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At-wavelength reflectometry with the EUV tube

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Description of the EUV tube

Principle of the EUV tube

- electron bombardment of solid targets
- characteristic emission in the EUV range
- modified open (windowless) x-ray tube

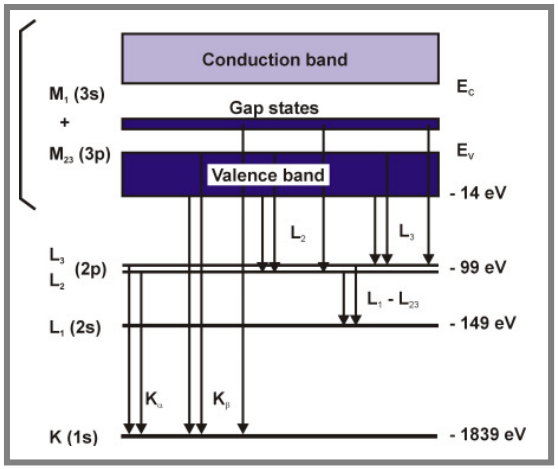
Advantages of the EUV tube

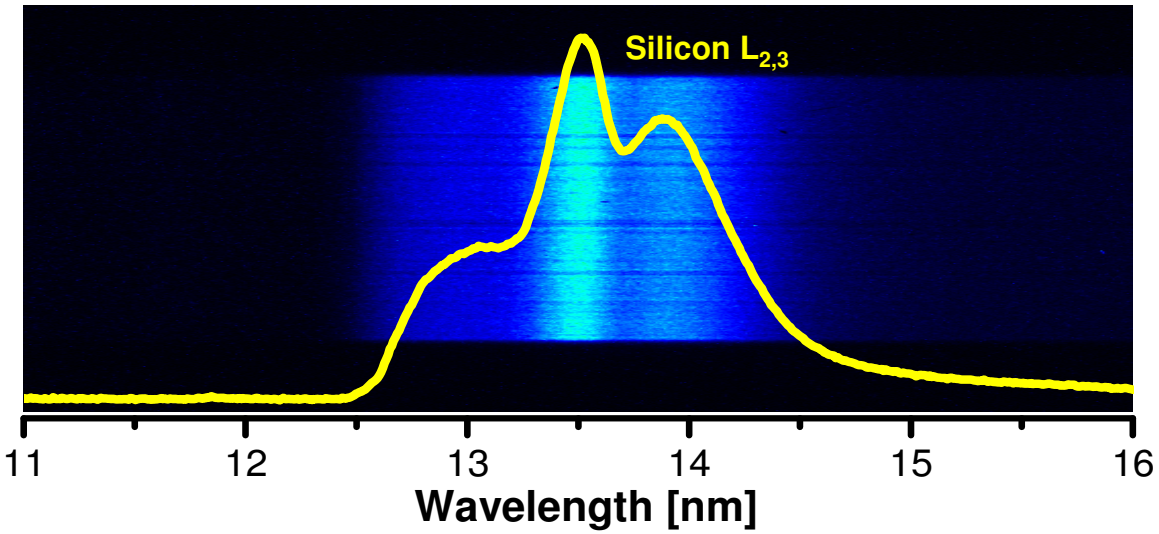
- compact setup, small footprint, simple operation
- clean debris-free source (no plasma)
- low cost-of-ownership
- automatic system start-up / source conditioning
- open tube design, variable emission wavelength
- excellent long-term temporal and spatial stability
- computer-controlled power and source size

Silicon EUV emission

Spectral properties (silicon targets)

- EUV emission by silicon L-shell radiation ($L_{2,3}$)
- spectral maximum at 13.5 nm
- emission band from 12.5 nm to 15 nm (~ 16 eV)
- very smooth spectrum, excellent spectral stability
- ideal for Mo/Si mirror metrology
- only out-of-band radiation: Si K (1.74 keV)

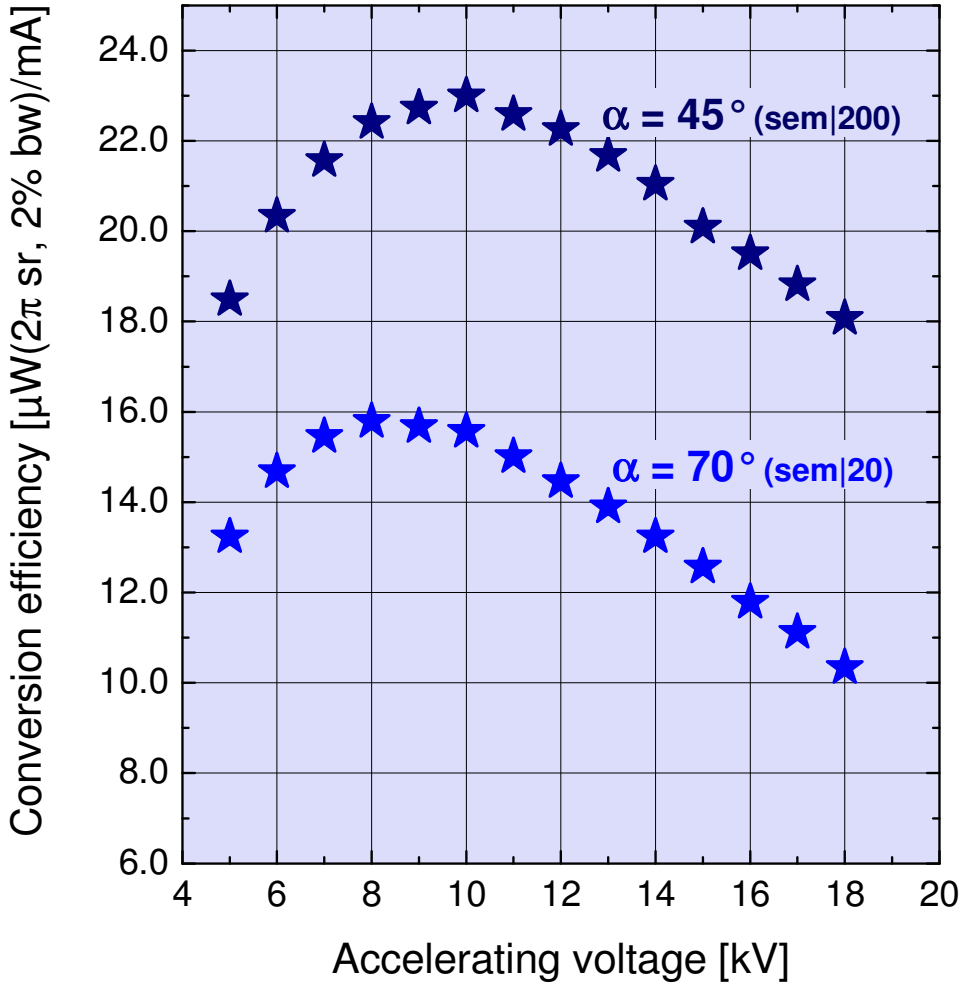




Various other target materials available to generate:

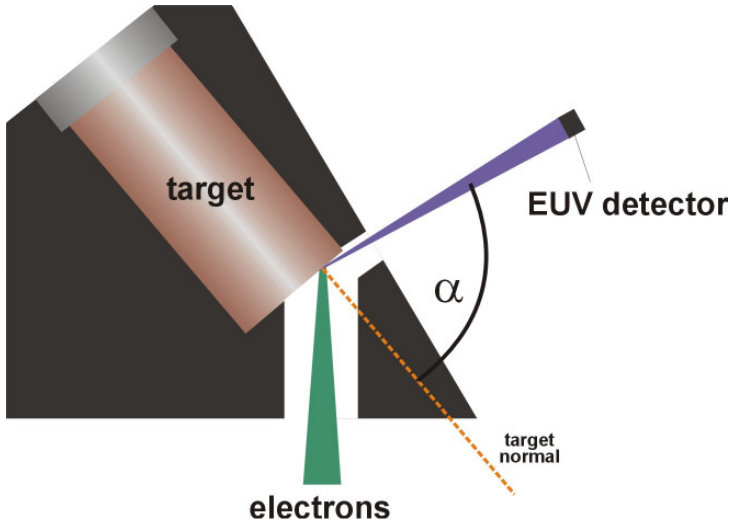
- EUV radiation
- soft-x-rays
- “water-window” radiation
- hard-x-rays

In-band EUV conversion



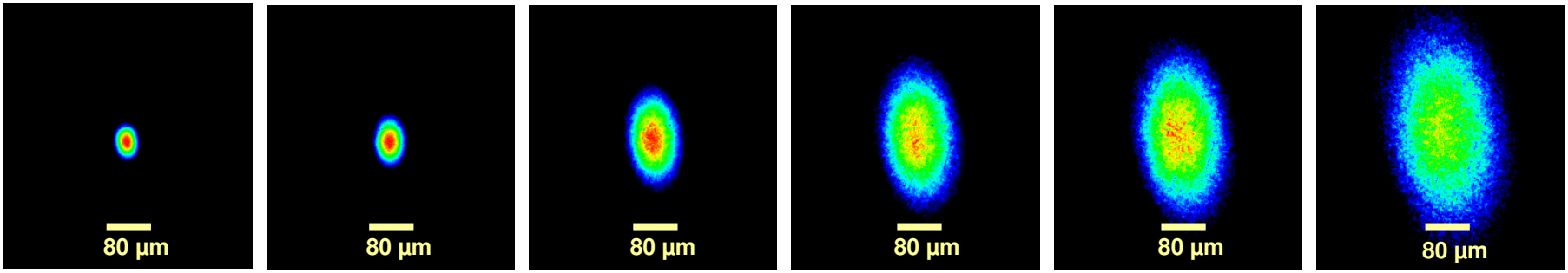
EUV conversion efficiency

- optimum high-voltage: 8 – 12 kV
- α = 45°: **23 µW/mA** (2π sr, 2% bw)
- α = 70°: **16 µW/mA** (2π sr, 2% bw)



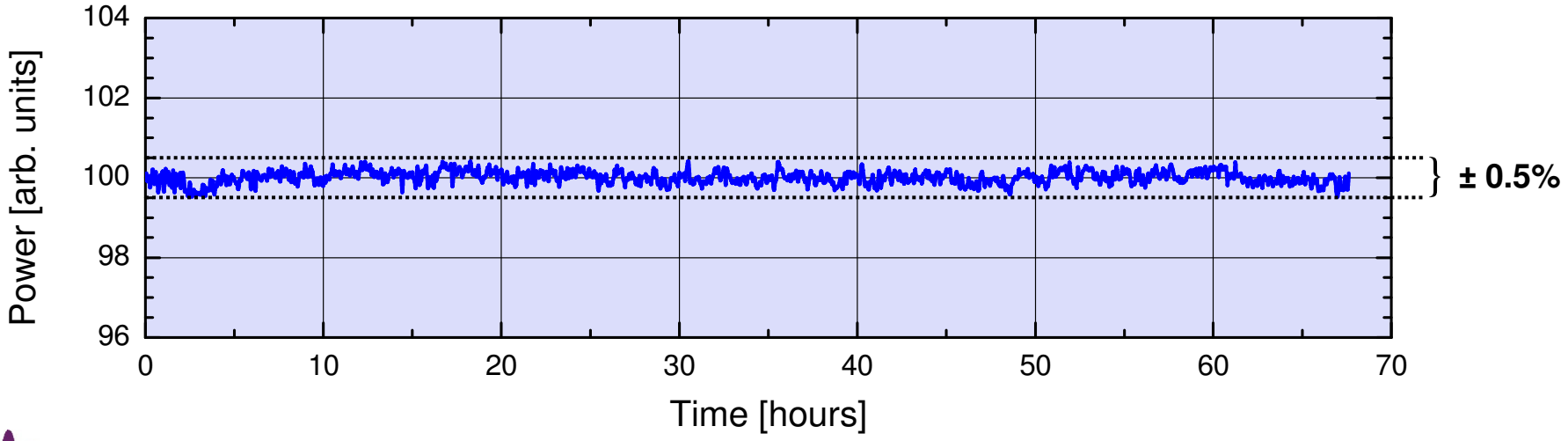
Source size and stability

Source size (pinhole images)



accelerating voltage: 10 kV, target current: 500 µA (constant EUV power)

EUV power stability



Technical specifications

sem|20 EUV tube (microfocus / brightness optimized)

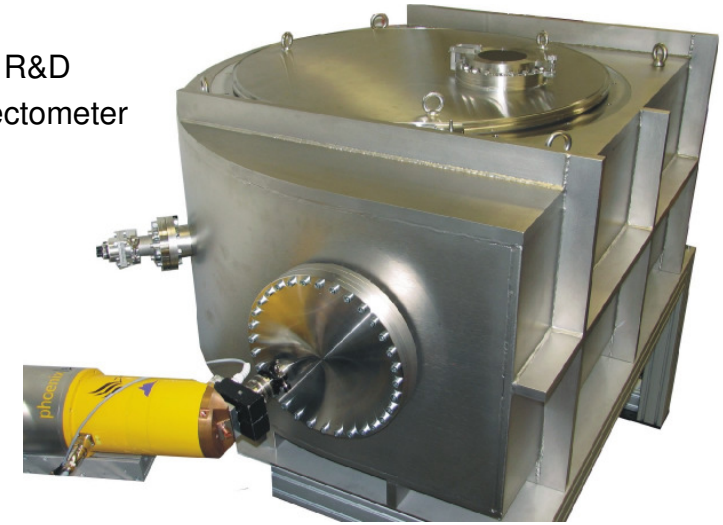
- high-voltage range: 5 kV – 20 kV
- max. target current (10 kV): 1.5 mA
- EUV source diameter: 20 µm – 300 µm (FWHM)
- target material: silicon (others on request)
- spectral emission band: 12.5 nm – 15 nm
- EUV emission maximum: 13.5 nm
- in-band EUV power: >20 µW (2π sr, 2% bw)
- total EUV power: >80 µW (2π sr)
- long-term power stability: <±0.5%

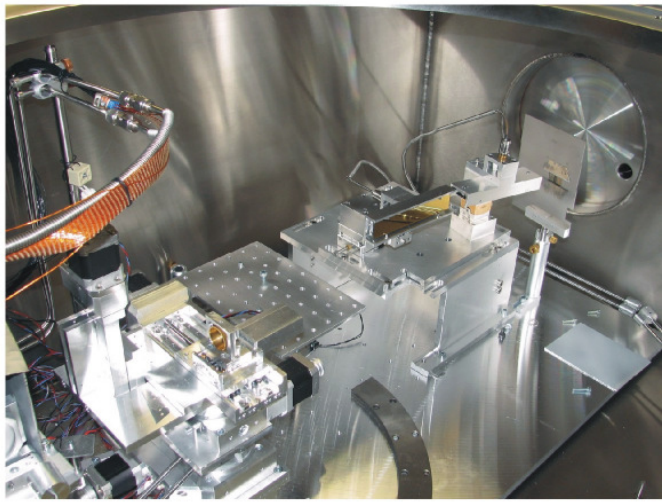
sem|200 EUV tube (minifocus / flux optimized)

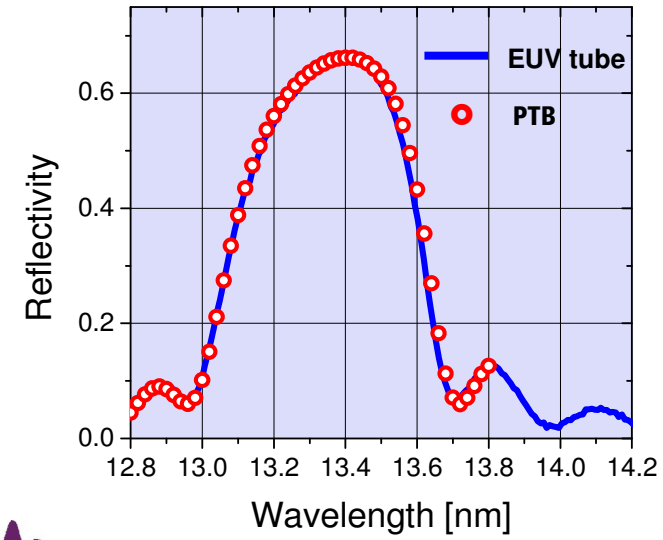
- max. target current (10 kV): 15 mA
- EUV source diameter: 200 µm – 1000 µm (FWHM)
- in-band EUV power: >300 µW (2π sr, 2% bw)
- total EUV power: >1200 µW (2π sr)

Compact EUV reflectometer I

Compact R&D
EUV reflectometer





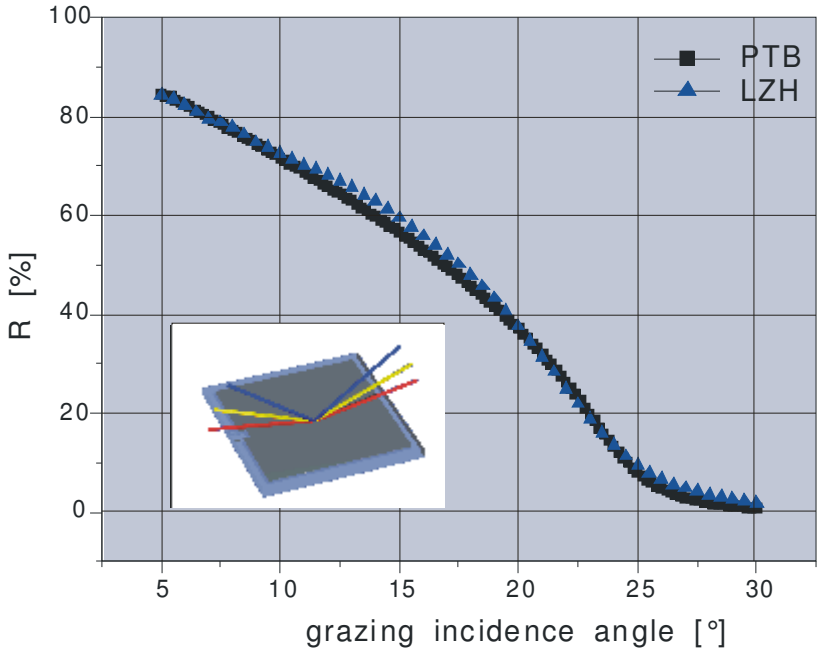


- compact devices for in-house EUV reflectometry
- characterization of multilayer optics, filters, etc.
- solutions for plane or curved mirror substrates

In co-operation with AIXUV EUV-Technology

Compact EUV reflectometer II

Compact grazing-incidence
EUV reflectometer



- compact reflectometer for the characterization of grazing incidence optics
- angle/surface scans, plane/curved samples

In co-operation with

Further information

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