Sub-Protocol: Metal Patterning via Lift-Off

Description: This document details the protocol for the high-resolution image reversal lithography used to produce the lift-off profile for metal patterning in the PIE Foundry standard microfabrication process. It is tailored for use on Parylene C coated silicon wafers.

MATERIALS

Acetone
Isopropanol (IPA)
N-Methylpyrrolidone (NMP)

EQUIPMENT

Glass dishes designated for lift-off
Sonicating bath

PROCESS

1. ACETONE SOAK

Note: Perform all steps in solvent fume hood
Note: Lift-off is a particulate generating process. Expect dishware and tweezers to become contaminated by metal particles. Designated tweezers and glassware for lift-off only processing.

1.1. Soak wafers overnight in room temperature acetone bath. Features should begin to appear after a few minutes. If not, the photoresist profile may be incorrect.
   a. Bath will need to be covered in aluminum foil to prevent solvent evaporation overnight.
   b. If possible, wafers should be stood vertical to reduce particle redeposition.

2. PREPARE SOLVENT BATHS

2.1. The following day prepare solvent baths in fume hood (organic solvents must be in glass containers marked for liftoff):
   a. NMP solution in ultrasonic bath set to 60 °C
   b. Room temperature bath of NMP rinse
   c. Room temperature bath of IPA
   d. Room temperature bath of DI water

3. DRY-BAKE

Note: this step should be performed immediately before photoresist deposition

3.1. Bake wafers at 60 °C in an oven under light vacuum (35-40 cmHg) and N¬2 flow (15-20 sccm) for >15 minutes

4. Ultrasonic Bath

4.1. Transfer wafer from acetone bath to NMP ultrasonic bath. As the wafer is removed from the solvent immediately spray with NMP while holding the wafer at a downward sloping angle to remove all remaining metal flakes. Make all efforts to prevent the wafer from drying.

4.2. Apply ultrasonic for 2 minutes

5. Solvent Rinse

5.1. Transfer wafer to the NMP rinse. Again, spray vigorously with NMP squeeze bottle while holding the wafer at a downward sloping angle to remove all remaining metal flakes. Let rinse for > 5 minutes.

5.2. Transfer wafer to the IPA rinse. Spray vigorously with NMP squeeze bottle while holding the wafer at a downward sloping angle to remove all remaining metal flakes. Let rinse for > 5 minutes.

5.3. Transfer wafer to the DI rinse. Spray vigorously with IPA squeeze bottle while holding the wafer at a downward sloping angle to remove all remaining metal flakes. Rinse with DI water 3× times.

5.4. Blow dry with N_2

6. Inspect and Clean

6.1. Inspect features under compound microscope.

6.2. Clean up chemicals and dishes

a. Dispose of NMP and IPA in solvent waste bottle

b. Glass dishes should be rinsed clean with acetone, IPA, and DI water