Introduction of Lithography: 
Fabrication of Team Spirit Silhouettes

Instructor: Hung-Ta Wang 
Assist. Prof. of MINT and Department of Chemical and Biological Engineering

Experiment Assistant: Lingling Guo, and Haiyu Quan 
Graduate students of MINT and Department of Chemical and Biological Engineering

10:00 am ~ noon, 06-25-2013
Learning Objectives

1. This MINT high school course introduces the concepts and key terms of photolithography.

2. The hands-on experiment allows students to visualize the fundamental process behind the microchip fabrication.

3. By prototyping of “team spirit silhouettes,” students will appreciate the versatility of photolithography for fabricating polymer thin film objects in virtually any shapes.
Microchips are the brains behind most electronic devices, such as computers, cell phones, and tablets. The industrial process for the fabrication of these complex electronic devices, photolithography, is based on polymer chemistry developed in 1959.

Photolithography (also termed "optical lithography" or "UV lithography") is a process used in microfabrication to selectively remove parts of a thin film or the bulk of a substrate. It uses light to transfer a geometric pattern from a photomask to a light-sensitive chemical "photoresist", or simply "resist," on the substrate.
Positive vs. Negative Resist

A positive resist is composed of an insoluble polymer that degrades into a soluble polymer when exposed to UV light.

A negative resist is composed of monomers or polymers that polymerize or crosslink to form insoluble polymers upon UV exposure.

**Figure** The difference in crosslinking density between a lightly crosslinked, soluble polymer (A) and a highly crosslinked, insoluble polymer network (B).

*J. Chem. Educ., 2005, 82 (9), p 1365*
Positive vs. Negative Resist

Schematic diagram showing the steps in the lithographic process used to construct microelectronics devices

http://researcher.watson.ibm.com/researcher/view_project_subpage.php?id=3661
SU-8 photoresist

SU-8 (containing epoxy resin, c-butyrolactone, HSBF$_6$, etc.) is a commonly used epoxy-based negative photoresist. The molecule of the epoxy resin is as below:

Upon exposure to UV (365 nm) radiation, a acid (HSbF$_6$) causes the epoxy resin to form a ladder-like structure with a high cross-linking density when heated above a critical temperature provided in a post-exposure bake.
Experiments

Step 1: spin-coating
Step 2: baking
Step 3: masking
Step 4: exposure
Step 5: post-baking
Step 6: developing
Personal Protective Equipment (PPE): nitrile gloves and UV goggles.

Reference:
Title: Introduction to photolithography: Preparation of microscale polymer silhouettes
Author(s): Berkowski KL; Plunkett KN; Yu Q; et al.