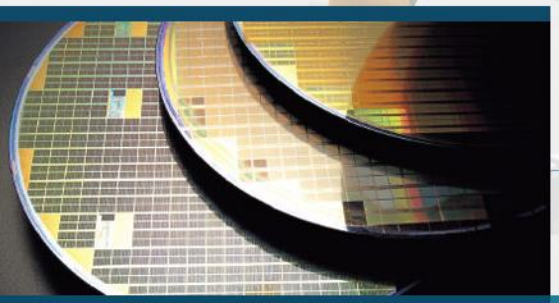
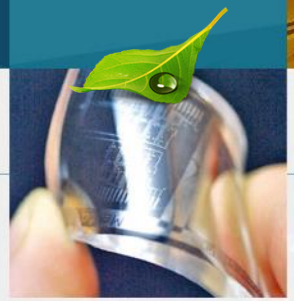
High-Throughput Nanomanufacturing using EUV Lithography

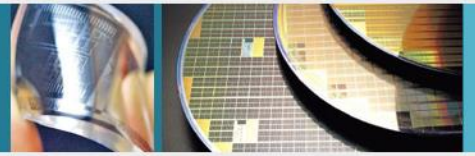


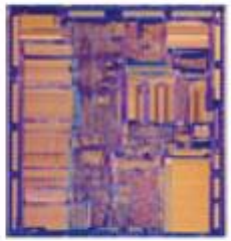



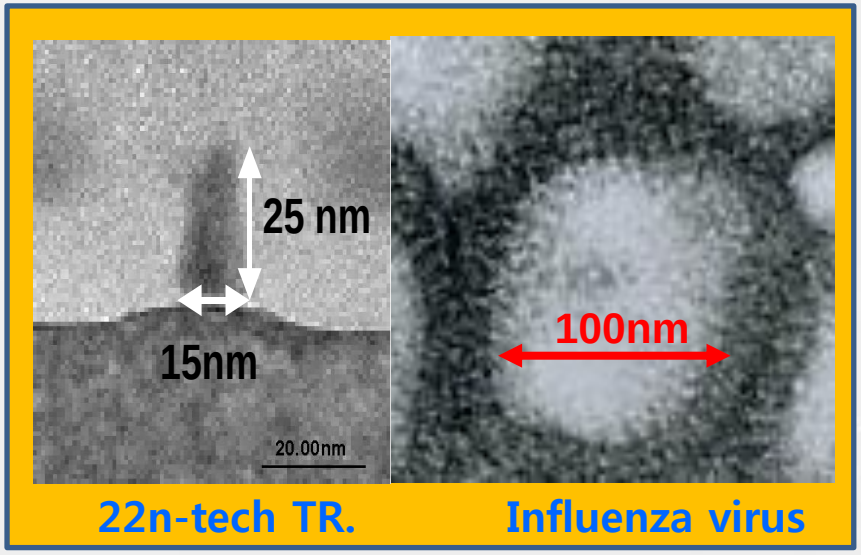
Prof. Jinho Ahn
Division of Materials Science & Engineering
Hanyang University

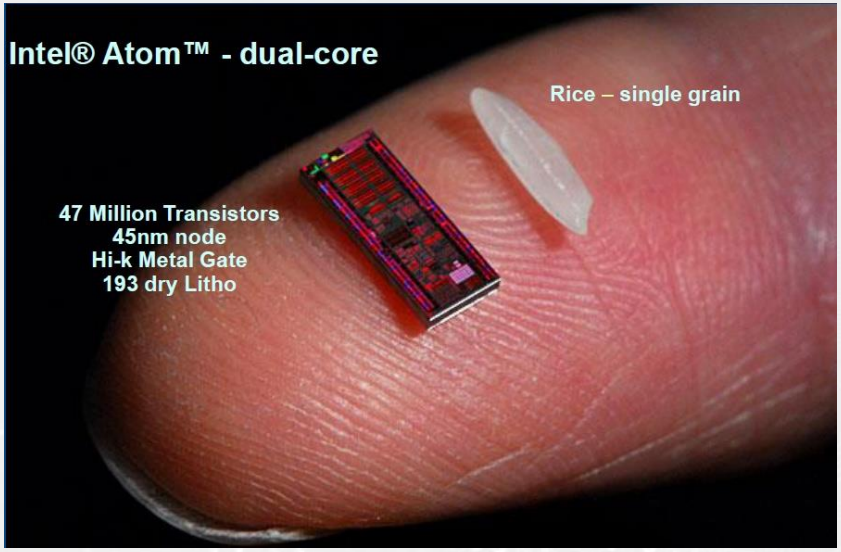
September 29, 2014

Integrated Device

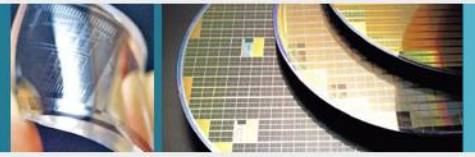


1950s	1960s	1970s	1980s	1990s	2000s
Silicon Transistor	TTL Quad Gate	8-bit Microprocessor	32-bit Microprocessor	32-bit Microprocessor	64-bit Microprocessor
					
1 Transistor	16 Transistors	4500 Transistors	275,000 Transistors	3,100,000 Transistors	592,000,000 Transistors

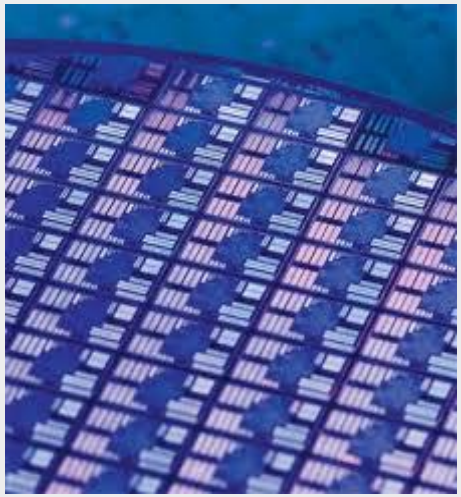


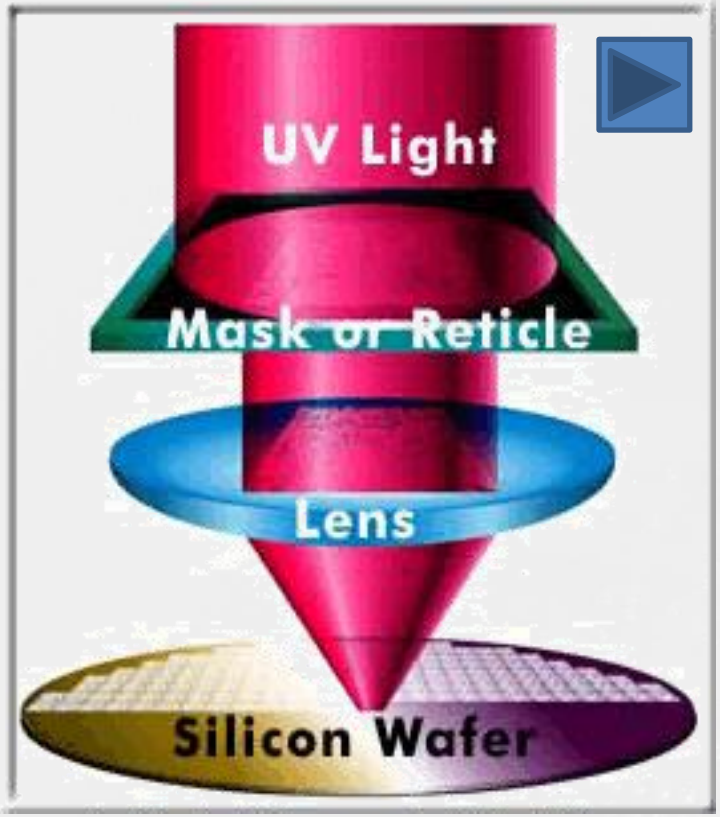


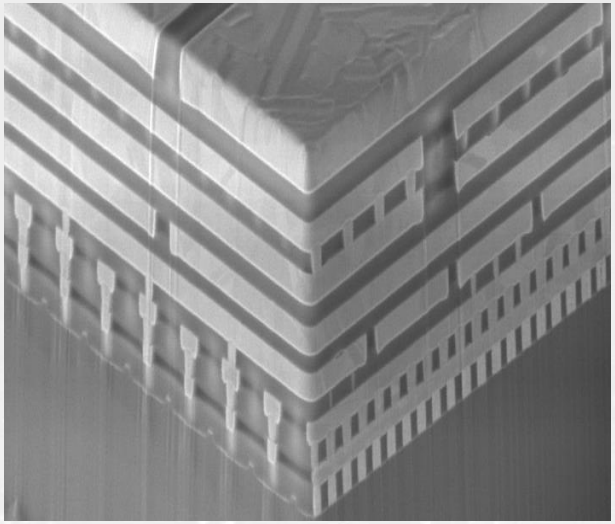
Lithography Technology



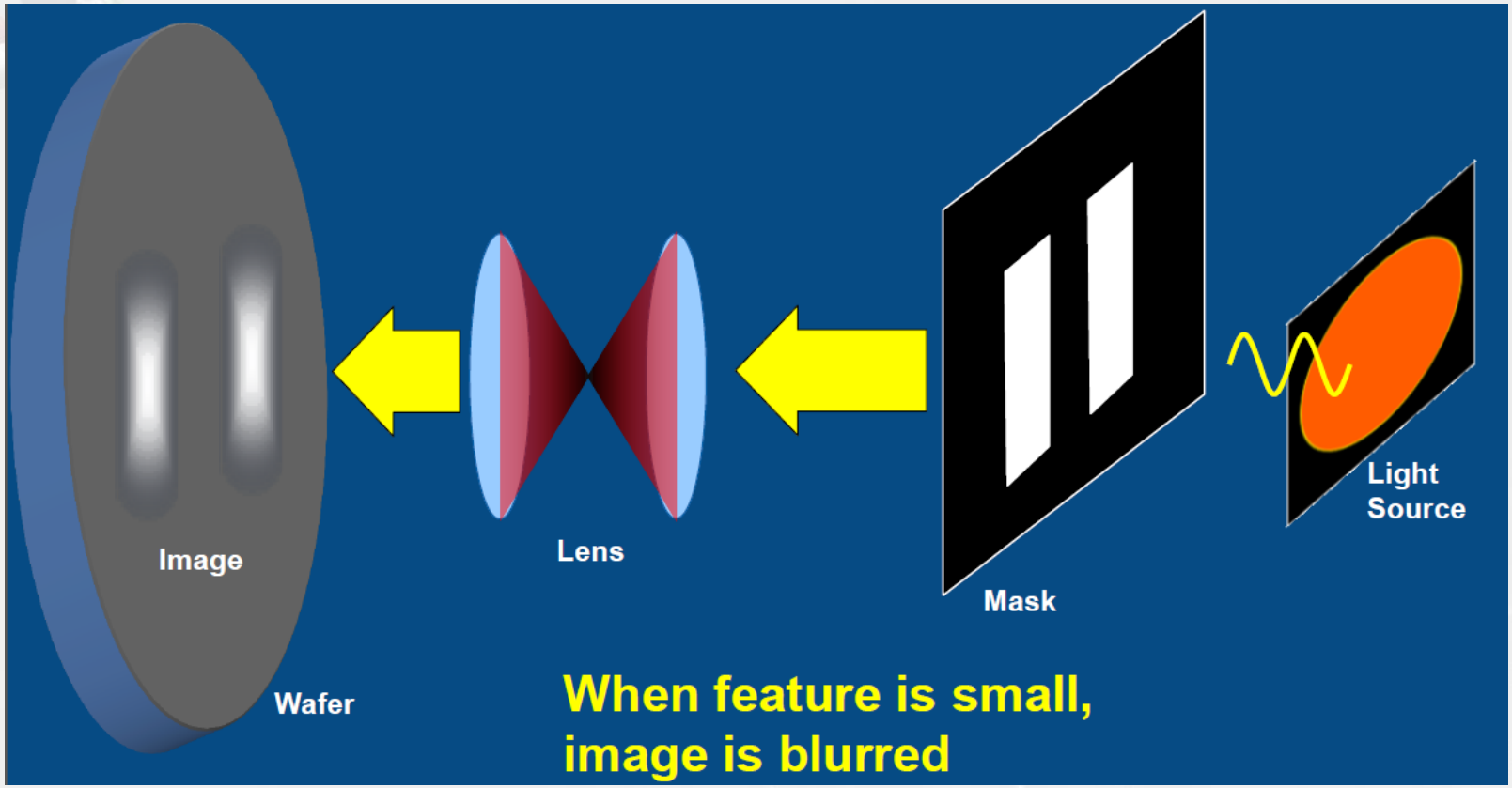
Lithography - Core Technology
for Device Shrinking & Integration



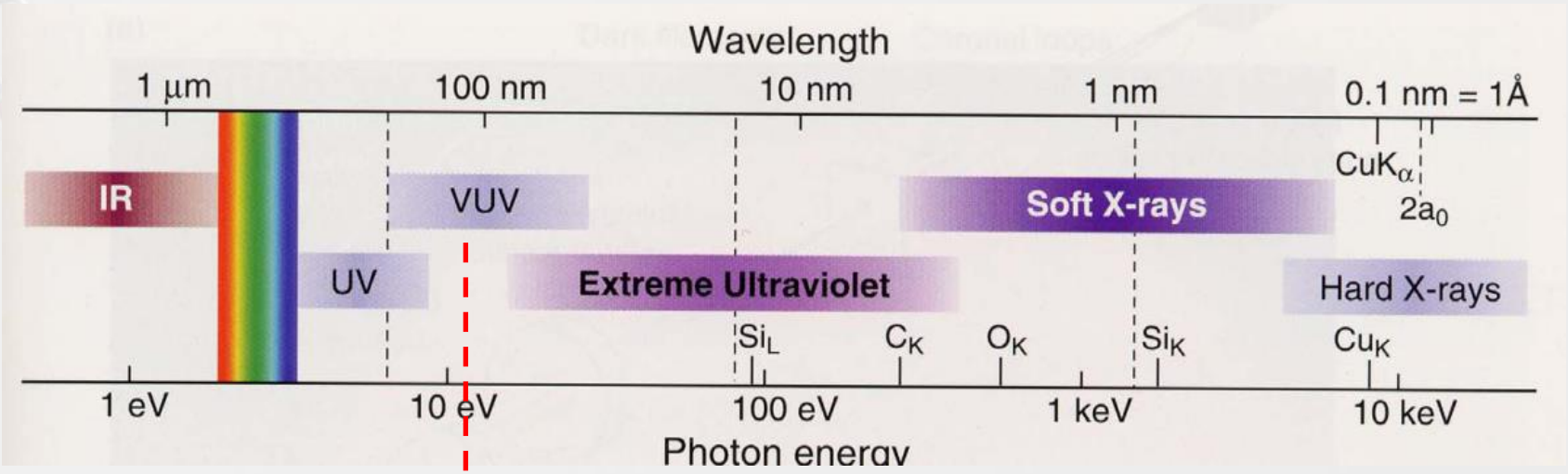


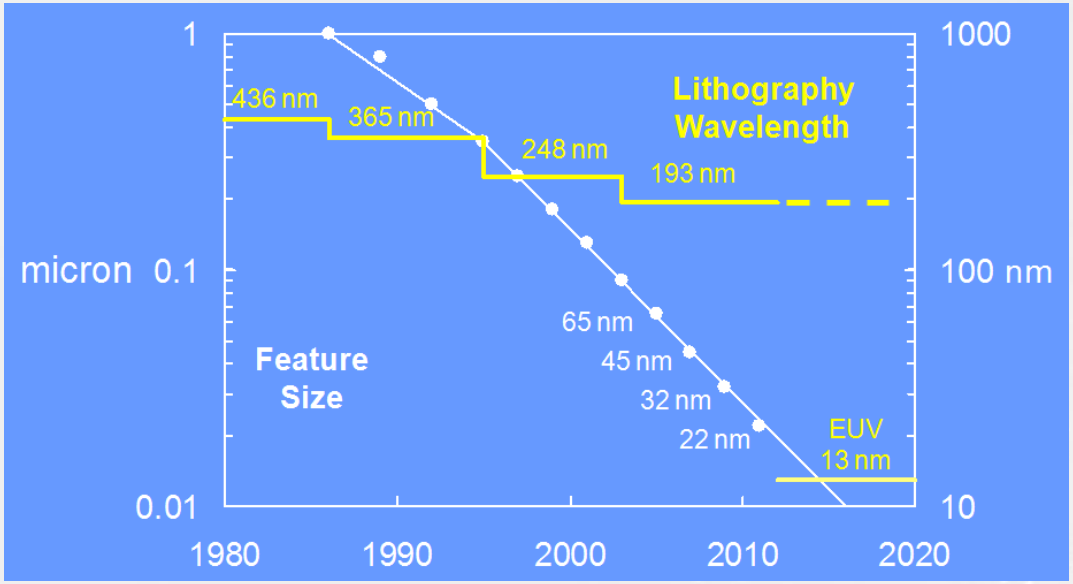


Resolution Limit depends on wavelength



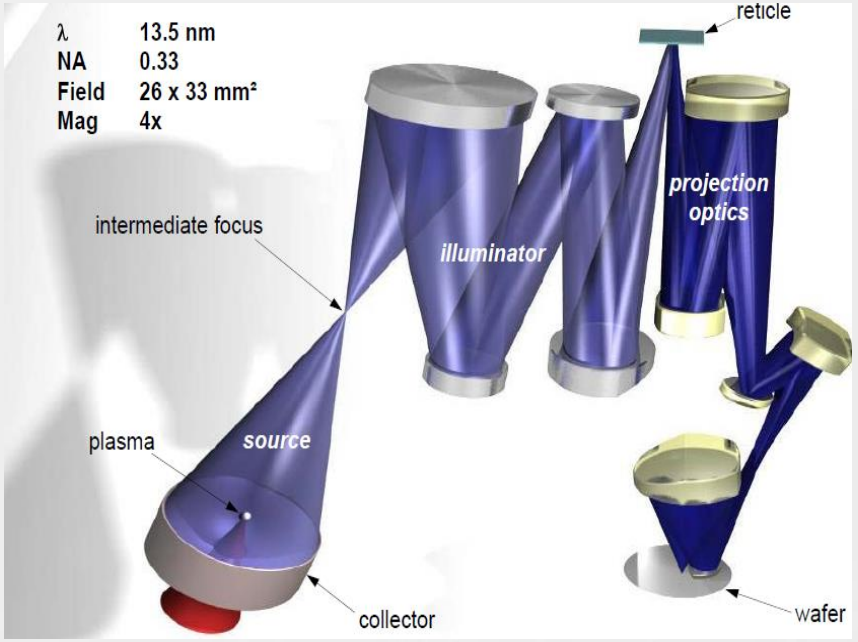
Light Source for Lithography





Extreme UV (EUV) Lithography

$$\text{Resolution} = k1\frac{\lambda}{NA}$$

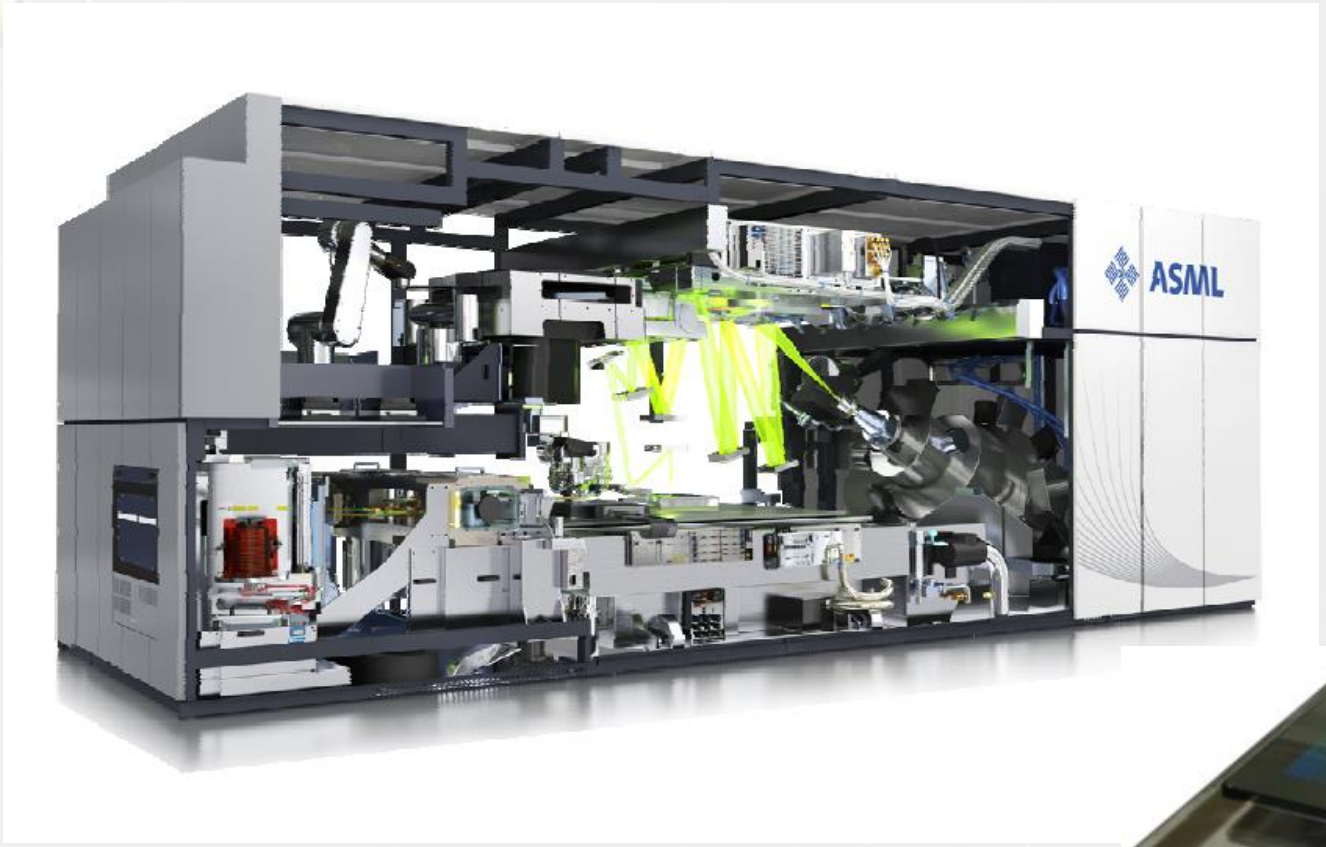


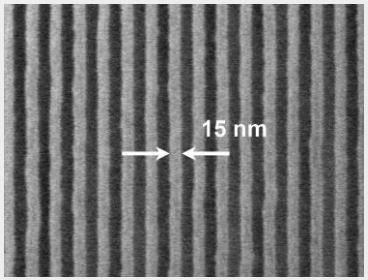
λ : 193nm → 13.5 nm

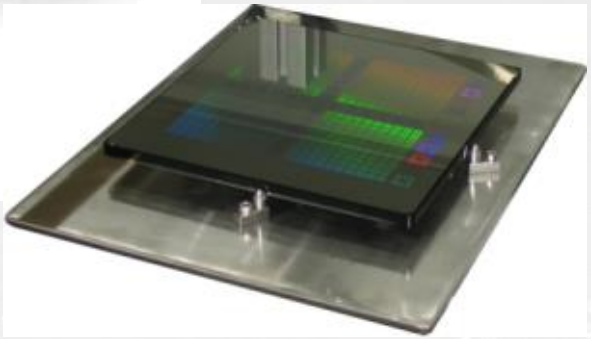
K1=0.25
32nm hp @ArF Immersion

K1=0.59
32nm hp @EUVL NA0.25

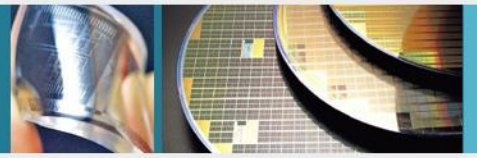
EUV Stepper and EUV Mask

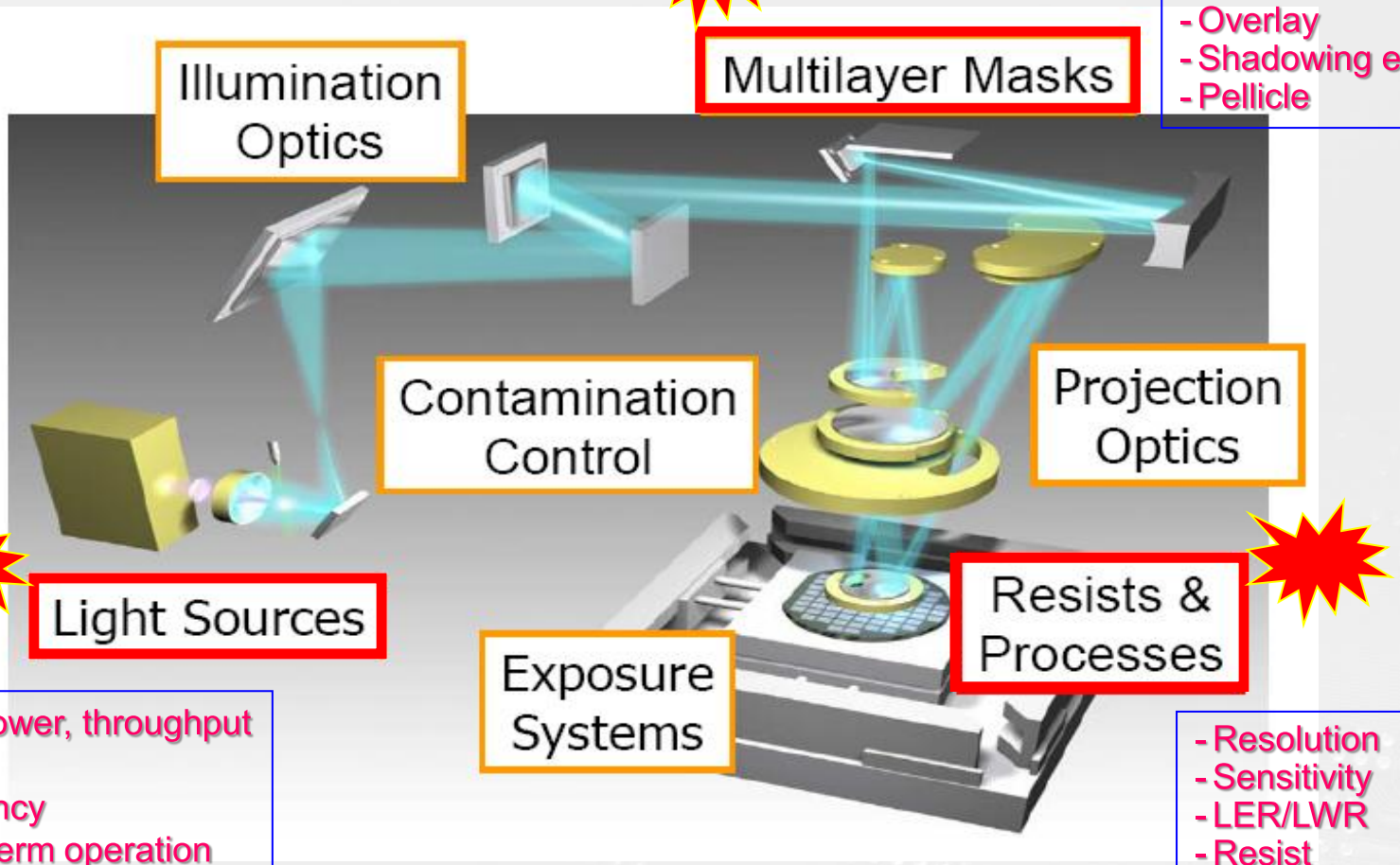






Element Technology & Issues





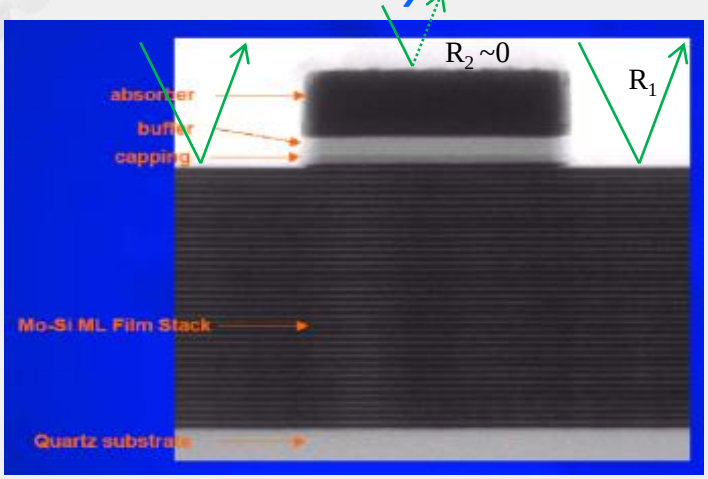
- Mask blank defect
- Inspection & review infrastructure
- Overlay
- Shadowing effects
- Pellicle

- Low power, throughput
- Debris
- Efficiency
- Long-term operation

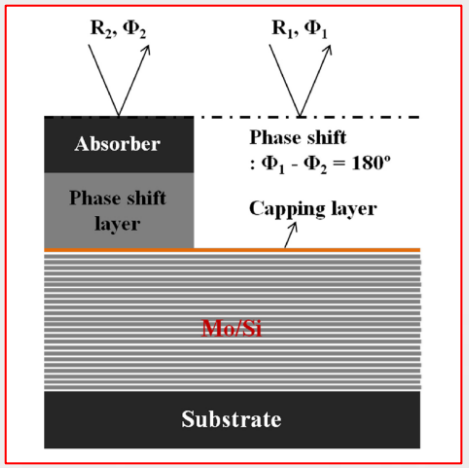
- Resolution
- Sensitivity
- LER/LWR
- Resist collapse

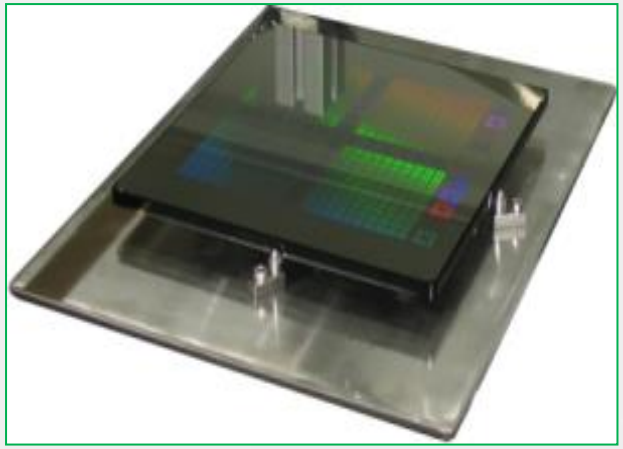
Our Work : EUV Phase Shift Mask

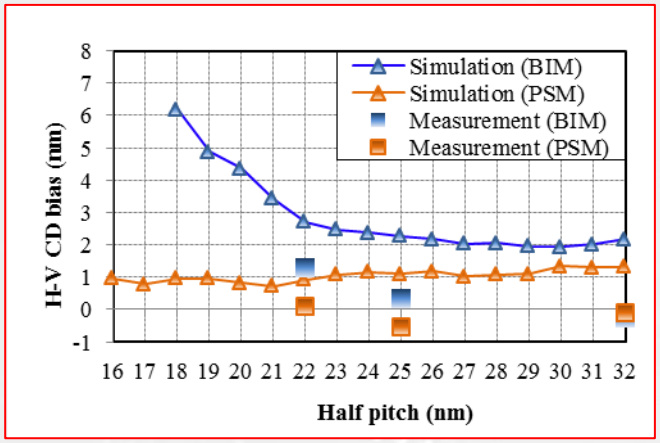
Gen. 1: Binary Mask

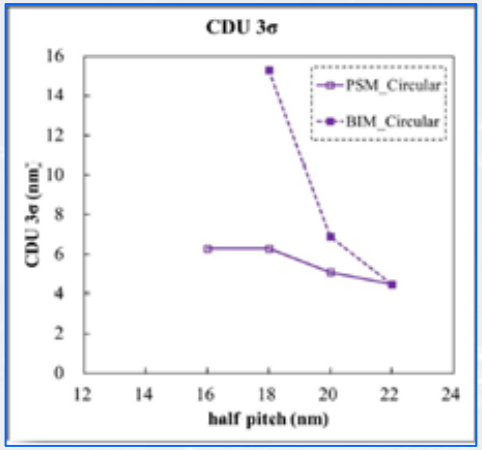


Gen. 2: Phase Shift Mask



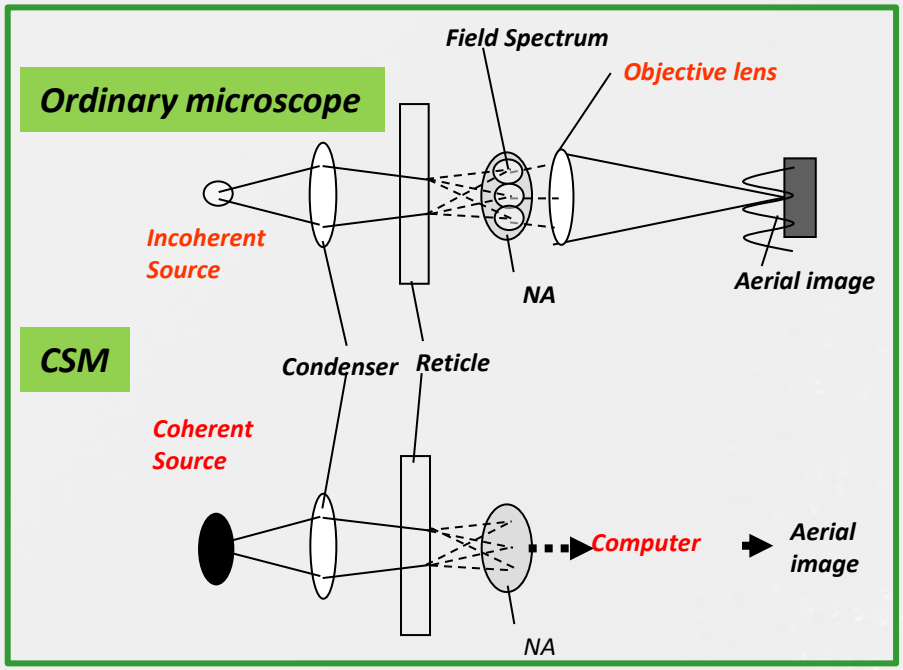


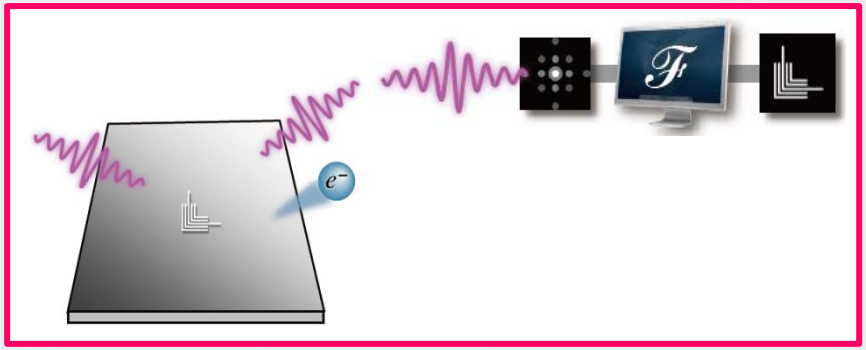


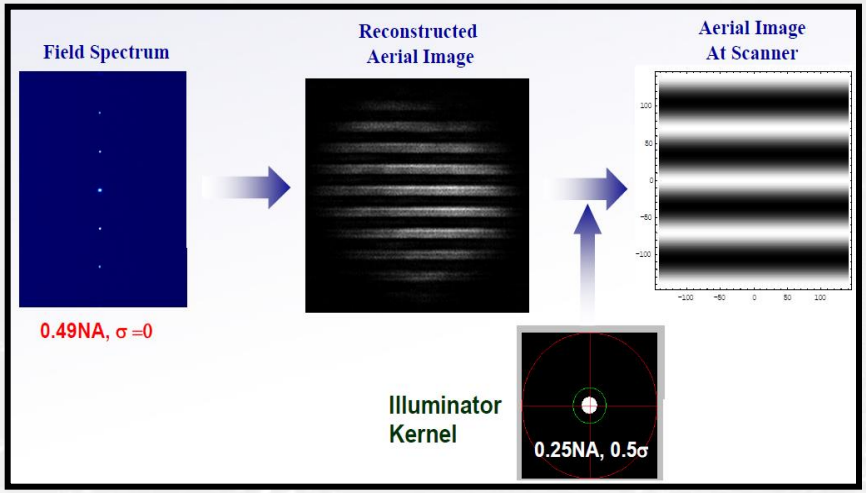


Our Work : New EUV Microscope

Coherent Scattering Microscope: Lensless Computational Microscope

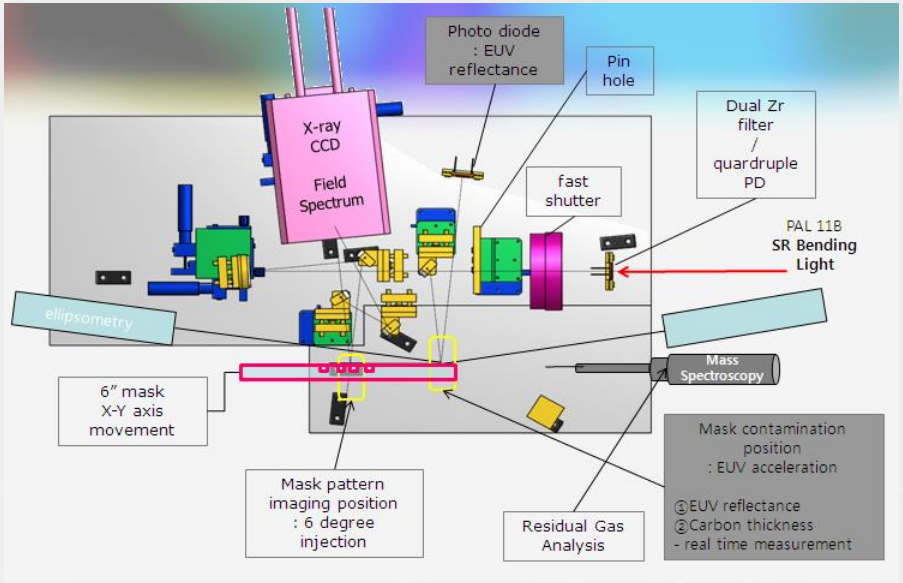


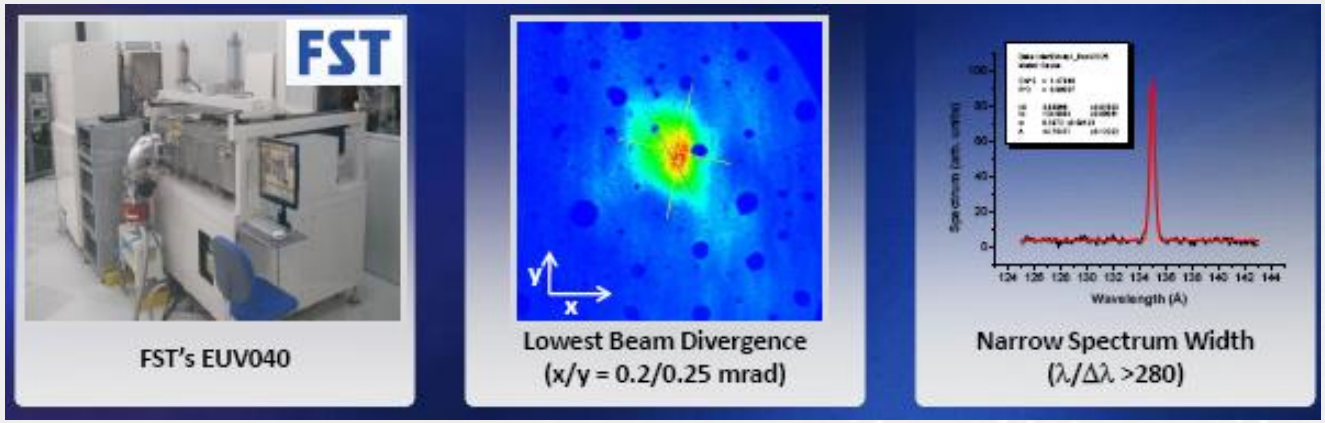




Our Original CSM

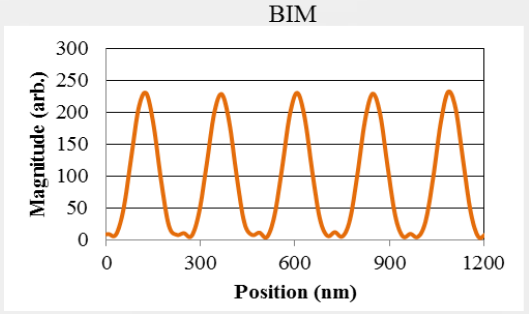
Collaboration with domestics partners

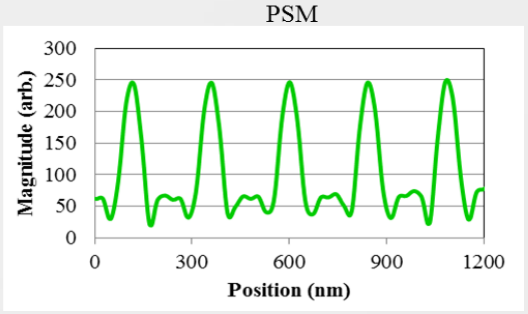


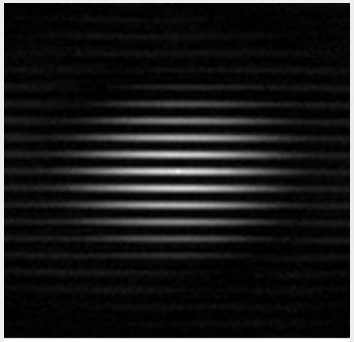


Mask Inspection with CSM

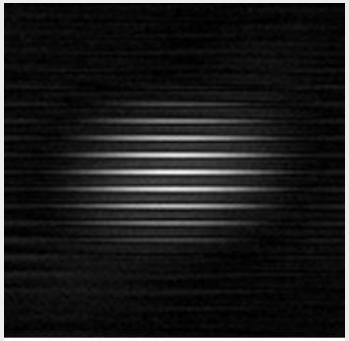
Coherent Scattering Microscopy



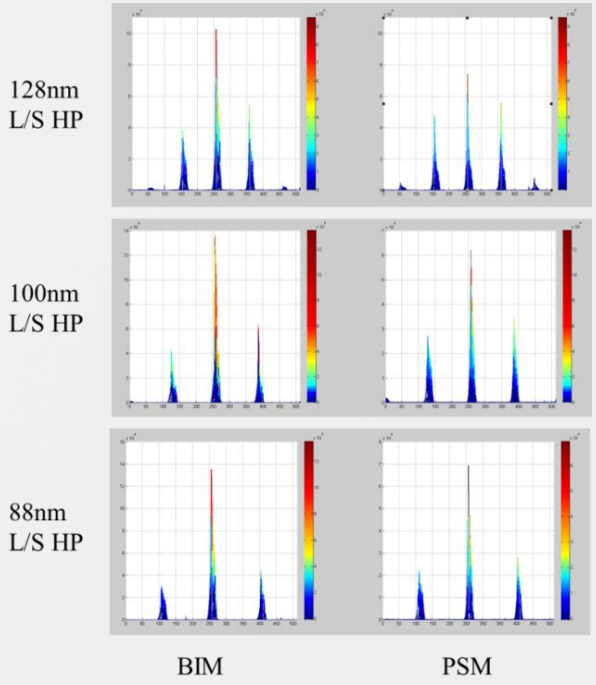


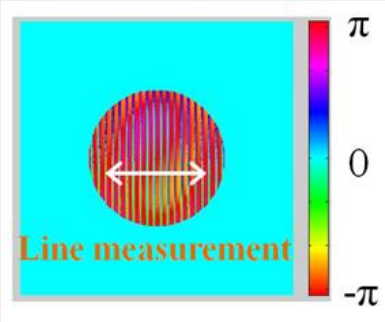


Binary

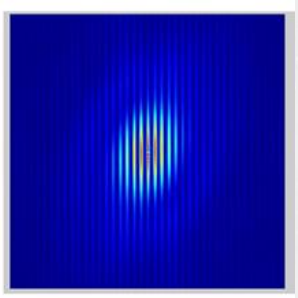


PSM

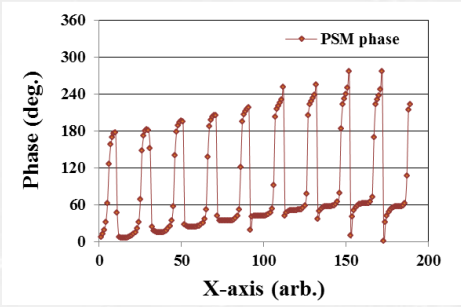




Phase map



Magnitude map



Phase profile

Inspection of fabricated EUV masks; binary intensity mask (BIM) and phase shift mask (PSM)


Thank you
for your attention
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