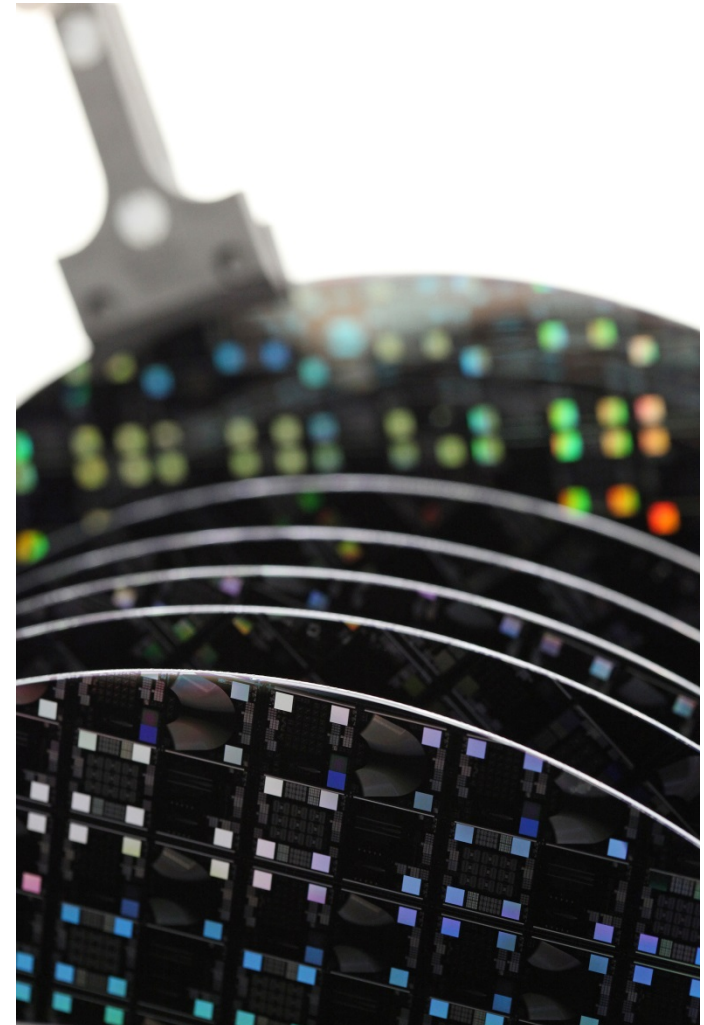


Lithography Tool Package

1. Introduction to Lithography

- from Ancient Greek λίθος, *lithos*, meaning "stone",
and γράφειν, *graphein*, meaning "to write".

Tine Greibe and Thomas Anhøj



Before we start

- Who am I?
- Who are you?
- Who are we?



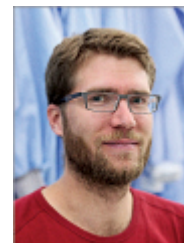
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Outline

1. Introduction

- Process steps in UV lithography

2. Spin coating

- Resist composition
- Pre-treatment
- Principle
- Softbake
- Spin curve

3. Exposure

- Hardware
- Process parameters
- Resolution
- Alignment

4. Development

- Principle
- Effects
- Resist tone, photo-chemistry, and contrast

5. Post-processing and characterization

- Post processing
- Characterization methods

6. Process effects and examples

- Process effects
- Real life process examples

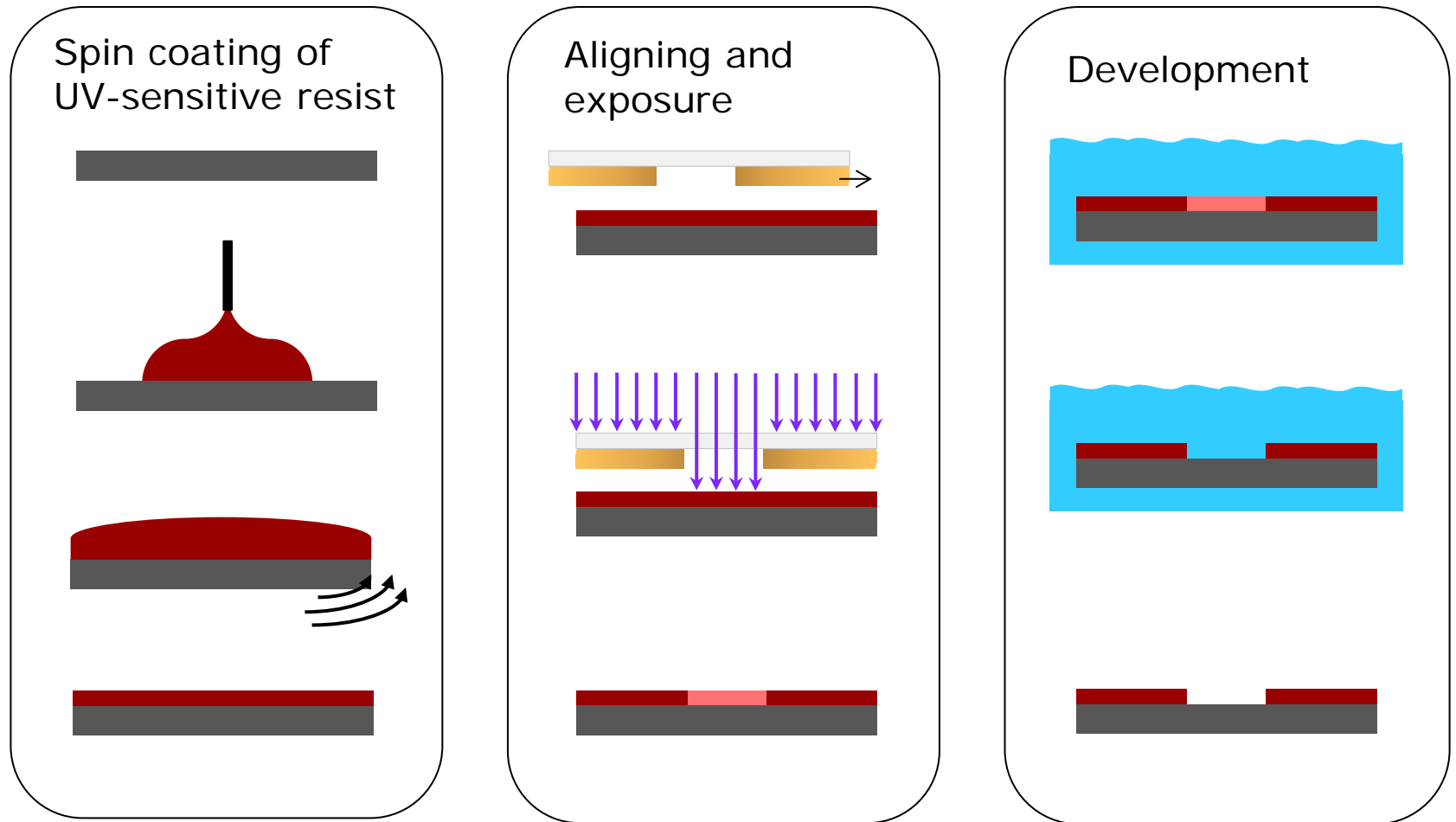


Lithography: methods

Technology	Exposure Source	Wavelength	Minimum Resolution [nm]
UV Contact Lithography	Hg vapor lamp	365 nm	1500
UV Projection Lithography	Hg vapor lamp	365 nm	800 – 350
Deep-UV Projection Lithography	KrF excimer laser	248 nm	250 – 90
Deep-UV Immersion Lithography	ArF excimer laser	193 nm	110 – 38
Extreme-UV Projection Lithography	IR Laser-produced Sn plasma EUV	13.5 nm	< 20
Electron Beam Lithography	Field-emission electron gun (100 keV)	3.9 pm	< 10

Available at DTU Danchip

UV lithography: process



UV lithography: equipment

- Coating:
 - 2 automatic spin coaters
 - 4 manual spin coaters
 - 1 spray coater
- Exposure:
 - 3 mask aligners
 - 1 UV flood exposure source
- Development:
 - 2 submersion developer benches
 - 1 automatic puddle developer
 - 1 manual spray/puddle developer
- Auxiliary:
 - HMDS priming ovens
 - Hotplates
 - Lift-off benches
 - Resist strip bench



Lithography: comparison

	UV Lithography	DUV Stepper Lithography	E-beam Lithography
Minimum Resolution	~1.5 μm	~220 nm	~10 nm
Process time (4" wafer)	<ul style="list-style-type: none"> ~2 min load and unload ~10 s per exposure 	<ul style="list-style-type: none"> ~10 min load and unload ~1 s per field exposure 	<ul style="list-style-type: none"> ~1 h of machine calibration + substrate load and unload A pattern area of 1 cm^2 takes ~8 h to expose with a beam current of 10 nA and a dose of 300 $\mu\text{C}/\text{cm}^2$
Throughput (4" wafer)	~25 wafer/hour	≥ 6 wafer/hour (much higher for 6")	0.1 - 3 wafer/hour
Training	Lithography TPT + separate trainings	Processed by DTU Danchip	Only available for Ph.D. students and up