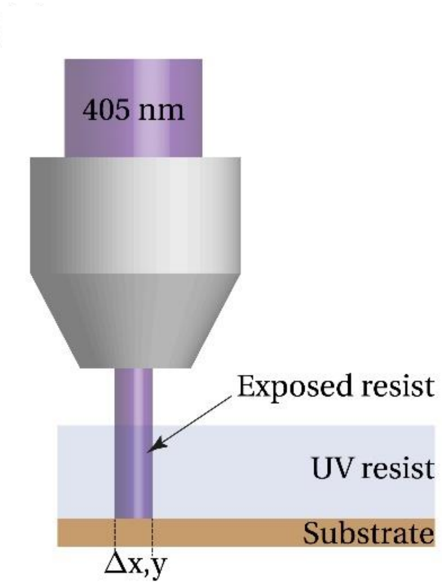
Lithography, Electroplating, Etching & 3D Printing

E-beam lithography



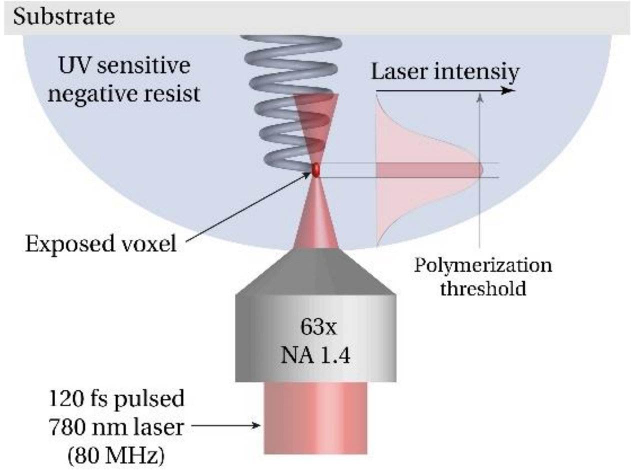
- Feature Size > 10 nm
- Good stitching
- Writing times
- Charging effects
- Up to 4 μm height

Laser lithography



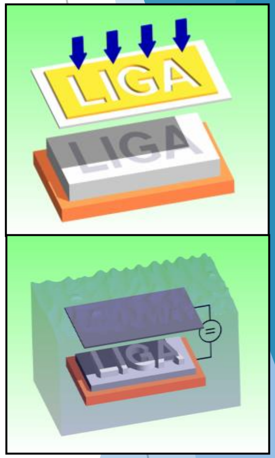
- Feature Size > 500 nm
- Good stitching
- Fast writing times
- No substrate effect
- Up to 100 μm height

3D Printing
(2 Photon polymerization)



- Feature Size > 150 nm
- Good stitching
- Slow writing times
- No substrate effect
- True 3D vs. 2.5D

LIGA
(X-ray lithography & Electroplating)



- Feature Size > 10 um
- Good stitching
- Slow writing times
- No substrate effect
- Up to 1000 um heigt

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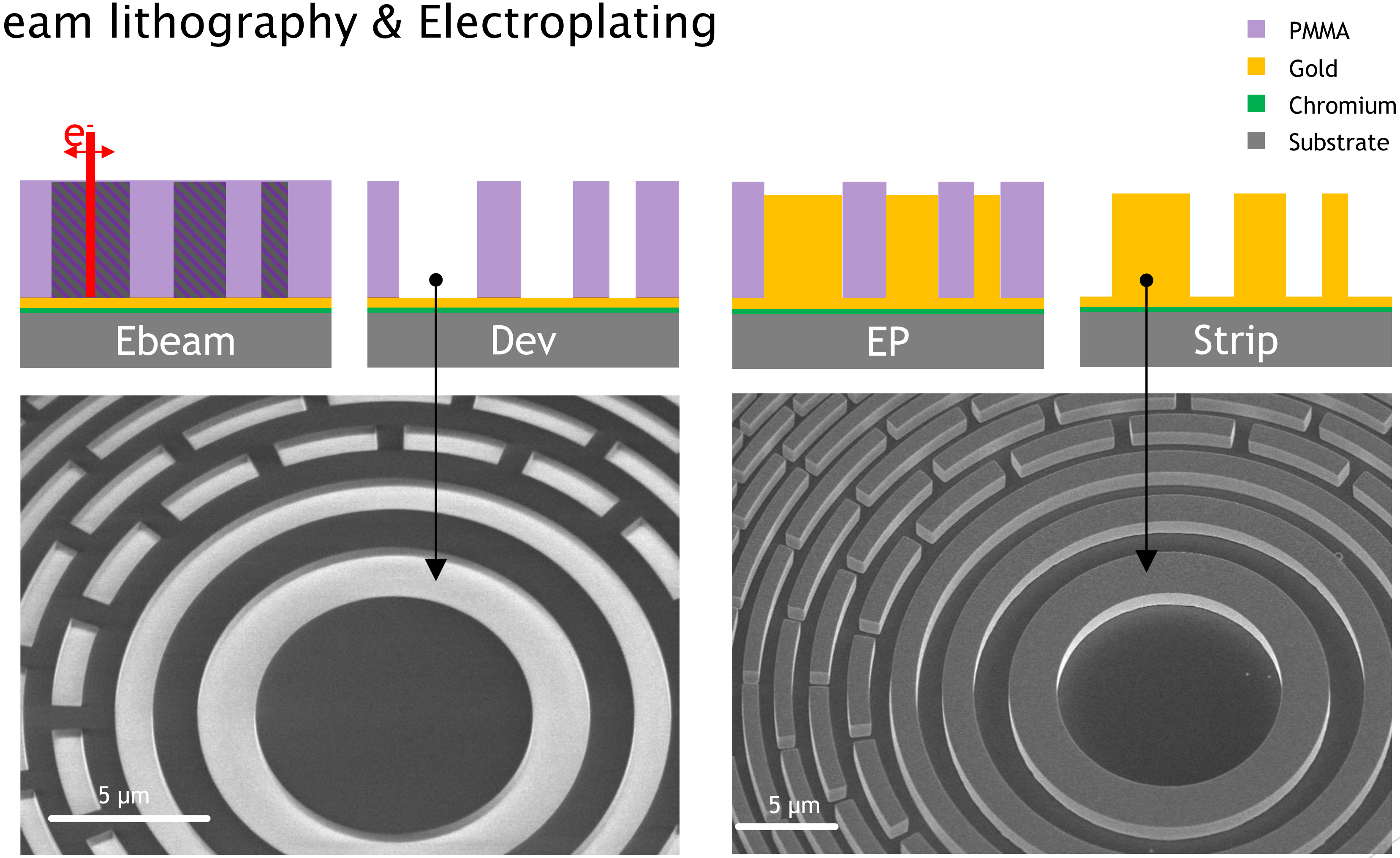
Example I

Phase Fresnel zone plate

E-beam lithography & Electroplating



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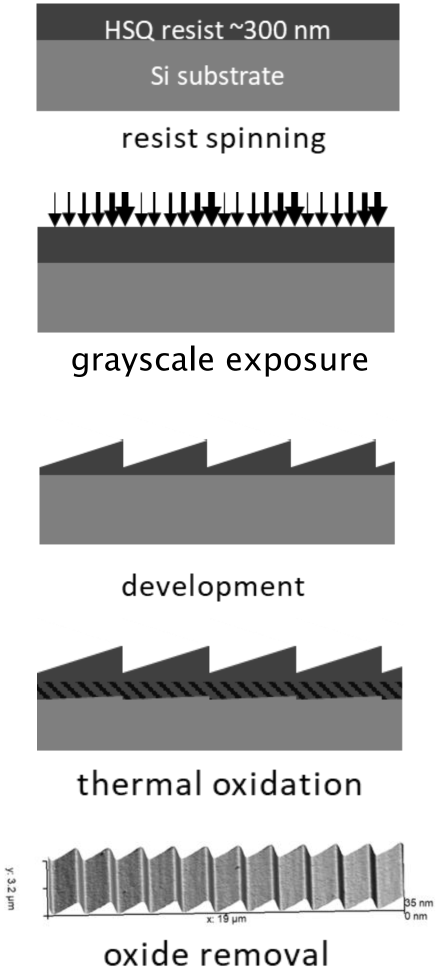
Example II

Blazed Reflective X-ray grating

Grayscale EBL and through-mask oxidation



Spin coating

- HSQ resist, thickness ~ 300 nm

Grayscale exposure

- Exposed area is converted to SiO_x

Development

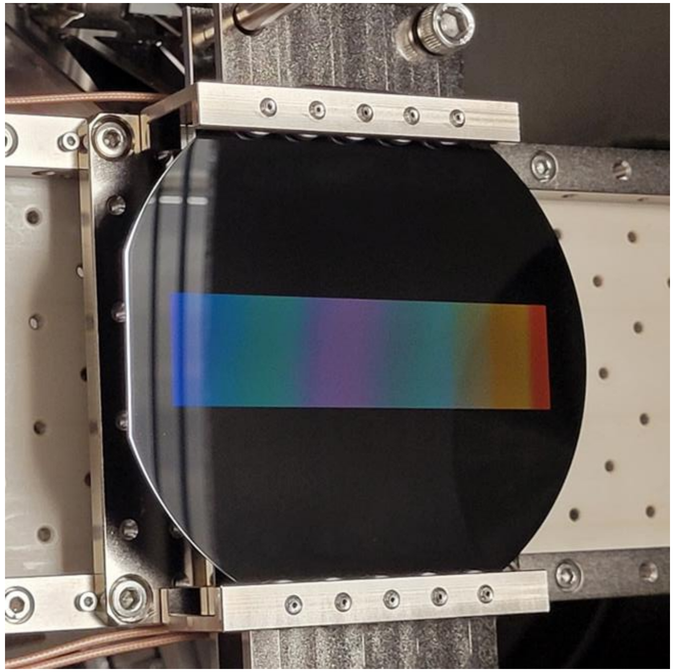
- NaOH-based developer

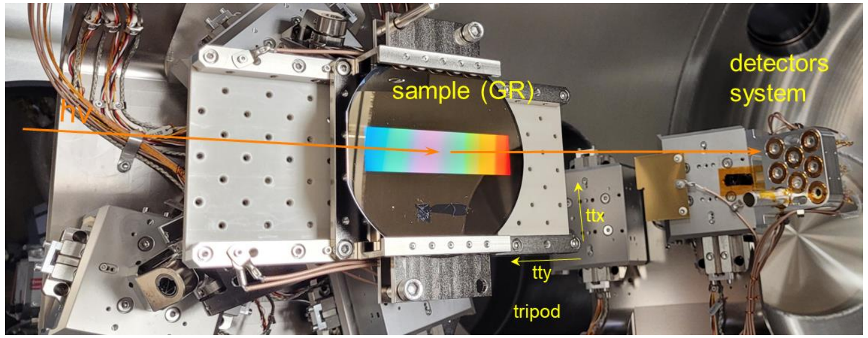
Thermal oxidation

- Dry oxidation, different SiO_x thickness → different oxidation speed

Example II

Blazed Reflective X-ray grating





Result: Smooth surface due to height feature reduction (10x)

oxide removal

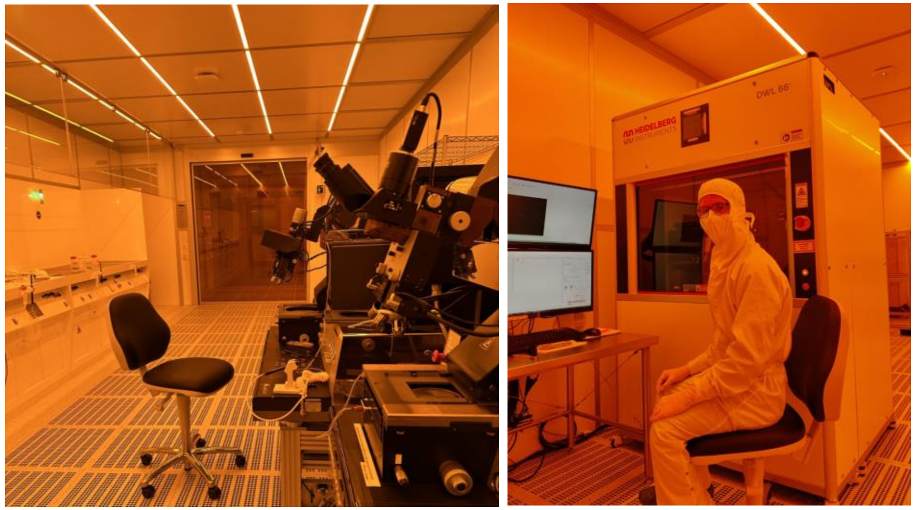
Cleanroom, Materials, Collaborations

Class 10/ISO 4 1000 m2 cleanroom at PSI

Lithography techniques: EBL, Laser, LIGA

Electroplating & Deposition*:

- Au & Ni
- Cr, Ru, Mo, Al



Etching/Wet chemistry*:

- Si, SiO2, Diamond

Collaborations:

- Nanoimprint lithography & Atomic Layer Deposition (ALD) of **metal oxides**

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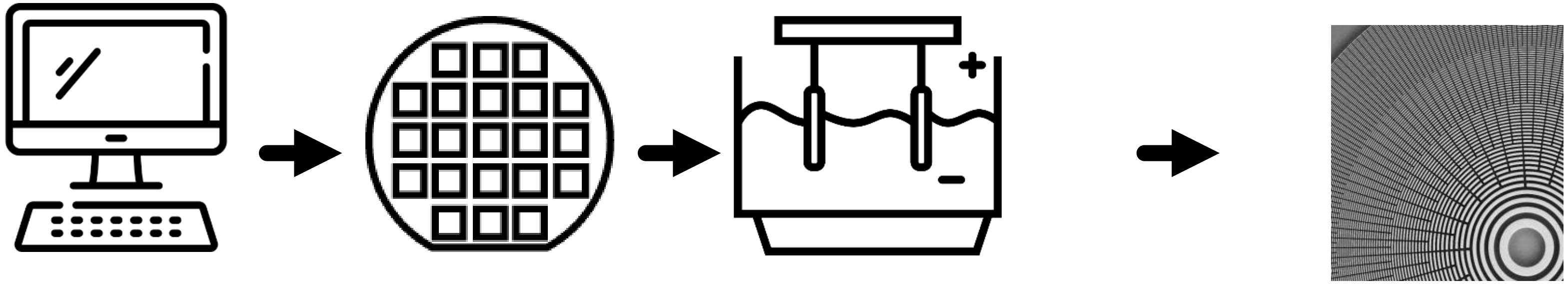
*A selection of materials

Contact, Consulting, Project & Collaboration

1. **Initial Contact**: Web-based inquiry and/or direct contacting
2. **Consulting phase**: Feasibility, Materials, Design, Lead times, and Project type (Order, R&D, Supplier agreement, etc.)
3. **Implementation phase**: Project type dependent
4. **Delivery and Services**: Metrology/Inspection



CAD design

Laboratory Processing and Writing

Electroplating and Post-Processing

SEM Inspection

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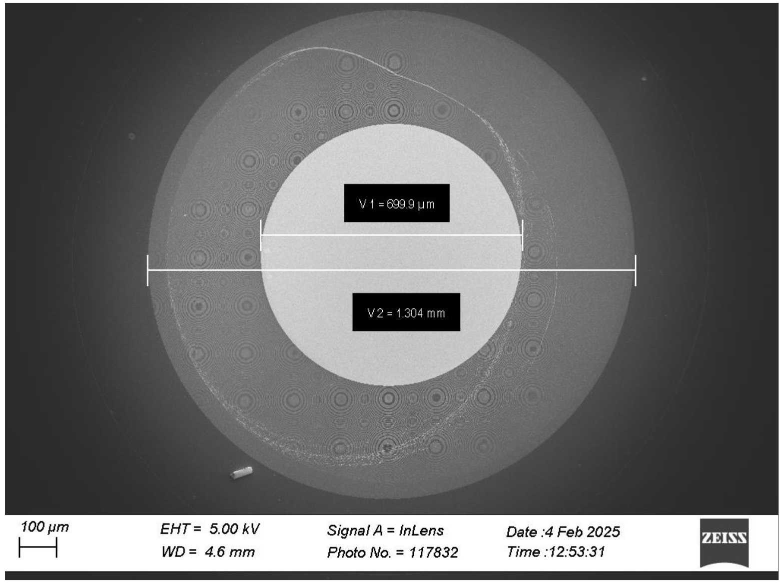
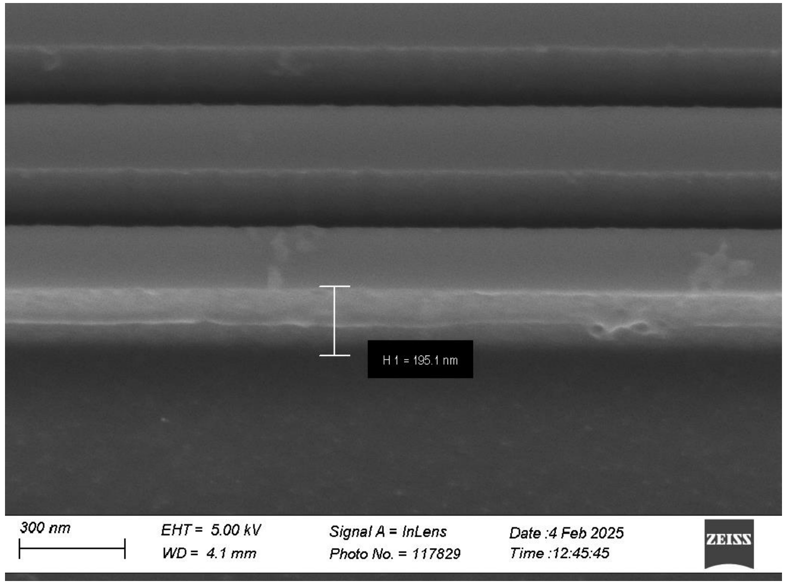
Vortex Optics

Spiral Fresnel zone plates for I05 at DLS I

SEM image, top view

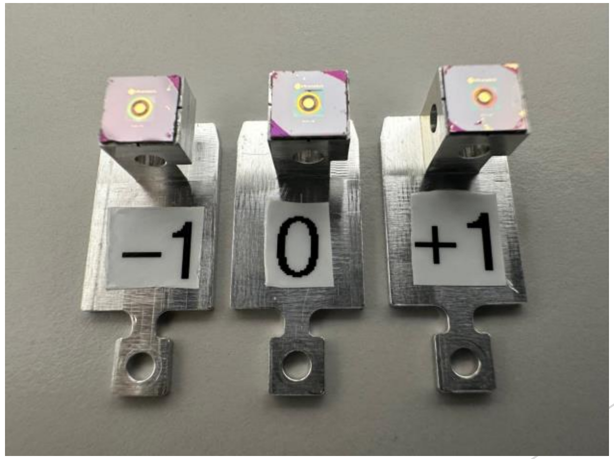


SEM image, side view



Specifications

- Contrast material: Si
- Thickness: 400 nm
- ⌀: 1300 nm
- drN: 200 nm



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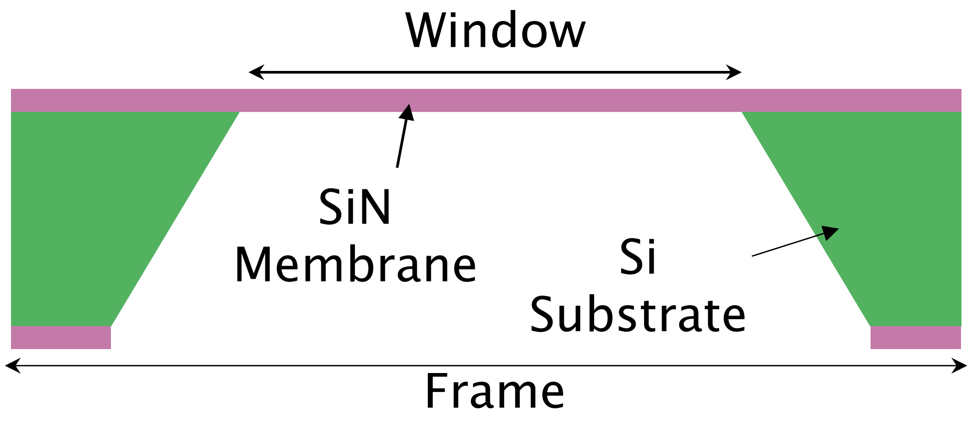
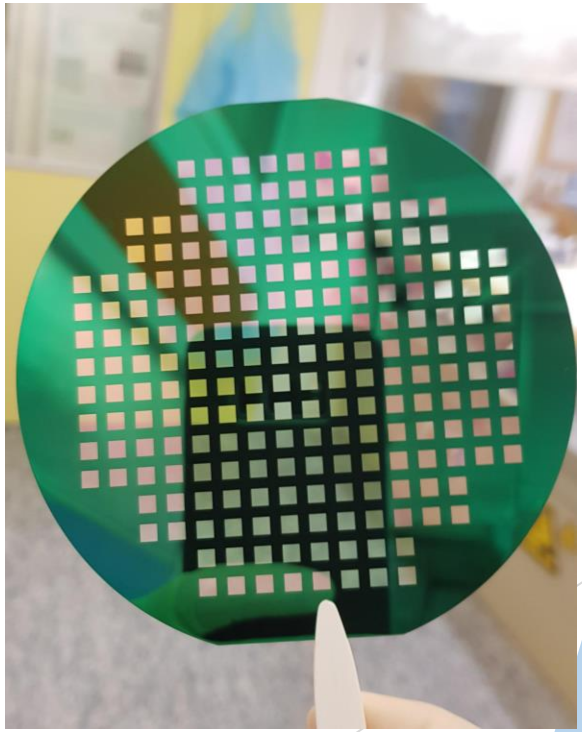
Spiral Fresnel zone plates for I05 at DLS I

A brief overview on substrates and membranes, aka chips

Chips consist of a solid Si frame featuring membrane windows of

- Si3N4 / SiC / Si with thicknesses ranging from
- 50 nm to 1 µm, and lateral sizes of
- 9 x 9 mm, 6 x 6 mm, 3 x 3 mm & custom-made

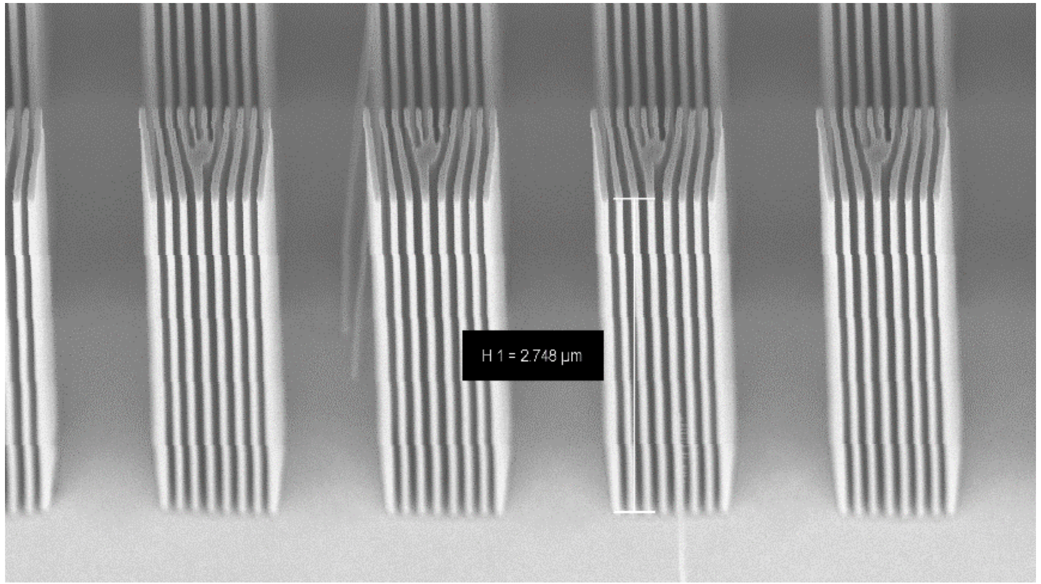




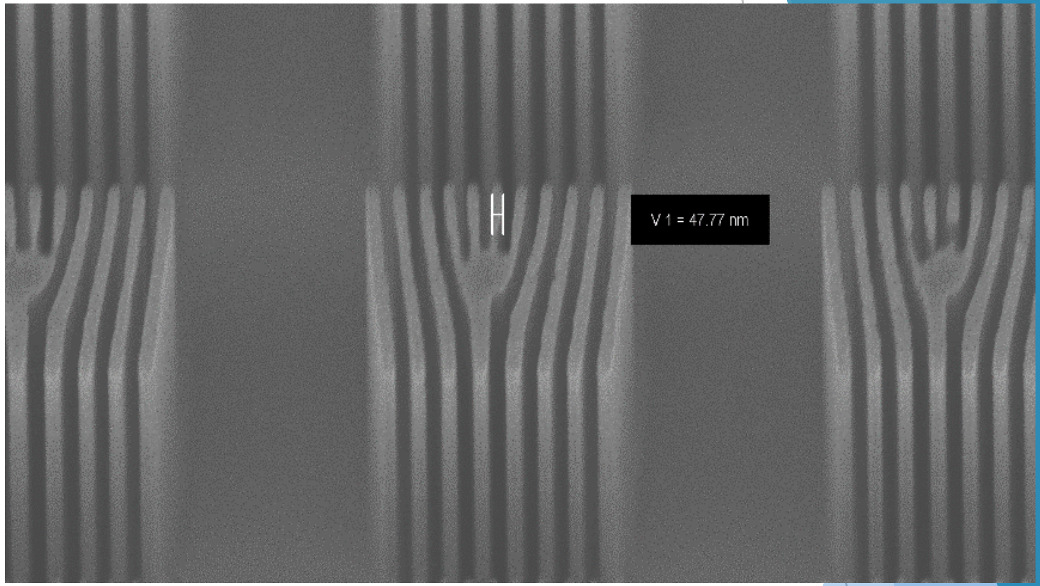
Vortex Optics

High-aspect ratio OAM=0, 1, 2, 3 Neutron gratings

SEM image, side view



SEM image, side view



Specifications

- Contrast material: Si
- Height: > 5 um
- Area: 5 x 5 mm
- Pitch: 100 nm

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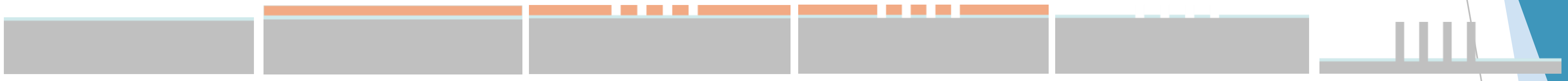
High-aspect ratio OAM=1, 2, 3 Neutron gratings

A brief overview of the process for achieving high-aspect ratios in Si,
MACE: Metal Assisted Chemical Etching



Pt PVD

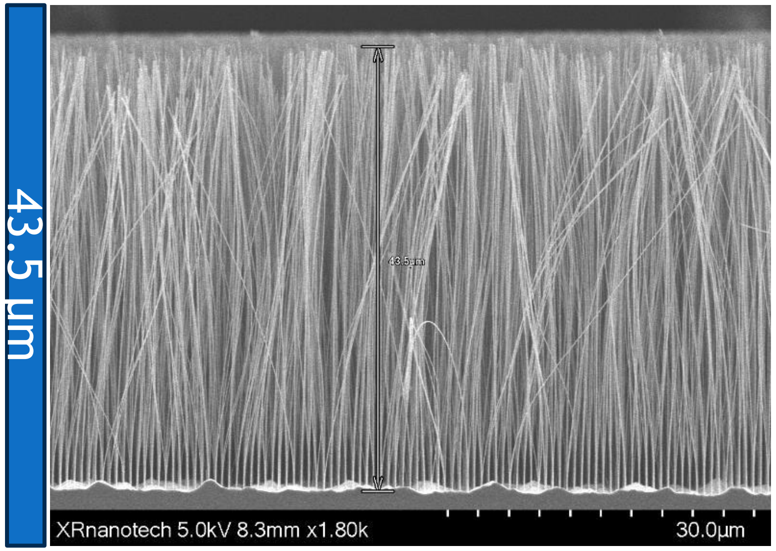
EBL Resist Coating

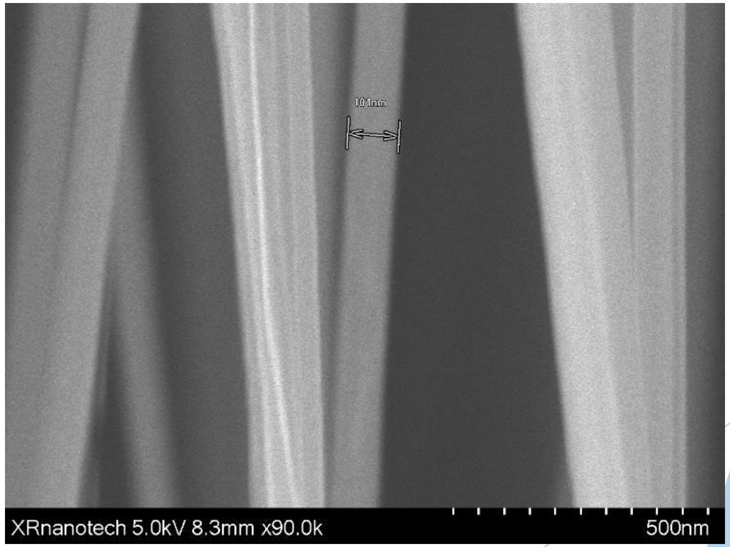
Ebeam Exposure; Development

Pt Ar Milling

EBL Resist Removal

Vapor HF Etching





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*Nanostructures & Optics with **Swiss** precision!*

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Thank you!

Any question?

European Commission
LEAPS League of European Accelerator-based Photon Sources
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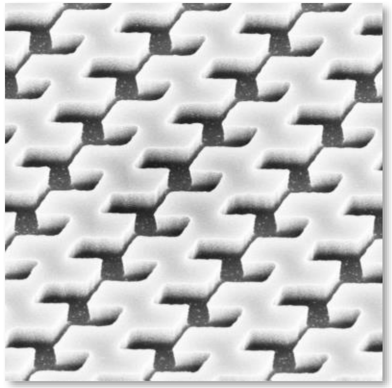
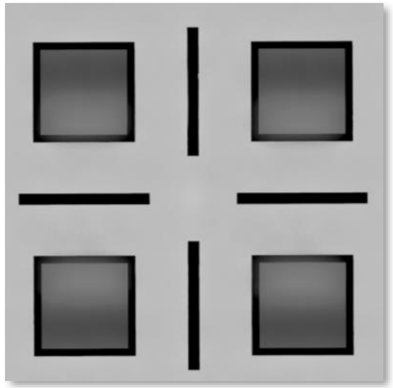
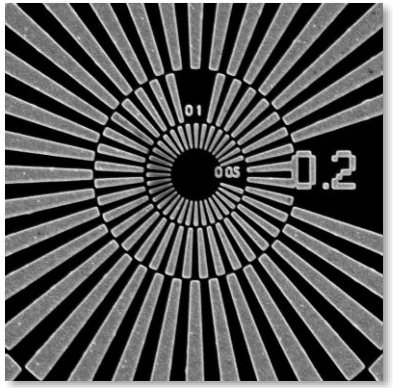
STARTUP SUPPORT IFJ
VENTURE KICK KICKSTART YOUR HIGHTECH BUSINESS
nextcorps LUMINATE
MC MASSCHALLENGE SWITZERLAND
CERN
PAUL SCHERRER INSTITUT PSI

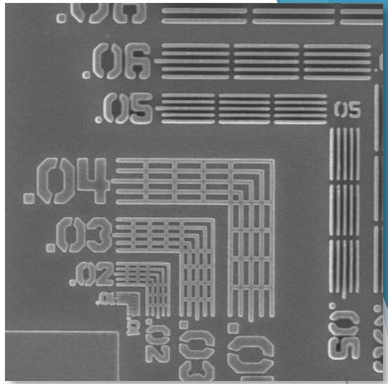

Custom optics


Thin membranes

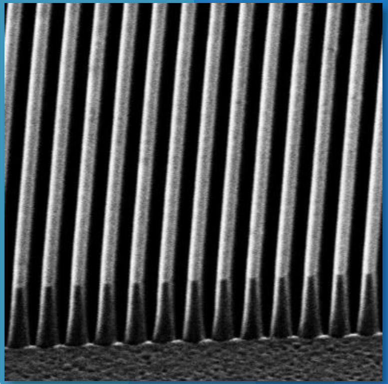


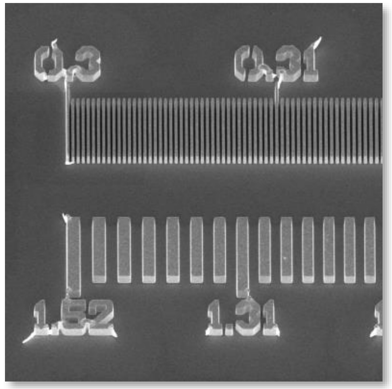
Siemens Stars


Blazed zone plates

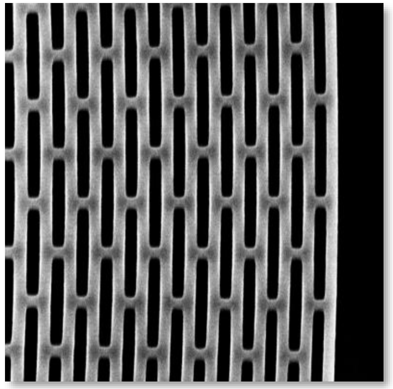


Hybrid targets

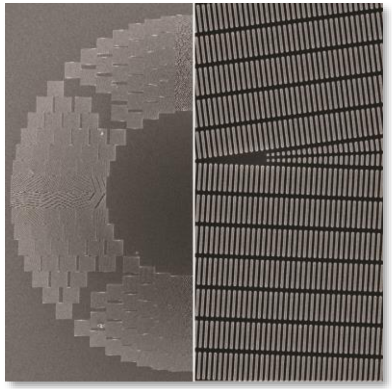

Diamond gratings

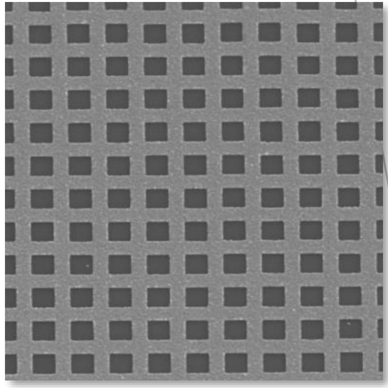


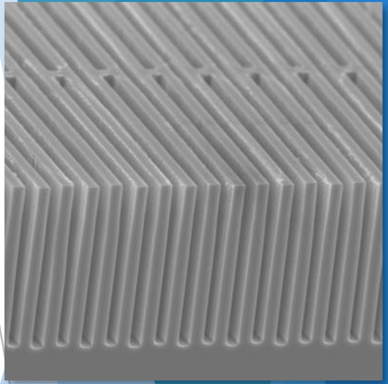
VLS gratings

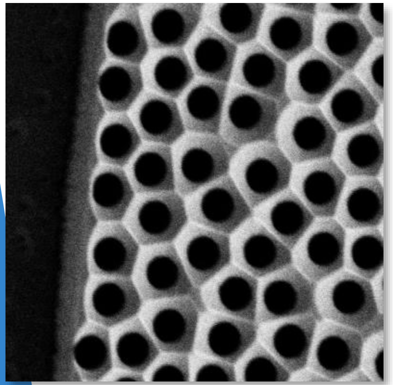

EUV zone plates

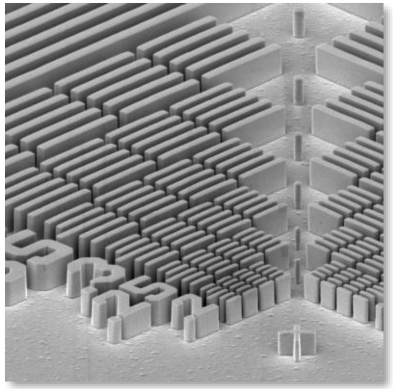

3D Siemens Stars


Condenser lenses


Wavefront sensors

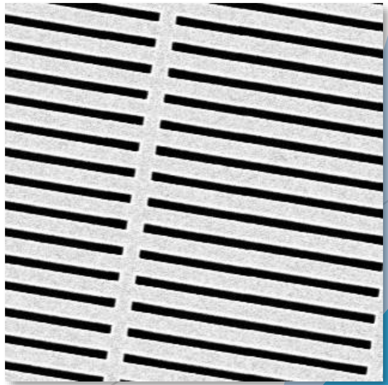

Silicon grating

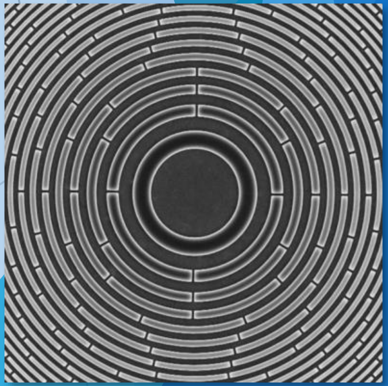

Diamond diffusers


MicroCT targets

Achromatic lenses


Phase rings


Metal gratings


Fresnel zone plates

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