Fab Diagram

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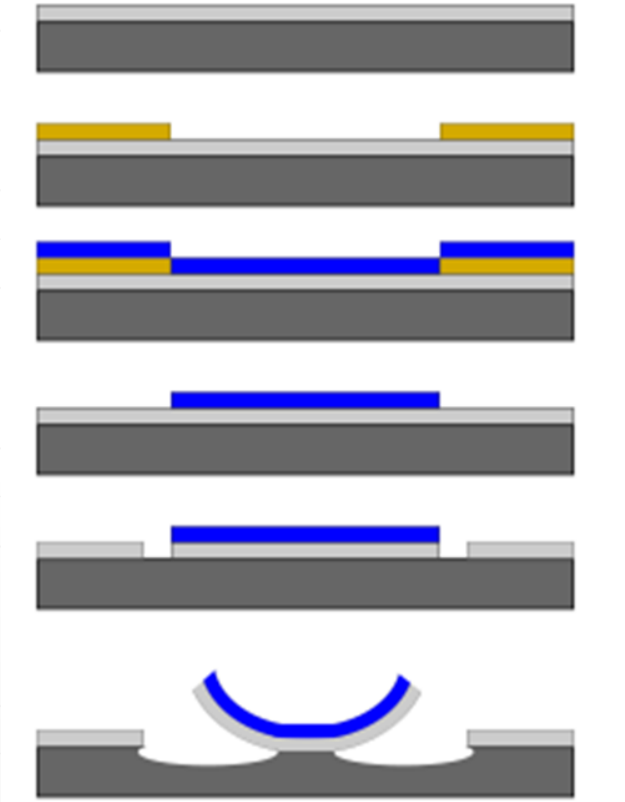
Steps:

1. Lithography 1
2. Deposition
3. Lift-off
4. Lithography 2
5. Plasma Etch
6. Isotropic Etch



Thin-film Deposition

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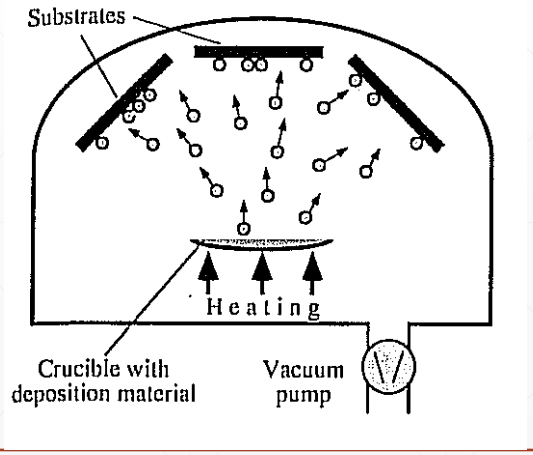
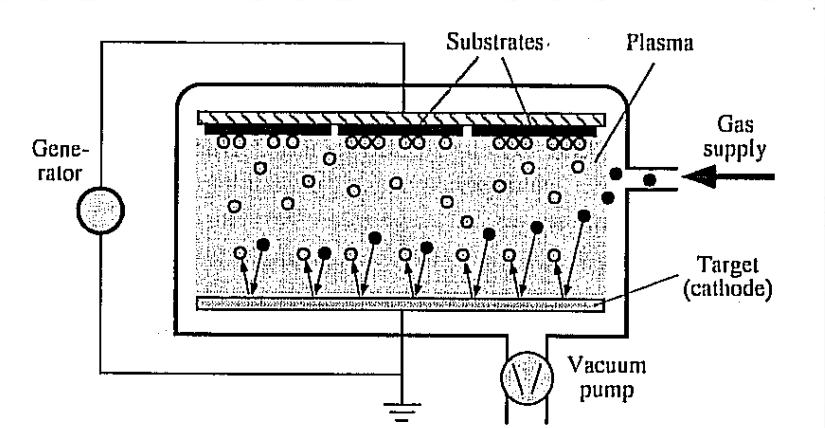
There are several methods to deposit thin layers of materials:

- Spinning (sol-gel, resist, etc).
- CVD – Chemical Vapor Deposition, with many variants (LPCVD, PECVD, ebeam, PLD, etc.)
- Sputtering Deposition
- Thermal Deposition (for instance SiO2)
- Other: screen printing, electroplating

Sputtering or evaporation of metals using targets and crucibles.





Thin-film Deposition

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The target materials and the substrates are placed in a vacuum chamber. For this project we will be using Nickle and Chrome

A large voltage is applied between the target and substrate so that the target is the cathode, and the substrate is attached to the anode.

A plasma is created by ionizing Argon gas.

The Argon gas bombards the target and sputters off the material and deposits it onto the substrate.

Thin-film Deposition

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Kurt J. Lesker PVD 75 is a three-source tool source system for deposition metals and dielectrics.

The PVD 75 features RF, DC, RF/DC stacking and ion beam assisted sputtering, which includes throttled pressure control and reactive gas mixing.

Material: Chrome-Nickel-Chrome

Stress: ~ 700 MPa

Thickness: ~ 210 nm

Thickness Measurement

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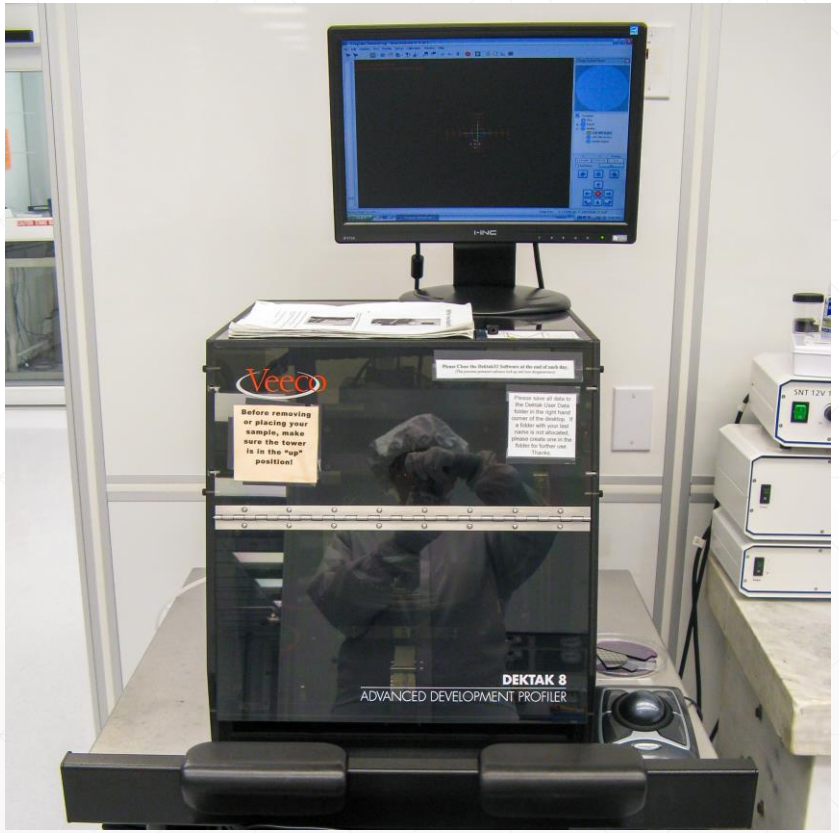
3-D Contact Profiling

We will be using a Veeco contact profilometer to measure our film thicknesses. The toll can provide down to a 7.5-angstrom step height measurement with a vertical range up to 1 mm and a maximum scan length of 200 mm. The low stylus force allows scratch-free measurement of soft materials.



Lift-off

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Metal lift-off is a microfabrication process for creating a pattern by depositing a thin metal film over the patterned photoresist with a specific lift-off profile (overcut) and removing the resist with solvent to leave behind the metal only in the patterned area, directly on the substrate.

Methods for creating photoresist lift-off profile:

- Single layer lift-off (for large features)
- Double layer lift-off
- Image Reversal

Lift-off

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Single layer lift-off

For large features using one layer of photoresist is sufficient. The photoresist is deposited and patterned with the standard photolithography processes. Once a metal layer has been deposited the photoresist can be removed with a solvent.

Double layer lift-off

Double layer lift-off processes uses two different types of resist on top of each other. For example, using PR1813 and Lift-off resist (LOR). Because of the chemical properties , the two resists do not interact with each other. The PR1813 can be precisely patterned on top of the LOR. The LOR can be easily removed once the metal layer has been deposited.

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Image Reversal

Image reversal uses photoresists capable of image reversal (IR) resulting in a negative pattern of the mask for lift-off techniques.

For example, PR1813 when processed according to the general protocol for positive resists it works like a normal positive tone resist. But with the additional process steps **“reversal bake”** and **“flood exposure”**, the material provides a negative resist image with undercut ideal for lift-off.

Lift-off Steps

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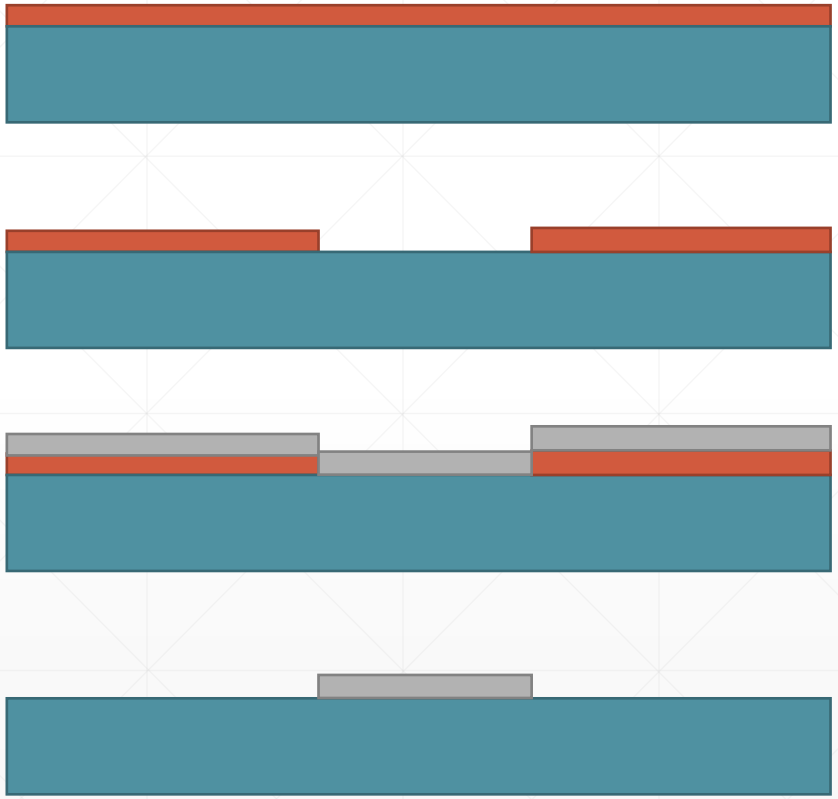
Single layer lift-off



Spin on PR1813

Standard Photolithography

Metal Deposition

Remove Photoresist using Acetone

Lab Assignment #2

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- Question 1: What is the expected photoresist thickness? What is the measured photoresist thickness?
- Question 2: Calculate the percent error between your expected and measured thickness.
- Question 3: What solvent was using for the lift-off process?
- Question 4: What parameters were using during the sputtering process?
- Question 5: What was the expected metal thickness? What was the measured metal thickness?
- Questions 6: Calculate the percent error between your expected and measured thickness.