

# ME363 Lab#9: Microfabrication I

## Soft Lithography Part I: Photographic Mask-Making

- Where: Potter333

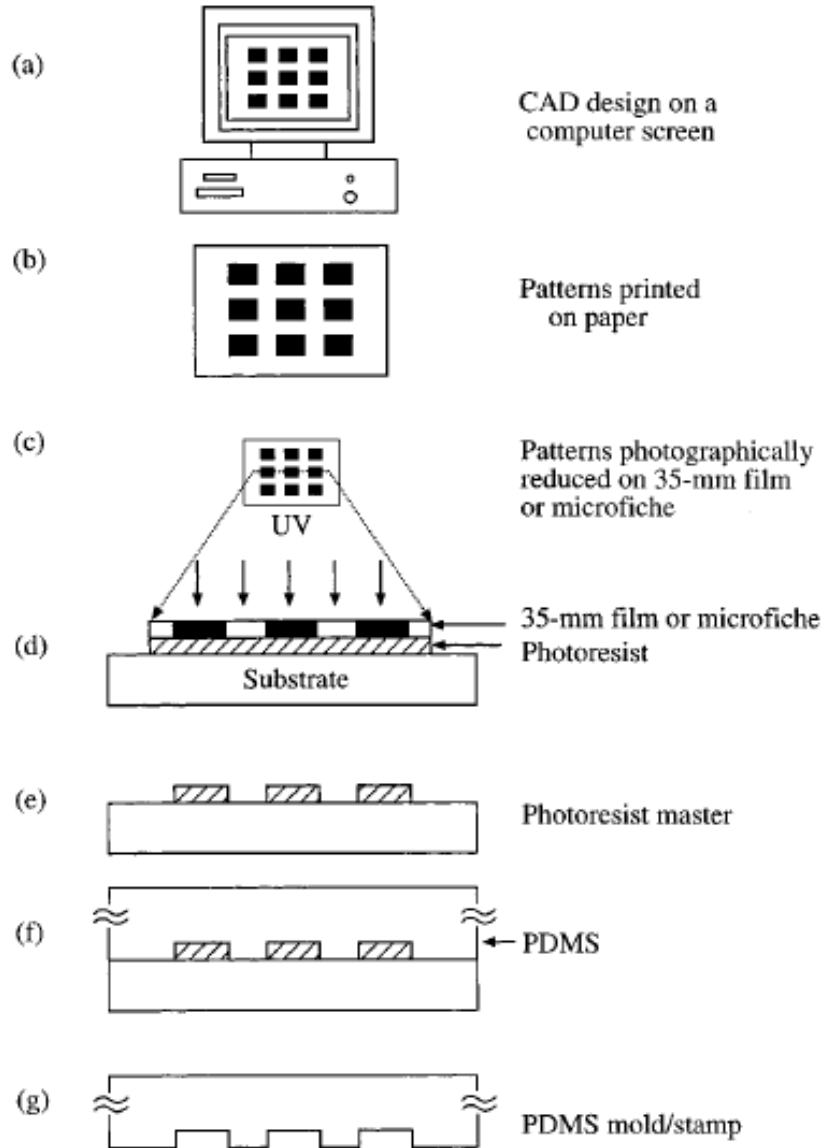
Room rules

- No chewing gum
- No drinks



# Soft Lithography at MMC

## MMC Lab Module for Soft Lithography

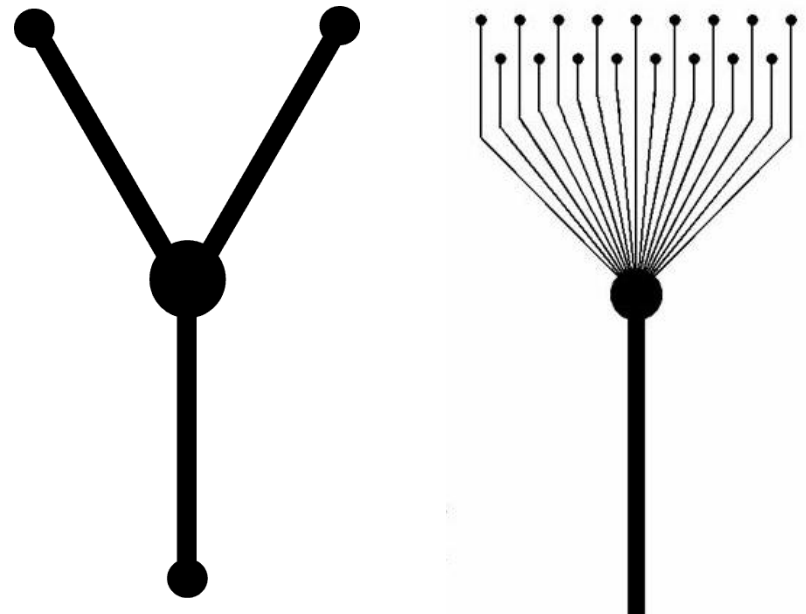


# ME363 Lab#9: Procedures

## Photomasks Making

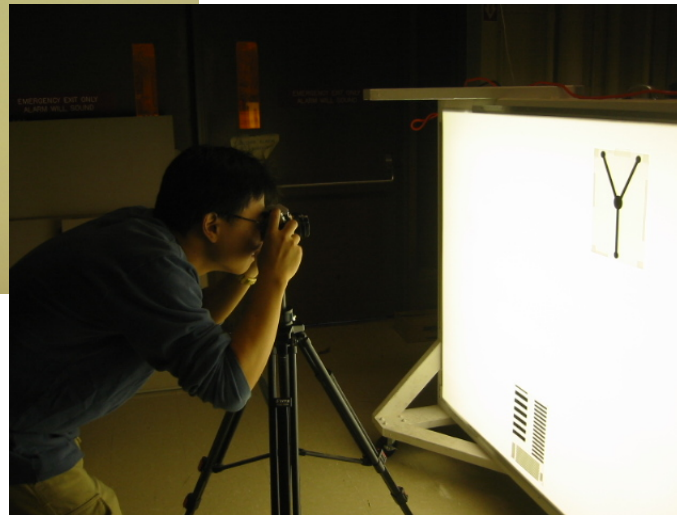
To design and make a photographic mask

- 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**

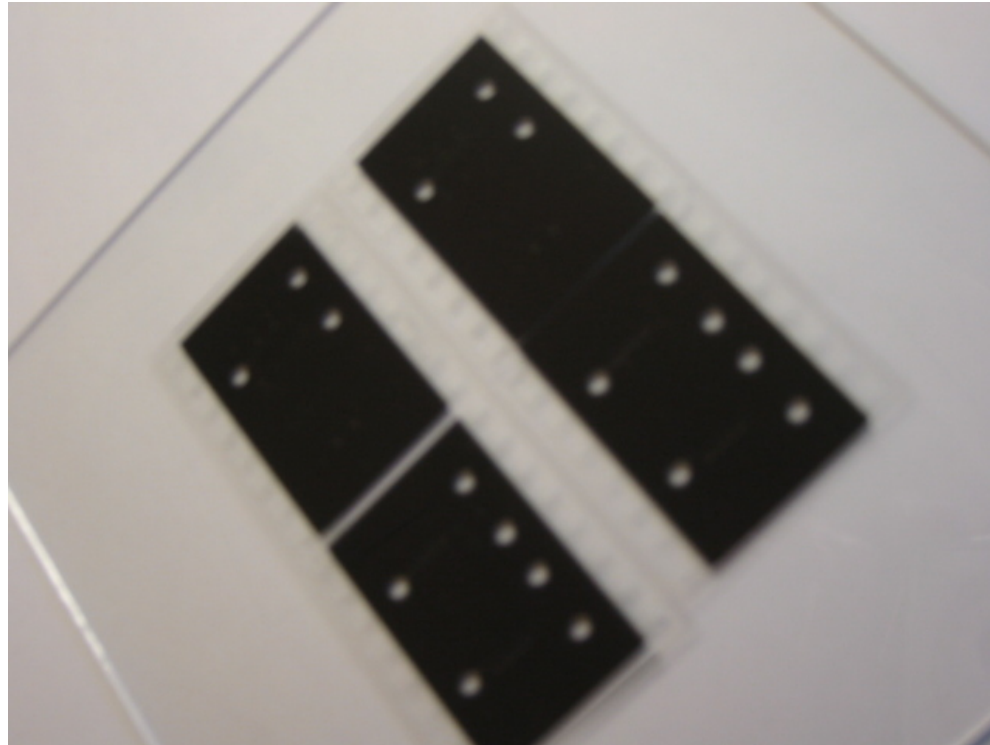
The distance of the film plane from the object,  $D$  is a function of optical reduction ratio,  $RR$ .  $D$  can be calculated by:

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

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

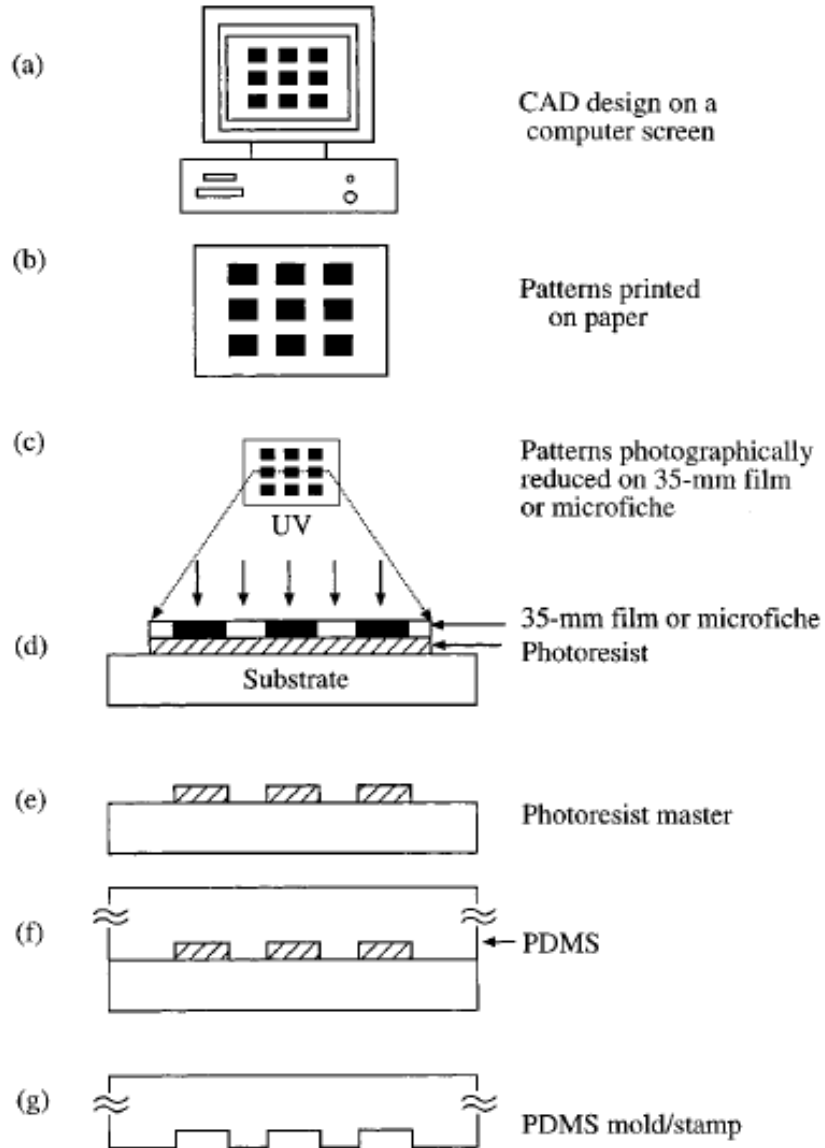


# ME363 Lab#9: Procedures

- Download lab modules from MMC website:  
<https://engineering.purdue.edu/ME363/public-web/manual.html>
- Each group prepare a pattern – any B&W image file, AutoCAD 2D design  
<https://engineering.purdue.edu/ME363/public-web/manual/ME363MMC.htm>
- Photographic Mask Fabrication

# 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<sub>2</sub> gun

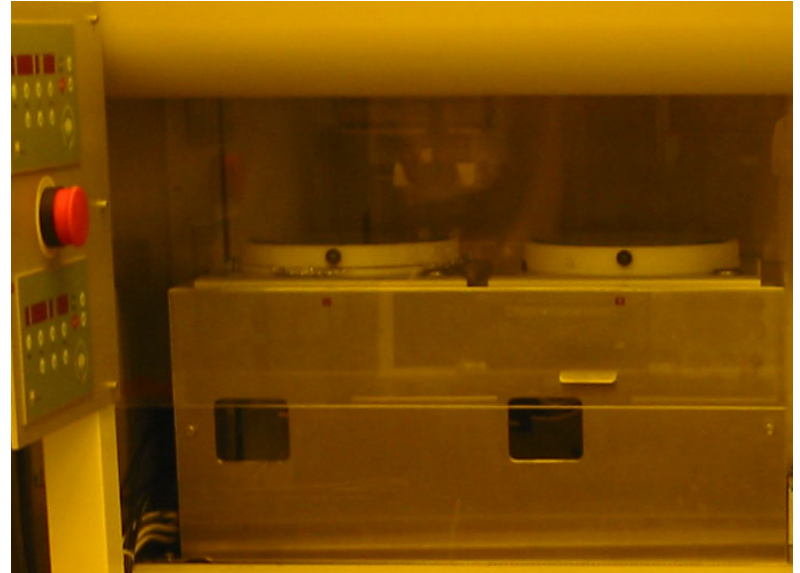


Class 10 biological safety cabinet in MMC



# ME363 Lab#10: Procedures

2. Spin coating photoresist on substrates
  - Photoresists used for soft lithography
    - SU-8
    - Thickness of photoresist on wafers: 25  $\mu\text{m}$
  - SUSS spin coater
  - User manual of spin coater  
<http://engineering.purdue.edu/MMC/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 °C hotplate 3 min, following with 95°C oven 30-35 min
- User manual of hotplate

<http://engineering.purdue.edu/MMC/manuals.htm>



# ME363 Lab#10: Procedures

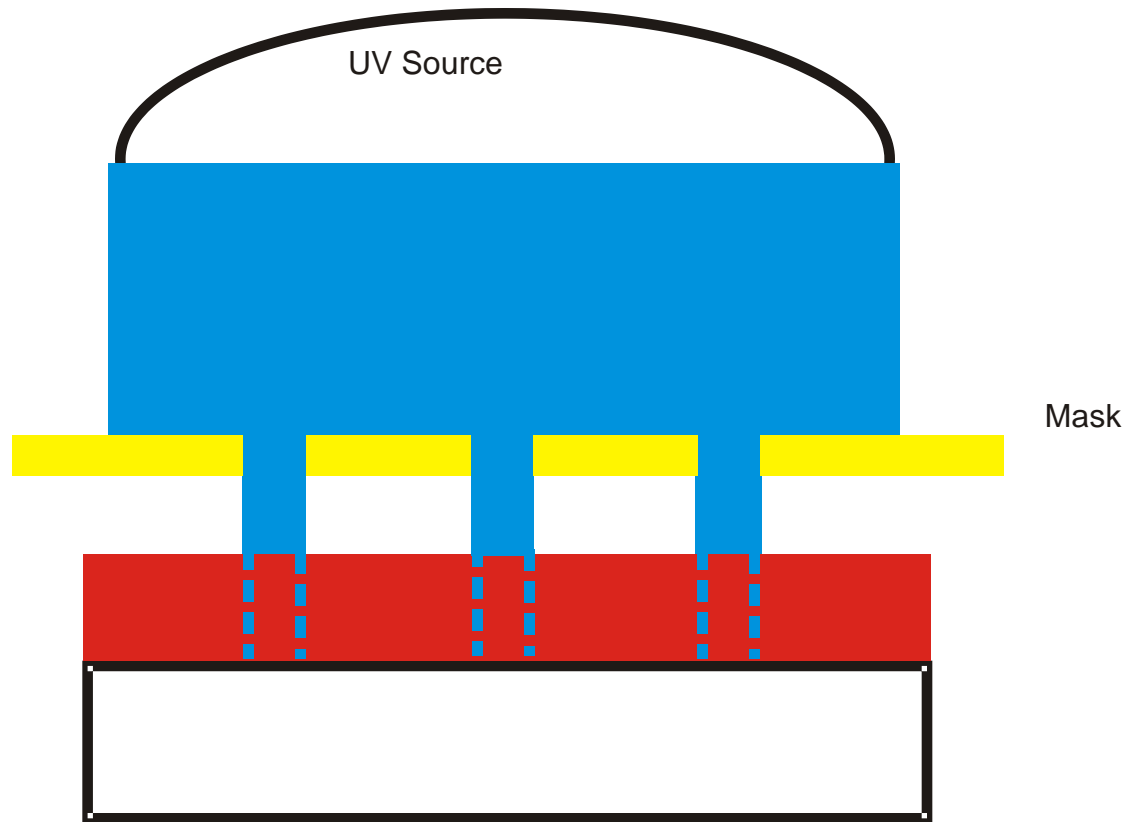
## 4. Photoresist exposure

- SUSS mask aligner 1006  
20 seconds at UV light density of  $21 \text{ mW/cm}^2$
- User manual of hotplate  
<http://engineering.purdue.edu/MMC/manuals.htm>



# ME363 Lab#10: Procedures

## 4. Photoresist exposure



# ME363 Lab#10: Procedures

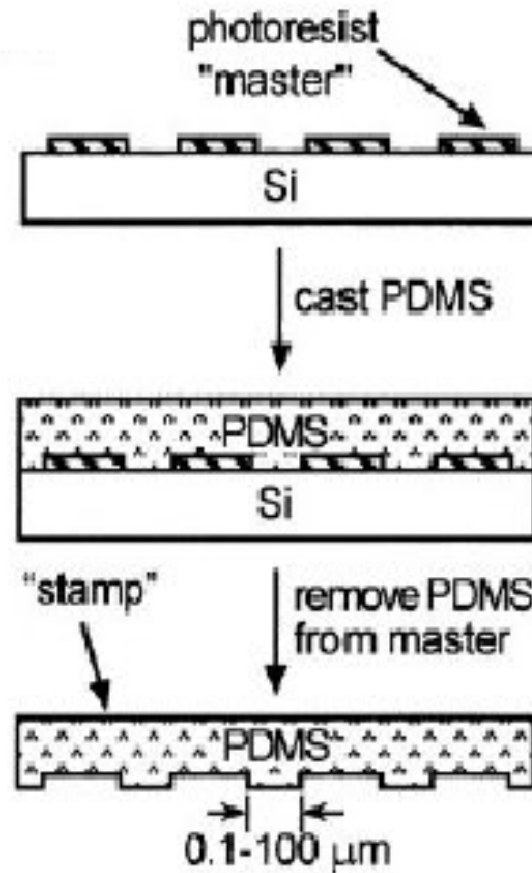
5. Hard baking after exposure
  - Post exposure baking: bake the SU-8 on a hotplate for acid-initiated, thermally driven epoxy cross-linking
  - 65 °C hotplate 1 min, following with 95°C oven 10 min



6. Develop the photoresist

# ME363 Lab#10: Procedures

## 7. Cast PDMS and cure

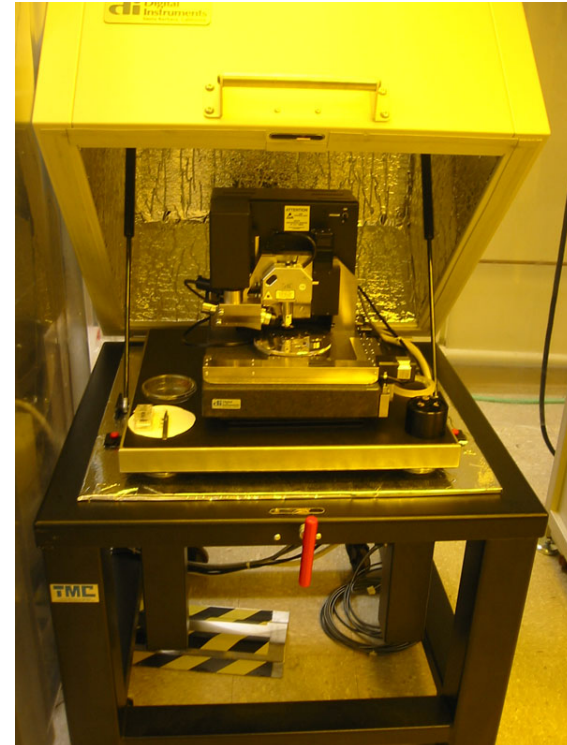
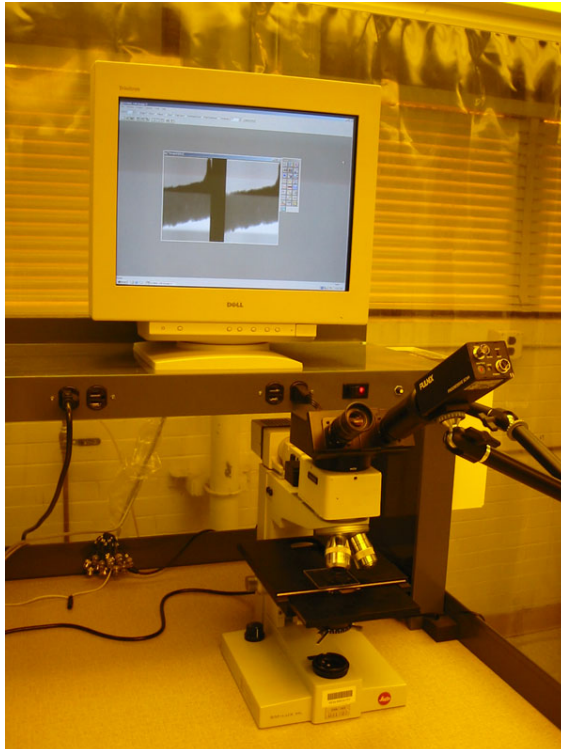




# ME363 Lab#10: Procedures

## 8. Micro-structure evaluation

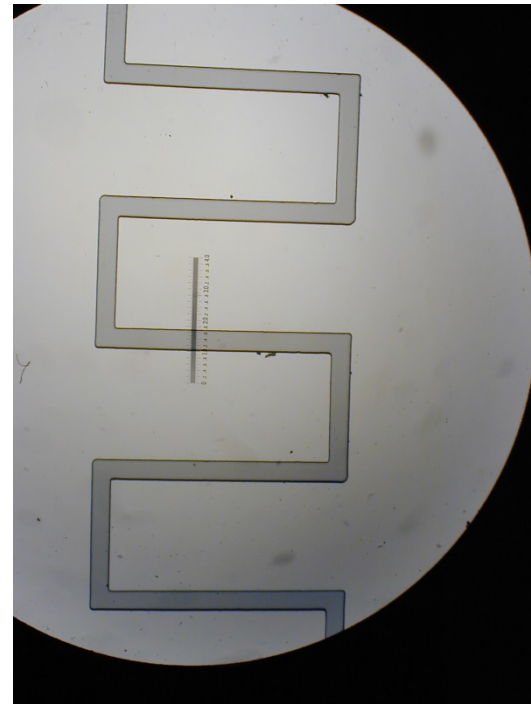
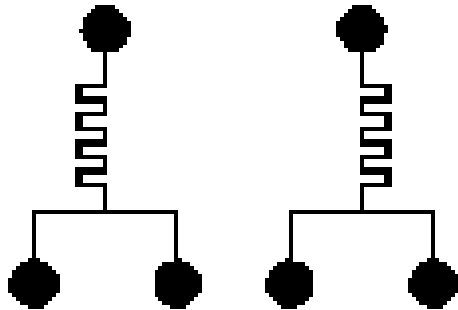
- Optical Microscope
- Atomic Force Microscope (AFM)



# ME363 Lab#10: Procedures

## 8. Micro-structure evaluation

- Optical Microscope



Microchannel on silicon: 50  $\mu\text{m}$  wide