Lab#7

Fabrication of Micromold using Electroplating of Nickel

1. Check Lab Notebooks and Collect Project Assignments.
2. This lab has two parts, which are 1.Fabrication of mold using SU-8 and 2. Fabrication of metal micro mold using nickel electroplating.
3. You will use one wafer per batch.
4. Part#1 Fabrication of SU-8 Mold
   i. Remove SU-8 10 from the refrigerator for at least 2 hours before starting the process.
   ii. Start with polished silicon wafer with seed layer (500°A,Chromium, 2000°A Copper, 700°A Chromium).
   iii. Remove top Chromium layer and do the cleaning process. (acetone/methanol)
   iv. Bake the silicon wafer at 200°C for 5 minutes.
   v. Dispense 3 ml SU-8 10 on the wafer (3 inch) after placing the silicon wafer on the spinner.
   vi. Spin at (I) 200 rpm, 10 seconds and stop. (II) 1000 rpm, 30 seconds. This spin speed will provide ~ 25 μm thickness.
   vii. Soft bake at 65°C for 3 minutes and 90°C for 7 minutes.
   viii. Place the wafer on 50°C hot plate for 2 minutes and then allow it to cool to room temperature.
   ix. Exposure dose is 230 -250 mJ/cm^2. Use the optical power meter to measure the lamp intensity and figure out the exposure time.
   x. Post Bake (I) 65°C for 1 minute and (II) 95°C for 3 minute.
   xi. Develop in SU-8 developer for 4 minutes.
   xii. Clean the SU-8 developer with IPA (avoid acetone.), and then dry with air or nitrogen.
   xiii. Hard bake at 150oC for 15 minutes.
   xiv. O_2 plasma descum, 200W, 200mtorr, 60sec (If required)
5. Part#2 Fabrication of metal mold using nickel electroplating
   i. Set up the electroplating bath as shown in the Figure1.

Table 1 Nickel Plating Solution Composition

Material	Quantity
Nickel Sulfate	200g/L
Nickel Chloride	5 g/L
Boric Acid	25 g/L
Ferrous Sulfate	8 g/L
Saccharin	3 g/L

   ii. Electroplating Solution Composition is given in Table 1
   iii. Typical calculations prior to electroplating
      1. Find the exposed seed layer area **A**;
      2. Choose the desired current density **J** = 1-10mA/cm^2
      3. Calculate the time it will take using:

$$t = \frac{thickness \times \delta Ni \times Faraday_const \times Nelectrons}{J \times molecular_weight}$$

Or

$$t = 29{,}253.73 \times \frac{film_thickness}{current_density}$$

where the constants are;

$$Faraday := 96488 \frac{C}{mol}$$

Solution molecular weight:

$$molecular_weight := 58.71 \frac{g}{mol}$$

The number of electrons is given as:

$$n_{el} := 2$$

The density of nickel is:

$$\delta_{Ni} := 8.9 \frac{g}{cm^3}$$

4. Calculate the amount of current **I** needed:

$$I = J \times A$$

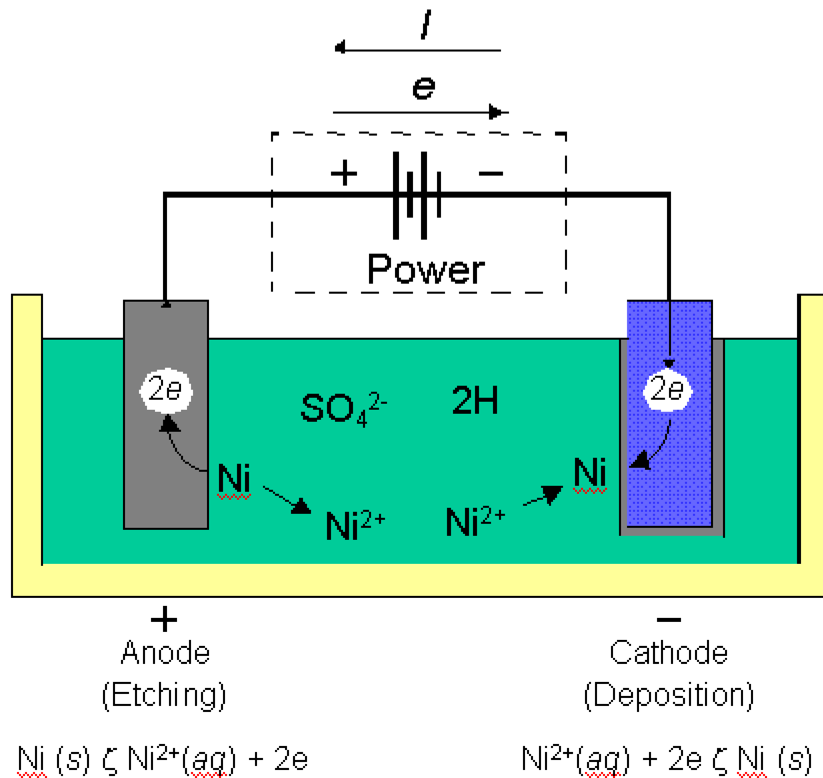

Figure 1 Electroplating Setup

iv. Pour the electroplating solution inside a beaker / plastic cube and let it stir for about an hour. Mark the solution level before stirring.
v. Clip the nickel target to one wall and the wafer to the opposite wall. Make sure you establish connection to the wafer, since photoresist acts as an insulator. You may need to scratch the surface using the clip in the closed position.
vi. Connect the negative terminal of your power supply (-) to ground and to the wafer clip
vii. Connect the positive terminal of your power supply (+) to an ampmeter current terminal
viii. Connect the ampmeter COM to the target clip
ix. Make sure the solution no longer sits on top of the stirrer (usually a hot plate). In addition, do not submerge the clips inside the solution.
x. Plate at the desired current and time.
xi. Put solution away. Next time you use, make sure the level is the same. If not, add more water until the level is the same.