5.3 May 2, 2005: Patterning, polymer deposition

Structure zone model clarification: Argon pressure correlates with sputtering rate and deposition rate at the substrate.

Masking and patterning: start with polymer thin film, use radiation to alter the structure and etching properties:

- Positive tone: radiation breaks the chain backbone, lowering molecular weight, so exposed regions are easier to dissolve.
- Negative tone: radiation cross-links the polymer, giving it a three-dimensional structure which dissolves more slowly.

Such exposure is followed by etching of the substrate material beneath, or deposition of a new thin film, followed by dissolution of the polymer.

Radiation types:

- Far-UV: resolution limited by wavelength and diffraction around mask features; expose a large area at once.
- Electron beams: very small electron "wavelength" allows extremely fine lines; "writing" a pattern takes a long time.

Balance: use EB to make the mask for far-UV patterning.

Making the polymer film: spin coating, produces uniform film in the same way a rotating plate procudes a uniform boundary layer.

Vapor deposition of polymer films "Polymer sputtering" obviously isn't about vaporizing entire polymer chains, but getting monomers to the substrate where they polymerize in situ. Deposition technologies:

- Plasma-enhanced CVD: use a plasma to radicalize monomers, usable for relatively "stubborn" and insensitive molecules like methyl-methacrylate to make PMMA photoresist films, which need lots of radiation to cross-link.
- Hot filament CVD: lower temperature, controllable between 160 and 500°C to make more delicate polymer films.
- Initiated CVD (iCVD): use a reactive initiator such as tert-butyl peroxide to form radicals, can use very sensitive acrylic polymers such as those with epoxy groups.