ME363 Lab#9: Microfabrication I

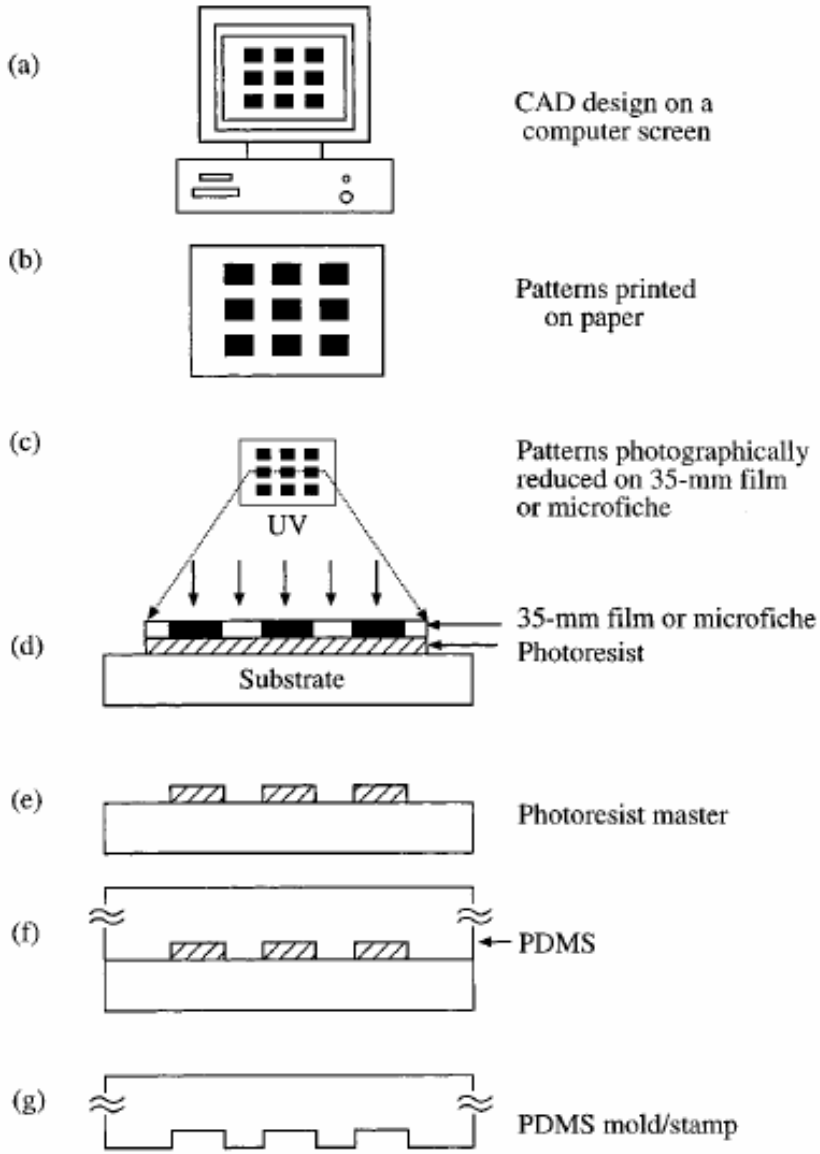
Soft Lithography Part I: Photographic Mask-Making

- When: Nov. 2-3
  2:30-5:30 pm
- Where: ME32

Clean room rules
- Long pants
- Closed-toe shoes
- No chewing gum

Soft Lithography at MMC

MMC Lab Module for Soft Lithography

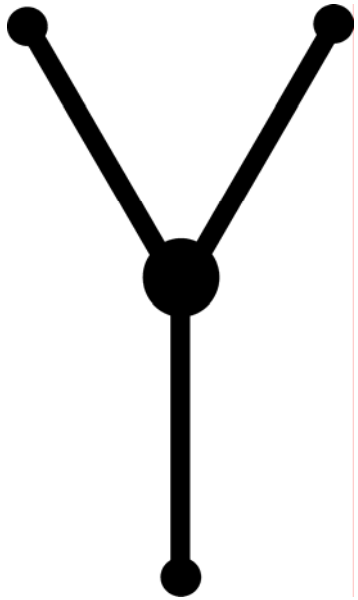


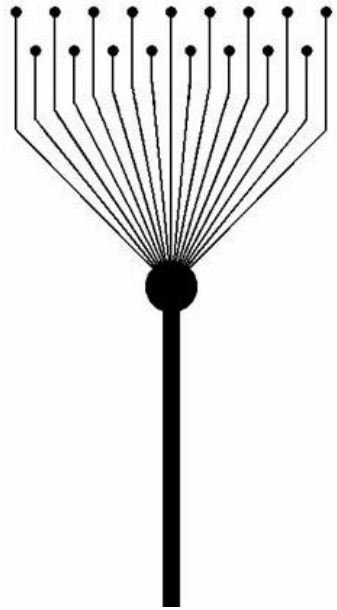
ME363 Lab#9: Procedures

Photomasks Making

To design and make a photographic mask

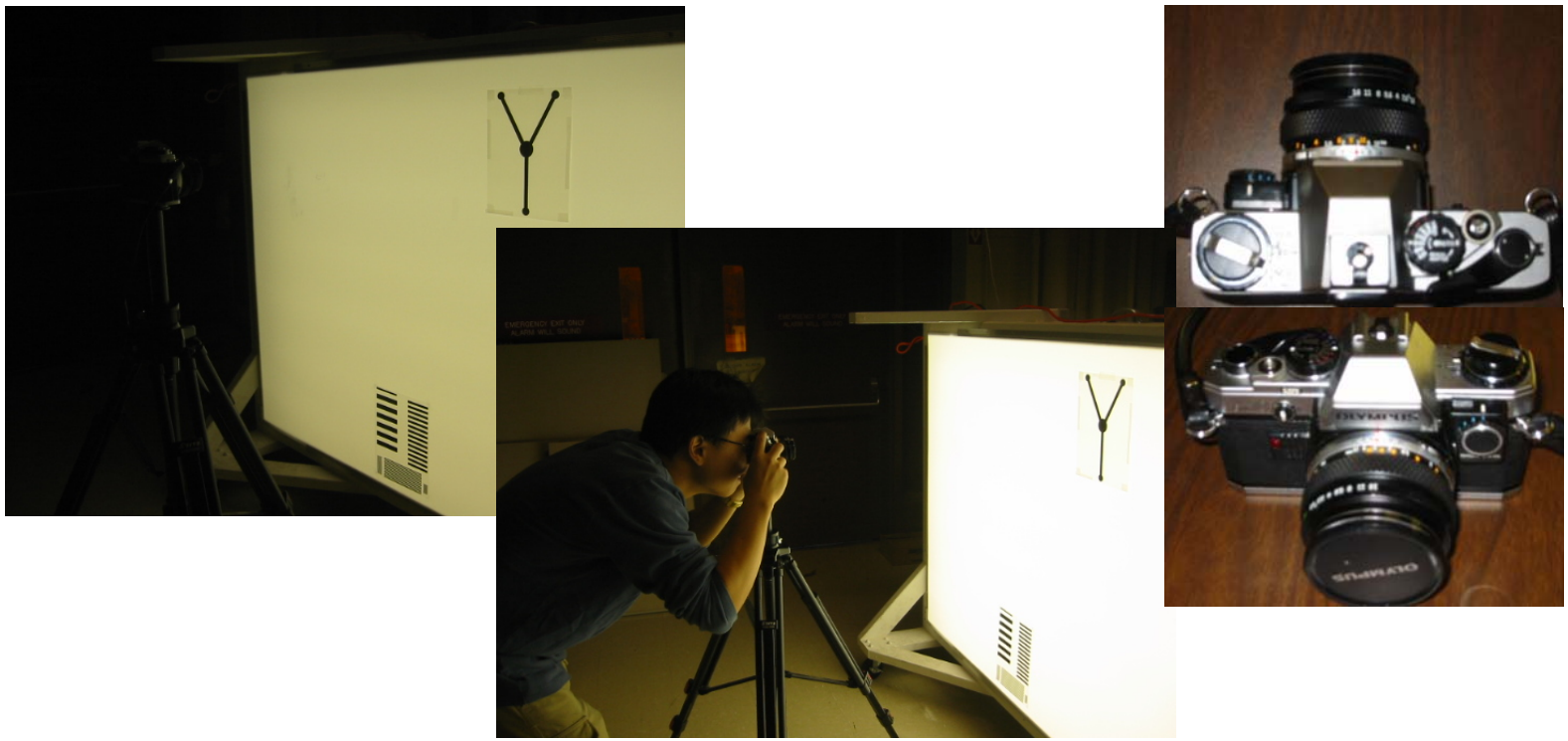
- Design any pattern
  - Any image software
  - AutoCAD
  - Adobe illustrator
- Print pattern onto transparency





ME363 Lab#9: Procedures

- Mount the transparency film onto the lightbox in ME91
- Take photograph of the pattern



ME363 Lab#9: Procedures

- **Calculate the distance of the film plane from the object**

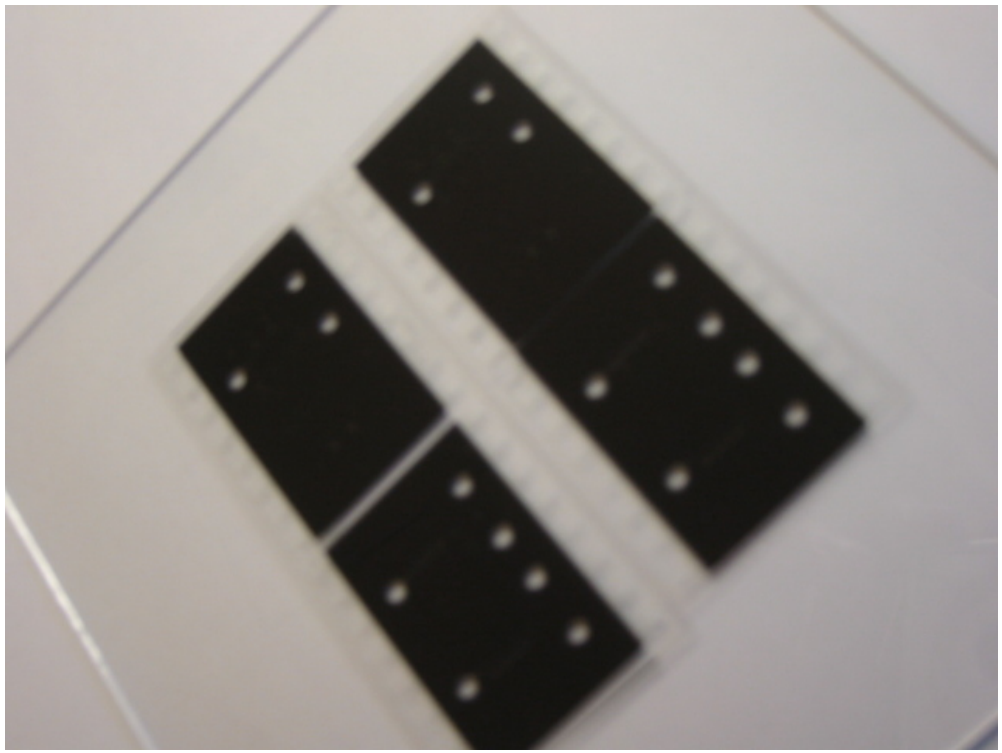
The distance of the film plane from the object, D is a function of optical reduction ratio, RR. D can be calculated by:

$$D = 0.0556*RR + 0.101 \text{ (meters)} \quad (1)$$

The optical ratio is about 7.7 when photographing the pattern from a standard transparency to a 35 mm film. Substitute the value of RR and calculate the distance D.

ME363 Lab#9: Procedures

- Develop the film and glue it onto a clean glass sheet



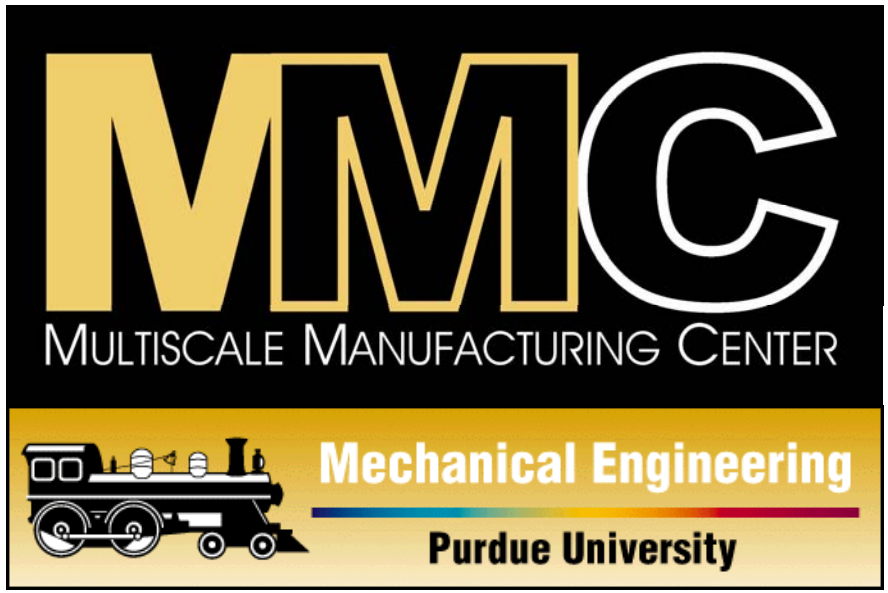
ME363 Lab#9: Procedures

- Download lectures and lab modules from MMC website: http://widget.ecn.purdue.edu/~mmcenter/ME363.htm
- Each group prepare a pattern – any B&W image file, AutoCAD 2D design http://widget.ecn.purdue.edu/~mmcenter/manuals.htm

  Photographic Mask Fabrication

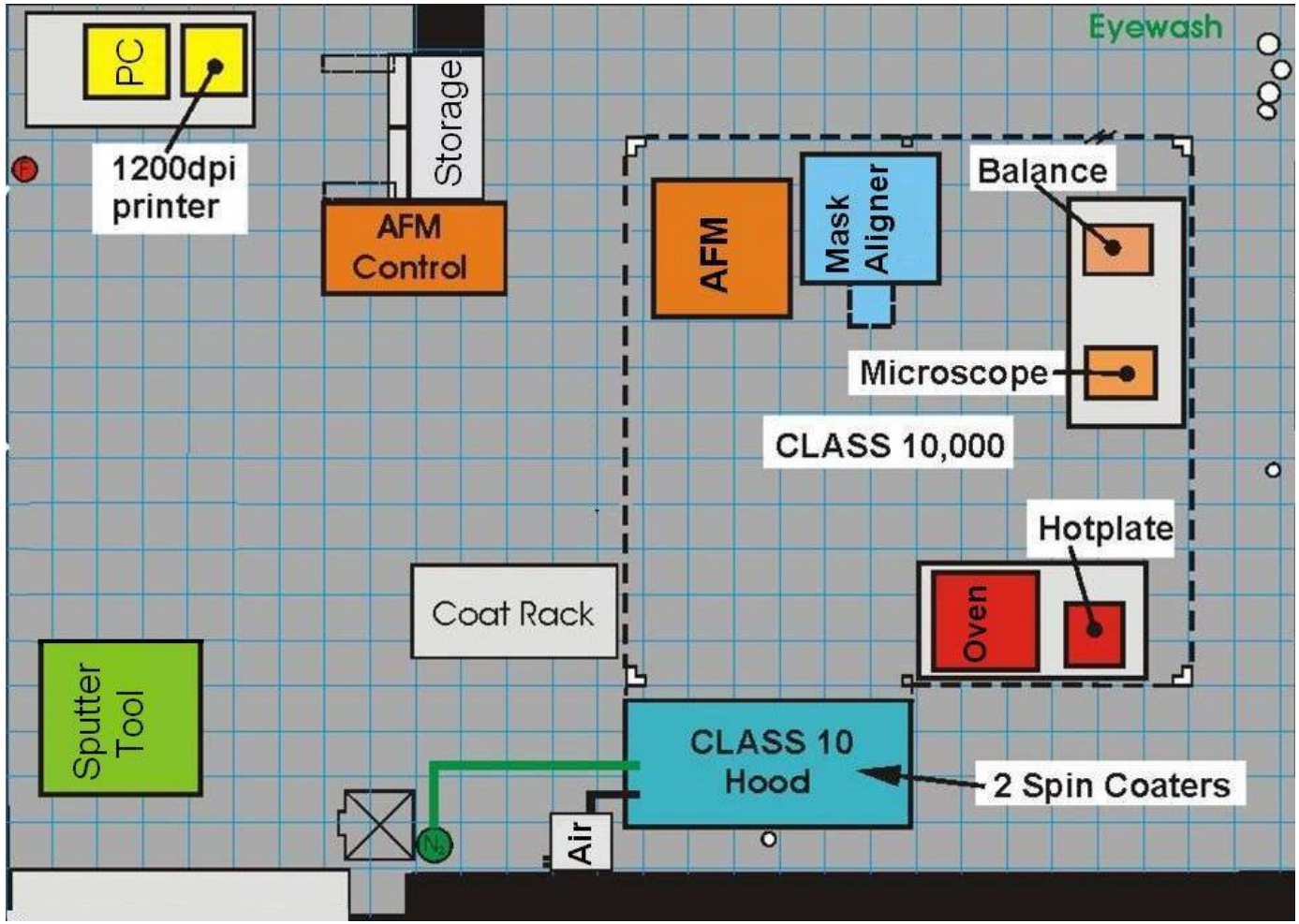
Soft Lithography at MMC

- Traditional machining
  - Manual mills and lathes
  - CNC mills and lathes
  - Vertical and horizontal saws
- Micromachining
  - Class 10,000 clean room
  - Class 10 solvent hood
  - Double sided mask aligner
  - 2 spin coaters
  - Sputtering machine
  - Atomic force microscope



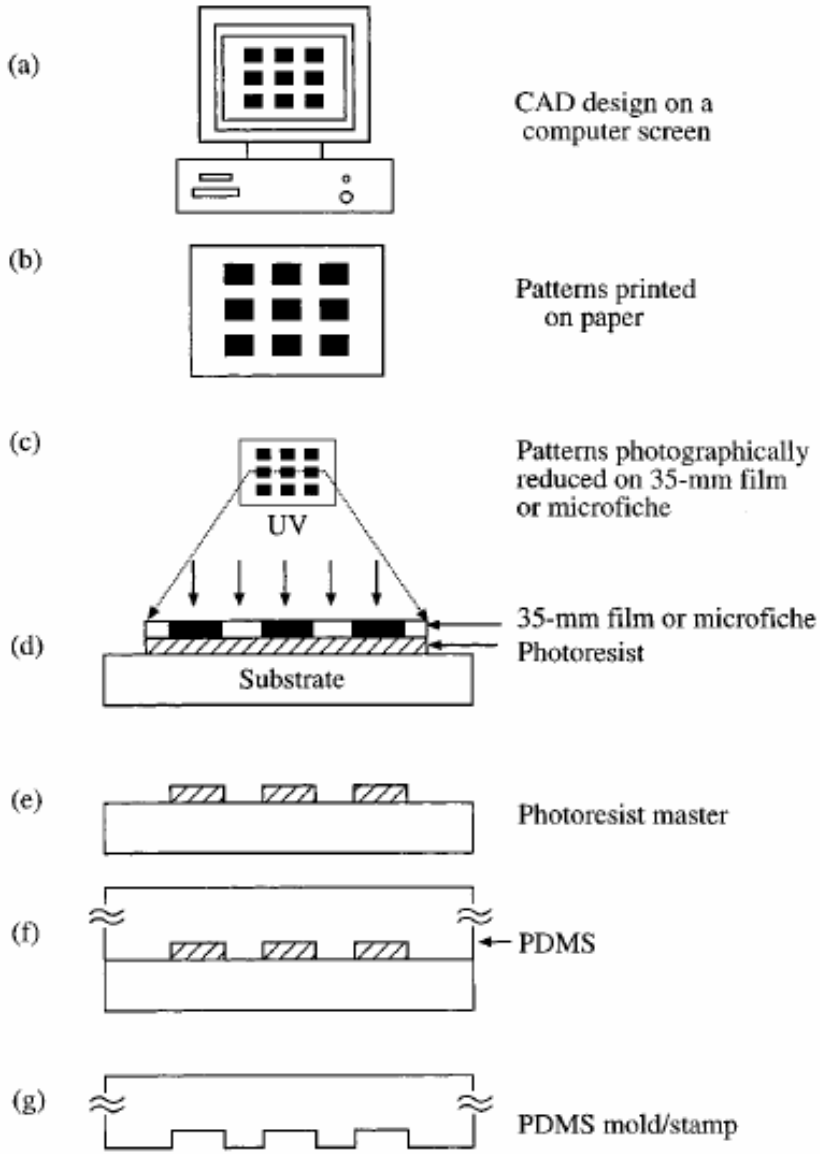
http://widget.ecn.purdue.edu/~mmcenter

Soft Lithography at MMC



Soft Lithography at MMC

MMC Lab Module for Soft Lithography



ME363 Lab#10: Procedures

1. Prepare substrate

- Choice of substrate
  - Silicon, glass, pyrex wafer for different photoresist spinning
  - Wafer diameter, thickness

4” single-side polished silicon wafer is used in the lab.

ME363 Lab#10: Procedures

1. Prepare substrate

- Substrate clean
  - Solvent clean process
  1. Cover the surface of the wafer with Acetone.
  2. Thoroughly scrub the surface of the wafer with a swab.
  3. Rinse the wafer with IPA (isopropanol)
  4. Blow dry the wafer with N_2 gun

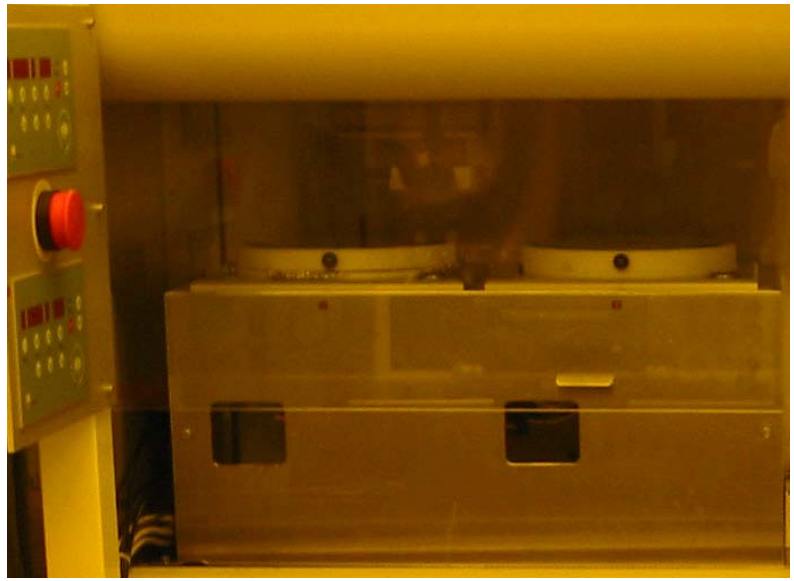
Class 10 biological safety cabinet in MMC

ME363 Lab#10: Procedures

2. Spin coating photoresist on substrates

- Photoresists used for soft lithography
  - SU-8
  - Thickness of photoresist on wafers: 25 μm
- SUSS spin coater
- User manual of spin coater

  http://widget.ecn.purdue.edu/~mmcenter/manuals.htm



Bench mounted spin coaters

ME363 Lab#10: Procedures

3. Soft baking after spinning using hotplate: to evaporate the solvent and densify the photoresist film

- 65 ºC hotplate 3 min, following with 95ºC oven 30-35 min
- User manual of hotplate

  http://widget.ecn.purdue.edu/~mmcenter/manuals.htm

ME363 Lab#10: Procedures

4. Photoresist exposure

- SUSS mask aligner 1006

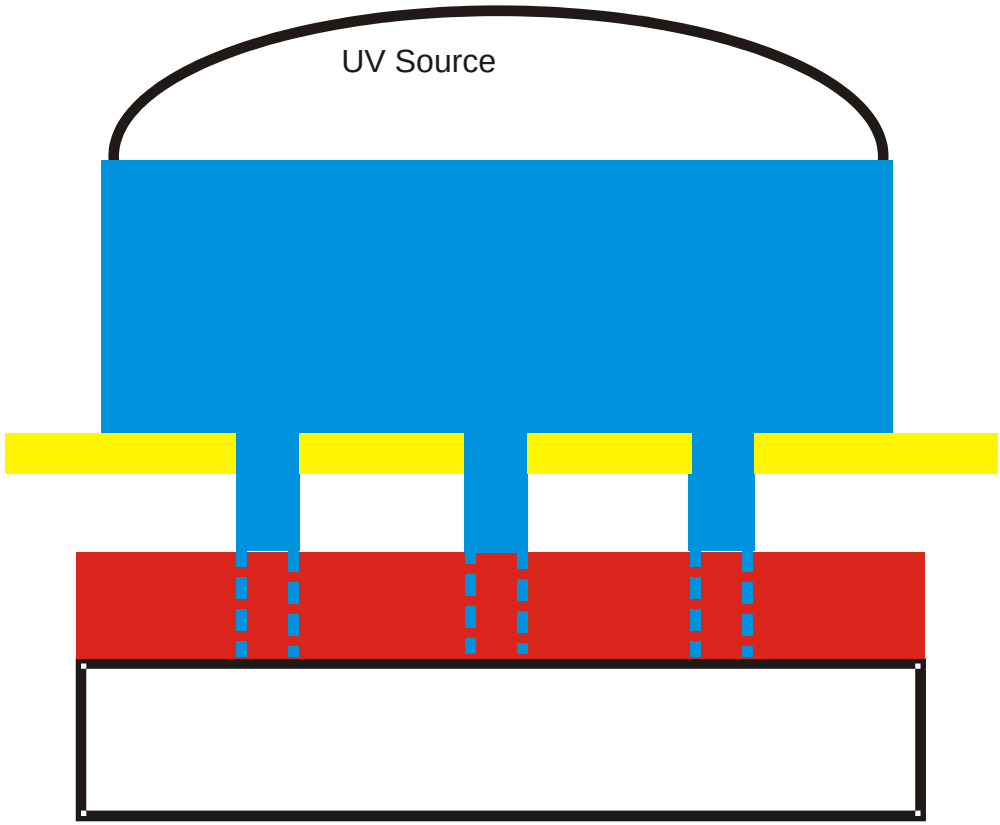
  20 seconds at UV light density of 21 mW^2/cm^2

- User manual of hotplate

  http://widget.ecn.purdue.edu/~mmcenter/manuals.htm

ME363 Lab#10: Procedures

4. Photoresist exposure



ME363 Lab#10: Procedures

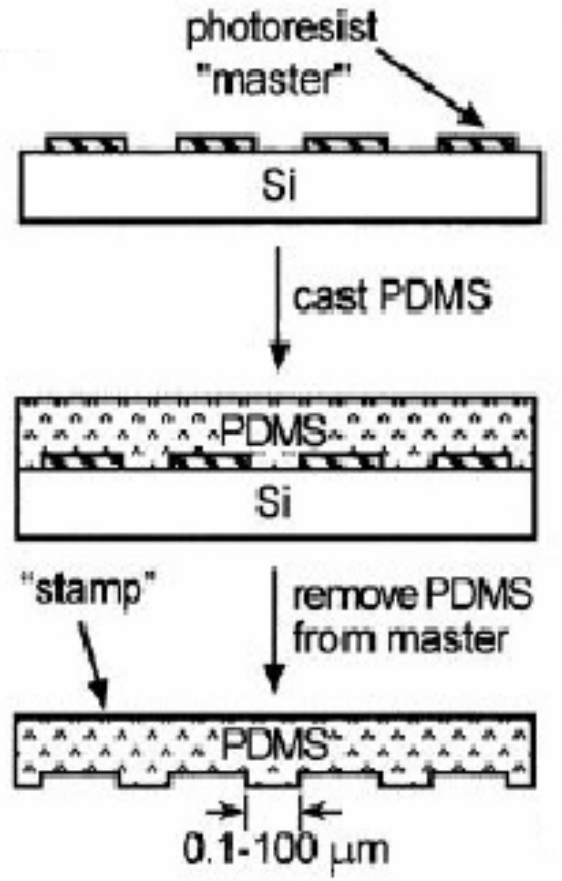
5. Hard baking after exposure

- Post exposure baking: bake the SU-8 on a hotplate for acid-initiated, thermally driven expoxy cross-linking
- 65 ºC hotplate 1 min, following with 95ºC oven 10 min

6. Develop the photoresist

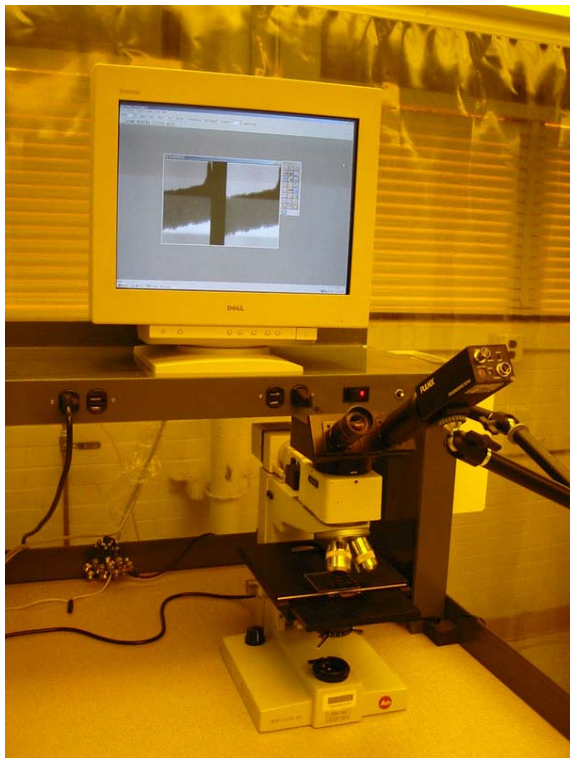
ME363 Lab#10: Procedures

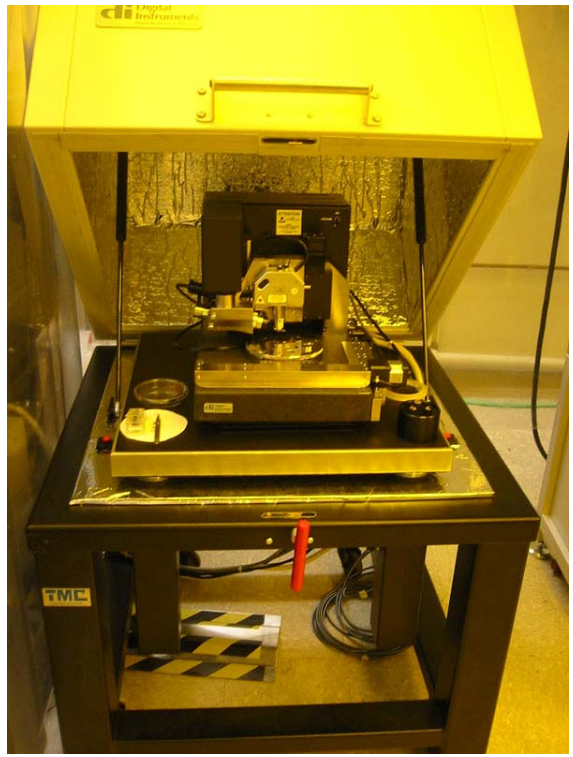
7. Cast PDMS and cure



ME363 Lab#10: Procedures

8. Micro-structure evaluation
    - Optical Microscope
    - Atomic Force Microscope (AFM)





ME363 Lab#10: Procedures

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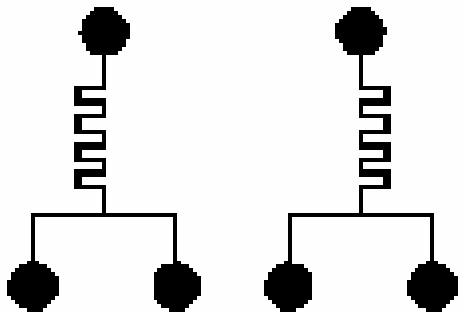

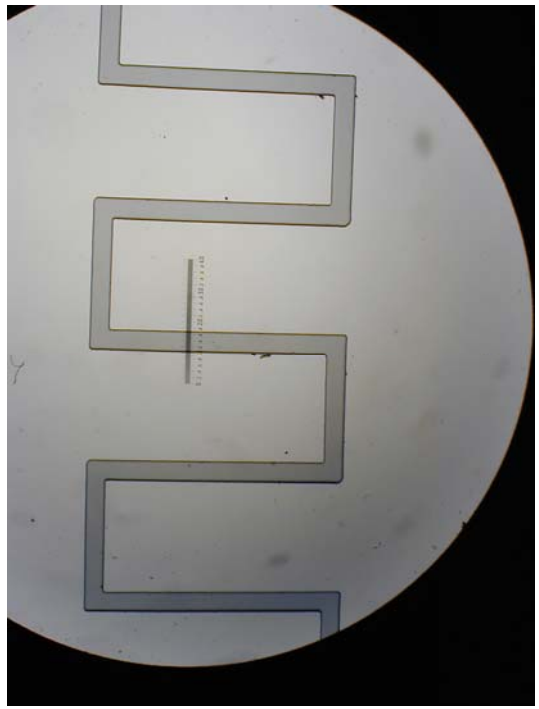

Microchannel on silicon: 50 μm wide