

## **Electrodeposition of Nickel Molds & Electrodes:**

1. Plug in and turn on hotplates for electroplating solutions. Heat nickel strike and nickel electroplating solutions to 55°C (hot plates approx. to 115-120 °C), with strong stirring
2. Add water to keep electroplating bath volumes at ~1600ml
3. Cover back of wafer with a white vinyl sticker, cutting a small gap to allow the alligator clip to contact the surface of the steel.

*Proceed with next steps when solutions are at 55 °C.*

**Nickel strike** – to allow firm adherence of nickel structures to steel wafers. (Skip this step when fabricating electrodes)

4. Position nickel plate and wafer in acrylic holder, with patterned wafer surface facing the nickel plate
5. Clip (+) lead to Ni plate in the strike solution, and the (--) lead to the wafer.
6. Turn off the stirring, and carefully remove the strike bath from the hotplate. Place the lid of the bath over the acrylic holder, inserting the Teflon plug to secure the holder (Figure 1) Replace the lid/holder back into the bath and return the bath to the hotplate.
7. **AVOID BREATHING THE FUMES FROM THE NICKEL STRIKE SOLUTION!!!**
8. Turn on power supply, apply 0.25 -1 A for 1-2 minutes.
9. Turn off power supply and remove wafer from solution.
10. Rinse wafer in DI water.

## **Nickel electrodeposition**

11. Position nickel plate and wafer in acrylic holder, with patterned wafer surface facing the nickel plate.
12. Clip (+) lead to Ni plate in the plating solution, and the (--) lead to the wafer.
13. Calculate the electroplating rate and time from the spreadsheet (Electroplating Ratio Equation.xlsx)\*
14. Turn on power supply, applying 0.25 – 0.5 A. Keep voltage below 1.2 – 1.5V to avoid bubble formation on the steel surface by decreasing amperage. Remember to recalculate plating time if changing amperage.
15. Leave system running for calculated deposition time.
16. Turn off power supply.
17. Remove wafer and rinse in DI water.
18. Strip photoresin from wafer (remove dry resin with 3% NaOH solution, S1818 with acetone)
19. When finished electroplating for the day, turn off hotplates. Remove nickel plate from the strike solution and rinse in DI water.

### **\*Electroplating rate equation:**

From Novak et al. *Lab Chip* 2013 – note that equation constant in original paper is an order of magnitude too small – should be 600,000 not 60,000

$$\text{rate } (\mu\text{m}/\text{min}) = \frac{600000\varepsilon IA}{QF\rho s}$$

$\varepsilon$  = efficiency (0.53)

I = current (typically 0.25A or 0.5A)

A = molecular mass (58.69g/mol for nickel)

Q = charge of nickel ions (2)

F = Faraday's Constant (96485 C/mol)

$\rho$  = nickel density (8.908 g/cm<sup>3</sup>)

s = exposed surface area of cathode in cm<sup>2</sup> (include exposed wafer edges, ~2.2 cm<sup>2</sup>)