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SCHOOL ON THE USE OF SYNCHROTRON RADIATION IN SCIENCE AND TECHNOLOGY:
"John Fuggle Memorial"

3 November - 5 December 1997

Miramare - Trieste, Italy

Additional notes to

X-ray Microfabrication with Synchrotron Radiation

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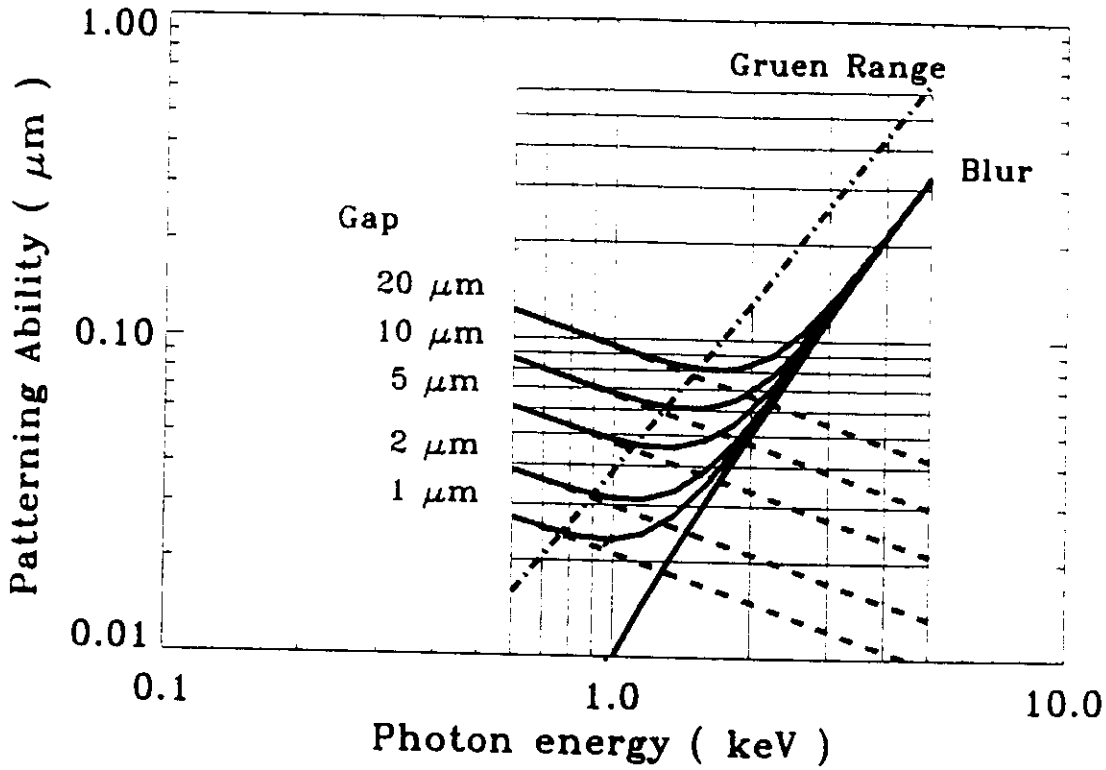
X-ray resists

Desirable properties

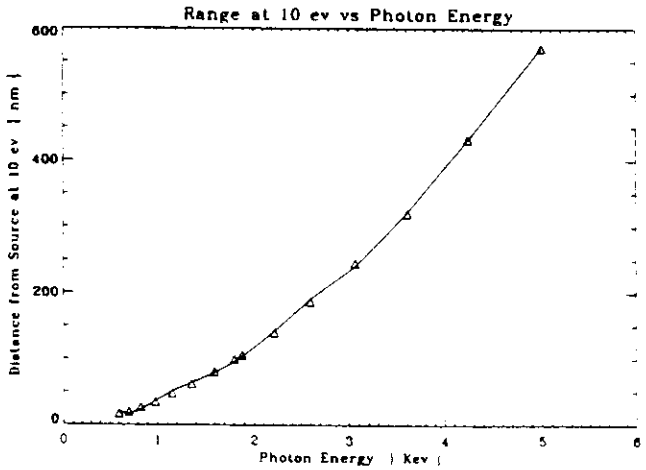
- high sensitivity to X-ray radiation of selected wavelength
- high contrast
  - high difference in dissolution rate between masked and unmasked region during development
- high resolution
- good thermal stability
- good resistance to etching agents
- compatibility with chemical bath

Exposure

- by phoelectrons (photoelectric X-ray absorption)
- e-beam resist can be used in X-ray resist
- sensitivity: energy absorbed per unit area (J/cm^2)
- dissolution rate of resist in developer : absorbed per unit volume (J/cm^3)
  - depends on X-ray absorption
  - for weak absorption: incident energy flux (J/cm^2) x X-ray linear absorption coefficient (cm^{-1})



'igure 3.18: XRL patterning ability, for an optimized mask and exposure system. 'he diffraction is computed for $F = 0.7$, and the photoelectron range is that shown ı Fig. 3.15. Fresnel number quantifying the diffraction process: $F = \frac{W^2}{\lambda g}$



Proximity effect (photoelectron diffusion/scattering)

Figure 3.15: Range to a final energy of 10 eV as a function of photon energy.

CKM 2.25

(Cerrina, XRL)

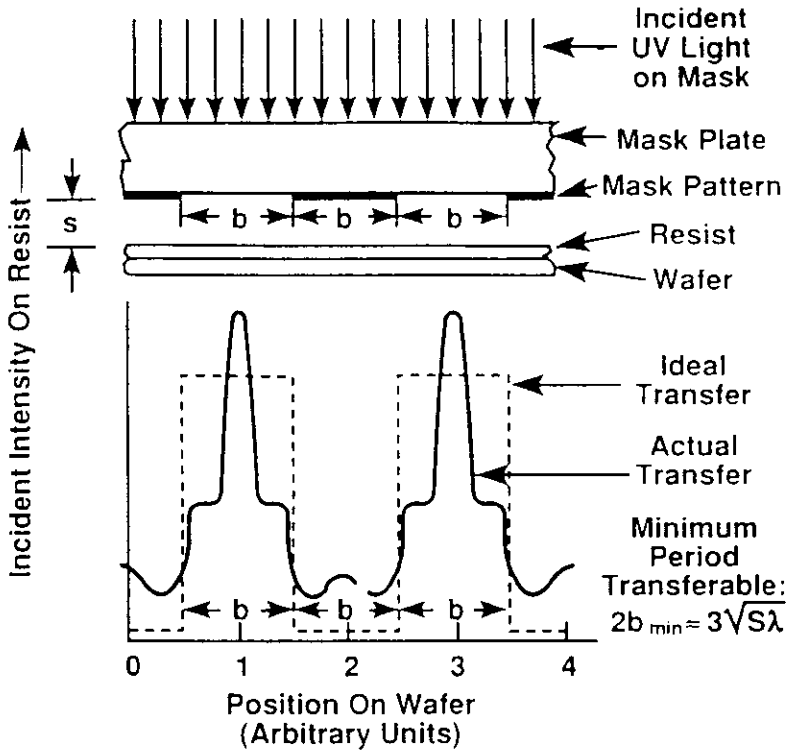


Figure 3. Intensity profiles of line and space pattern at the photoresist surface defined by contact printing (dotted line) and proximity printing (solid line).

Theoretical resolution capability of shadow printing for a conventional photoresist and a mask consisting of equal lines and spaces of width b

$$2b_{min} = 3\{\lambda[s + (1/2)z]\}^{1/2}$$

2b grating period

[1/2b is the fundamental spatial frequency (ν) of the mask]

s gap between mask and the photoresist surface

λ wavelength of the exposing radiation

z photoresist thickness

Diffraction in proximity (contact/shadow) printing : Fresnel near-field approximation.