

# X-ray optics

# X-ray diffraction gratings

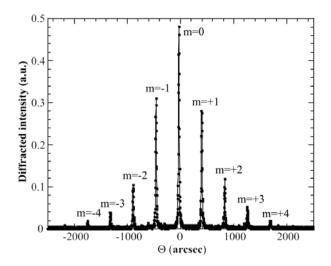
Rectangular grooves with period from 0.5  $\mu m$  Groove height up to 200 nm Grating size up to 20×20 mm2

# Substrate:

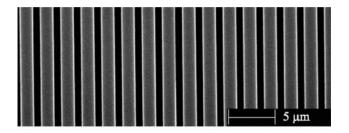
• Si, SiO

### Coatings:

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



# Multilayer diffraction grating



period D=2  $\mu$ m

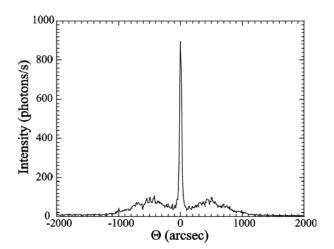
50 W/Si bilayers (d=50 Å)

# Multilayer diffraction grating with random position of grating grooves



period D=2  $\mu$ m

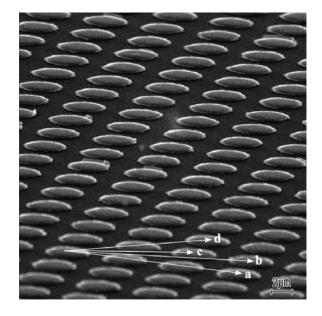
50 W/Si bilayers (d=50 Å)

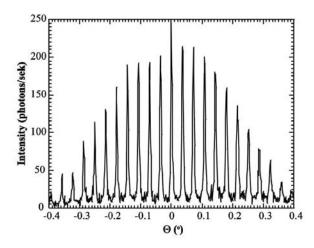


# 上海昊量光电设备有限公司 中国区代理

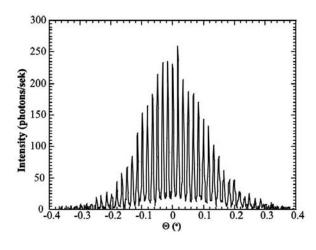
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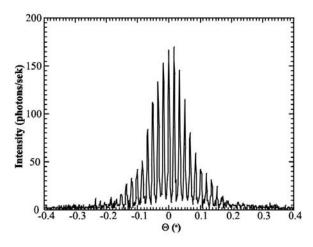
# 2D grating with round reflecting multilayer elements



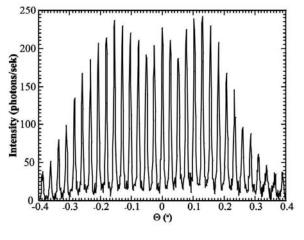


a: d=6 mm, δΘ=0.036°



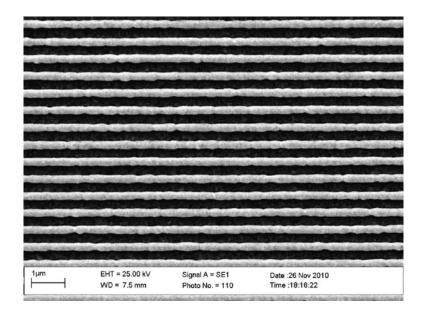


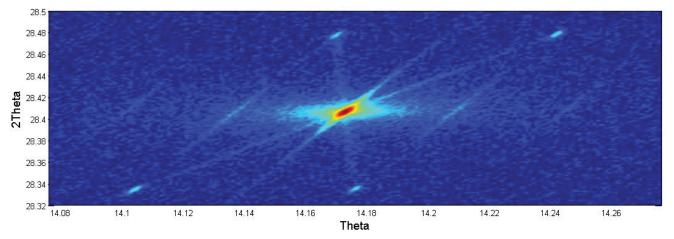
b: d=18.9 mm, δΘ=0.012º



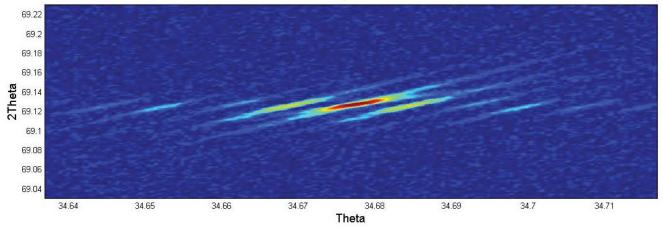
d: d=8.5 mm, δΘ=0.025°

# 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:

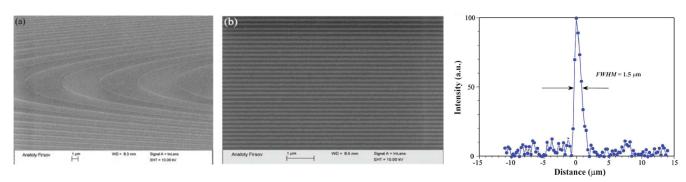
- 1D focusing up to 50×50 mm<sup>2</sup>
- 2D focusing up to 20×0.2 mm<sup>2</sup>

# Substrate:

• Si, SiO<sub>2</sub>

# Coatings:

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



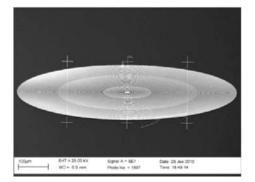
Central and outermost zones of grazing incidence zone plate

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

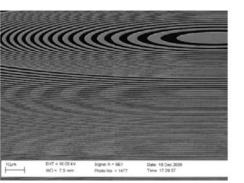
Bragg-Fresnel lenses Groove height up to 200 nm Last zone size 0.1 µm

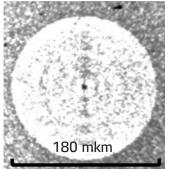
#### Substrate:

- 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