

X-ray optics

X-ray diffraction gratings

Rectangular grooves with period from 0.5 μm
Groove height up to 200 nm
Grating size up to 20×20 mm²

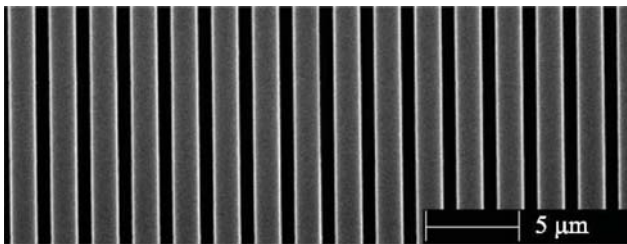
Substrate:

- Si, SiO₂

Coatings:

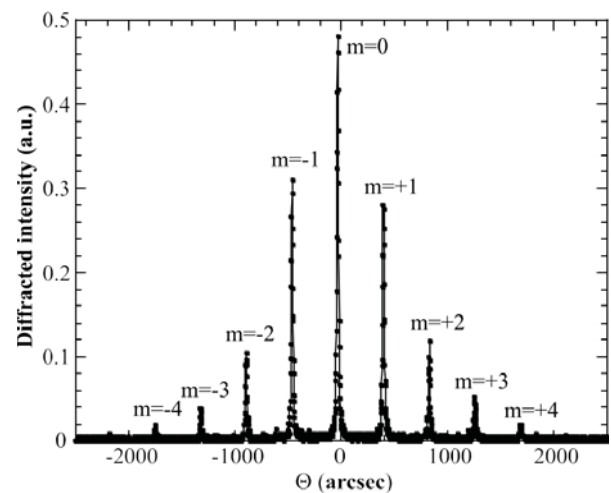
- thin films W, Al, Au etc.
- multilayer mirrors W/Si, Mo/Be, Cr/Sc etc.
- substrate etching

Multilayer diffraction grating

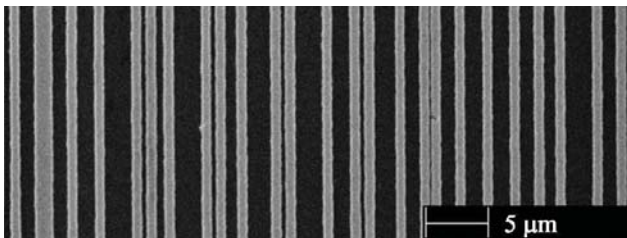


period $D=2\text{ }\mu\text{m}$

50 W/Si bilayers ($d=50\text{ }\text{\AA}$)

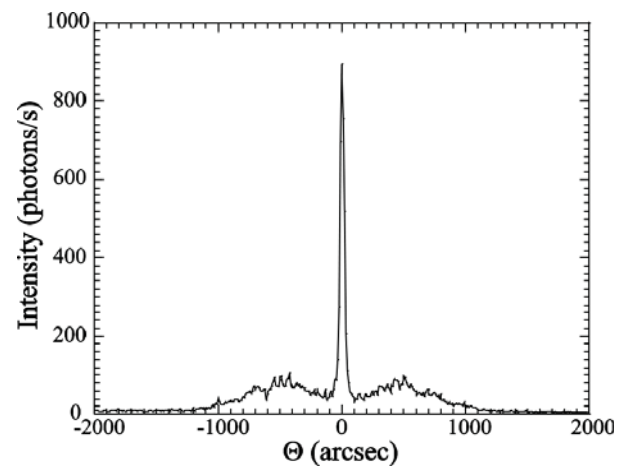


Multilayer diffraction grating with random position of grating grooves

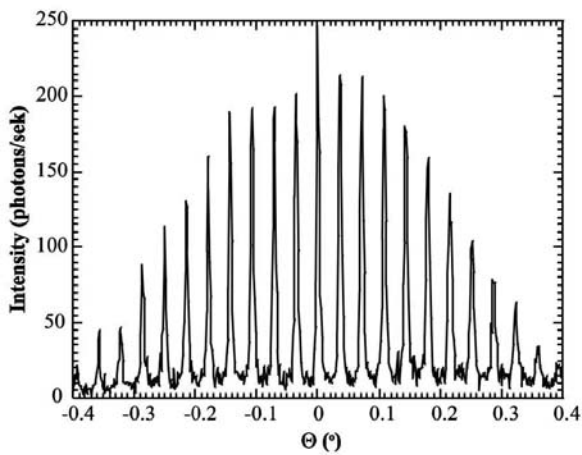
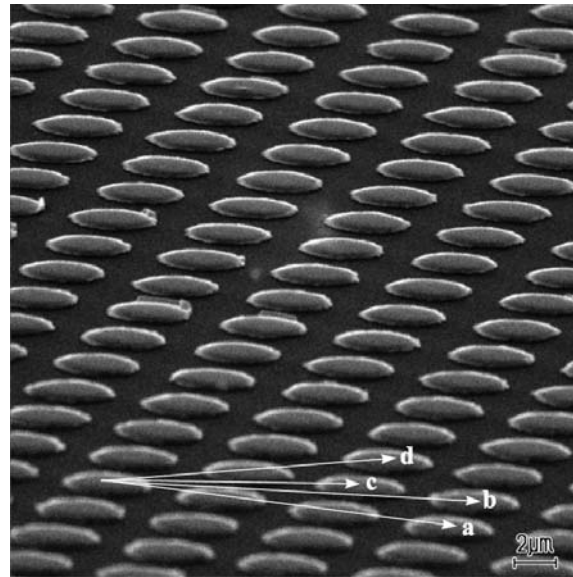


period $D=2\text{ }\mu\text{m}$

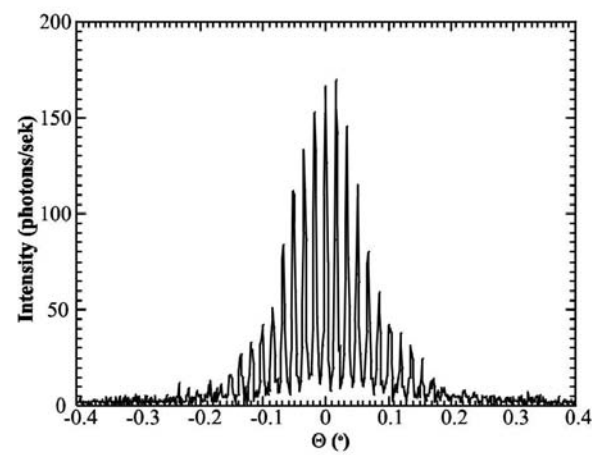
50 W/Si bilayers ($d=50\text{ }\text{\AA}$)



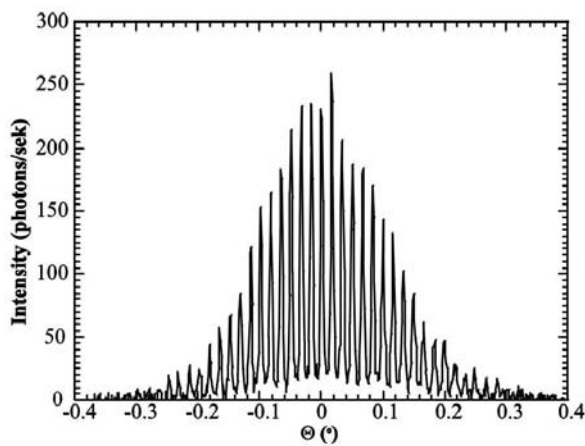
2D grating with round reflecting multilayer elements



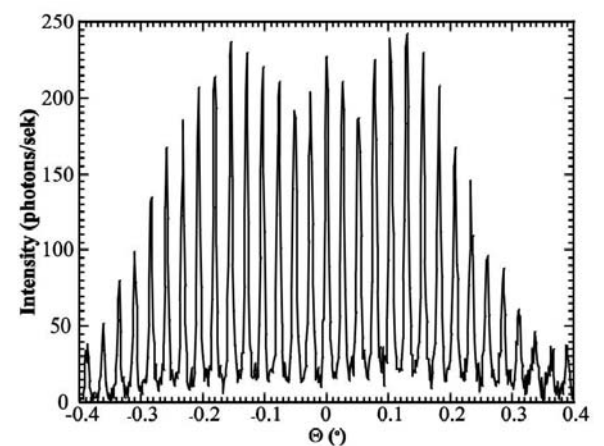
a: $d=6$ mm, $\delta\Theta=0.036^\circ$



b: $d=18.9$ mm, $\delta\Theta=0.012^\circ$

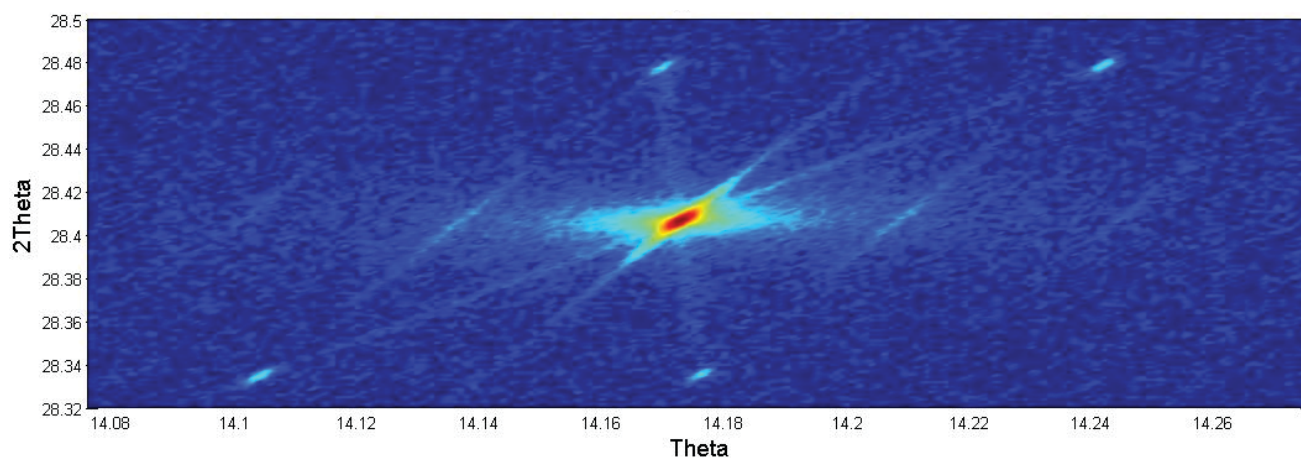
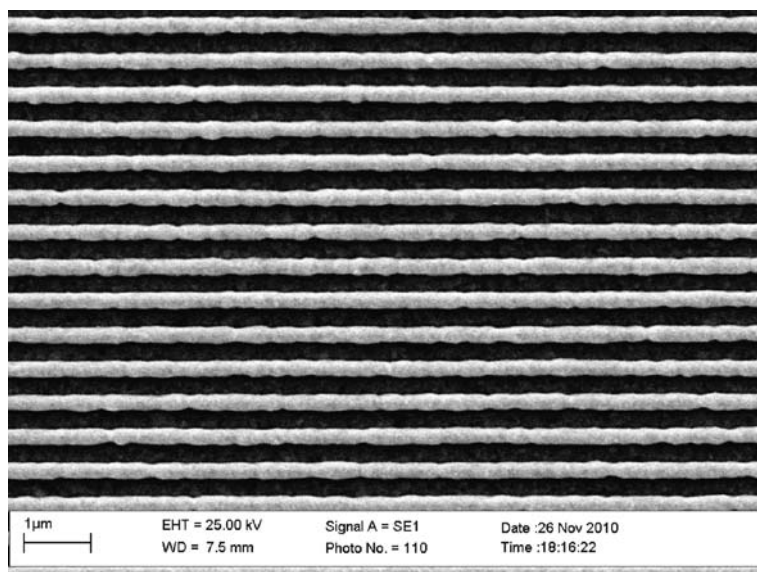


c: $d=13.4$ mm, $\delta\Theta=0.016^\circ$

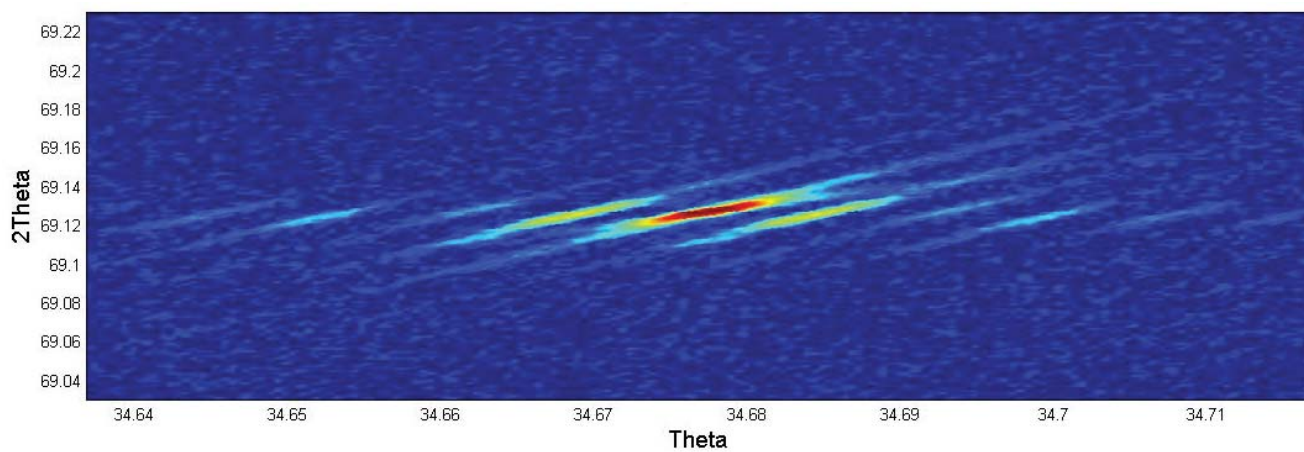


d: $d=8.5$ mm, $\delta\Theta=0.025^\circ$

X-ray diffraction gratings for Bragg reflection



X-ray diffraction by diffraction grating with thin film coating



X-ray diffraction by diffraction grating with etched grooves

X-ray focusing

Grazing incidence phase Fresnel
zone plates 1D or 2D x-ray focusing
Groove height up to 100 nm

Zone plate size:

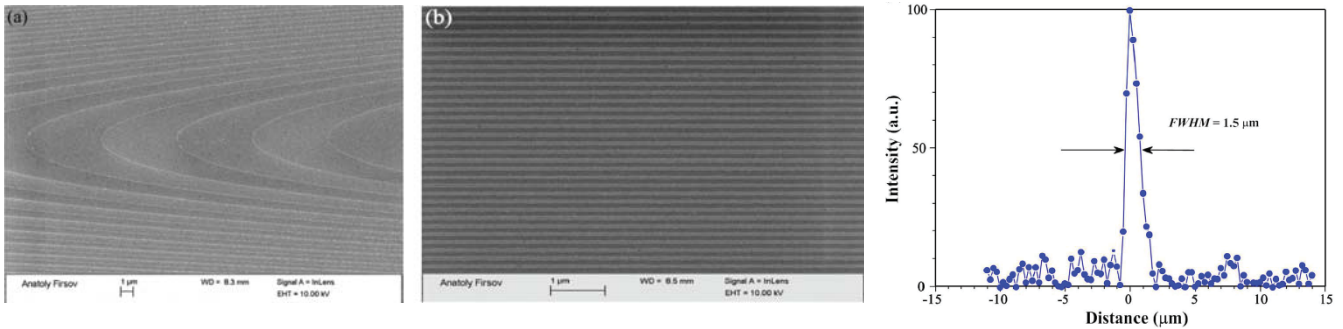
- 1D focusing up to 50×50 mm²
- 2D focusing up to 20×0.2 mm²

Substrate:

- Si, SiO₂

Coatings:

- thin films W, Al, Au etc
- substrate etching



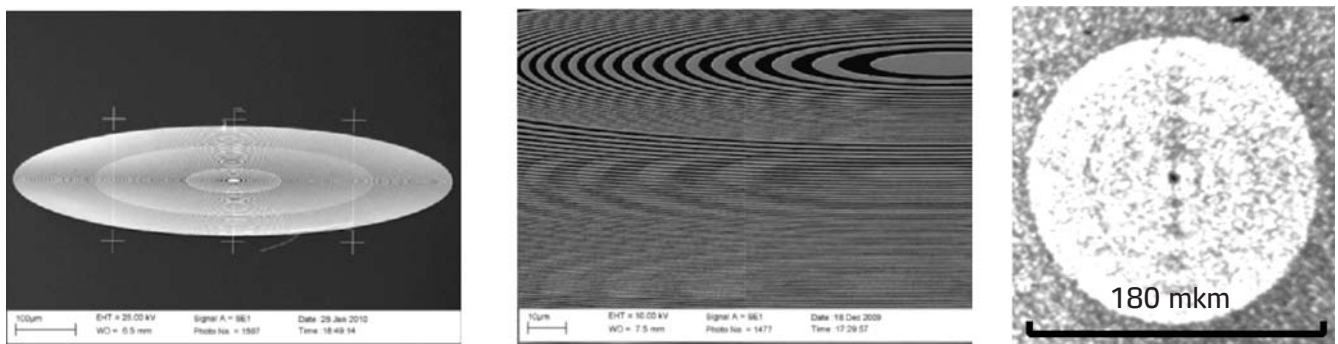
Central and outermost zones of grazing incidence zone plate

X-ray focusing by grazing
incidence zone plate on laboratory
x-ray source

Bragg-Fresnel lenses
Groove height up to 200 nm
Last zone size 0.1 μm

Substrate:

- single crystal Si
- multilayer mirrors W/Si, Mo/Be, Cr/Sc etc.
- thin films W, Al, Au etc.
- substrate etching



Full view and central zones of Bragg-Fresnel lens

X-ray focusing
by Bragg-Fresnel lens

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