Metal Liftoff

Standard Operating Procedure

Faculty Supervisor: Prof. Robert White, Mechanical Engineering (x72210)
Safety Office: Peter Nowak x73246 (Just dial this directly on any campus phone.)
(617)627-3246 (From off-campus or from a cell phone)
Tufts Emergency Medical Services are at x66911.

For more information on liftoff see:

"Development of liftoff processes for patterning of magnetic and other materials"
http://www.phys.ufl.edu/~nanoscale/reports/year1/liftoff.html

M.J. Madou., "Fundamentals of Microfabrication", CRC Press, 2001, 18-19.

Revised: June 9, 2008

Warnings:

The solvents used in this process are highly flammable. Be careful not to expose these solvents to high temperatures (such as a hotplate). Solvent fumes are also a health hazard, be sure to process in the fume hood.

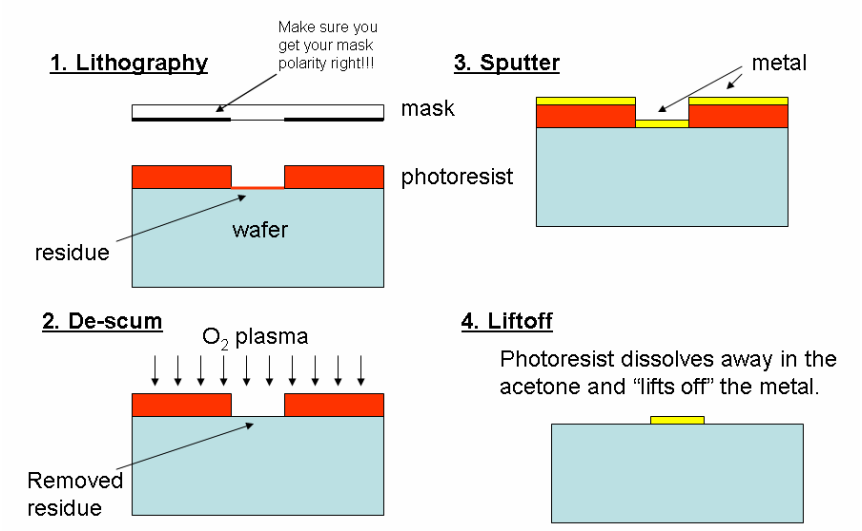
1.0 Material Requirements:

1.1 Equipment: Wafer tweezers, glass Petri dishes, glass beakers

1.2 Chemicals: Acetone and isopropanol are volatile, flammable solvents. Avoid heat sources. Do not breathe fumes. Conduct processing in the fume hood. Keep away from sparks and flames. In case of fire, use water spray, alcohol foam, dry chemical, or carbon dioxide.

1.3 Engineering Controls: Conduct procedure in the fume hood. Dispose of chemicals as described in the end of this document.

1.4 Personal Protective Equipment: Nitrile gloves and eye protection for all procedures. When working in the fume hood, also wear trionic gloves, apron, and chemical goggles.



2.0 Procedure:

2.1 Follow the Standard Lithography SOP to spin, pattern, develop, and softbake a layer of DQN photoresist (such as SPR220 series or 1800 series resist). Good liftoff results require photoresist film thicknesses significantly thicker than the metal layer being lifted off. Good results have been achieved with 4.5 μm thick photoresist for 1 μm thick metal. (This is SPR220-3 at 1000 rpm).

2.2 For best results, a brief oxygen plasma "de-scum" is suggested between lithography and metal deposition. This brief plasma etch will remove any thin photoresist residue which could cause poor metal adhesion or contact. The de-scum can be performed in the March CS1701F RIE tool. A 200W, 20 second oxygen plasma at 100% O_2 flow rate (all other gases off) should be sufficient. See the SOP for the CS1701F for details.

2.3 Follow the Nanomaster NSC 3000 DC Magnetron Sputter Tool SOP to deposit the metal layer on top of the photoresist.

2.4 The metal liftoff can be performed either with or without a sonicator. The sonicator will decrease the time required for the acetone soak.

2.4.1 Liftoff without the sonicator.

2.4.1.1 Use the two glass Petri dishes marked "Liftoff, acetone/isopropanol."

2.4.1.2 Fill one Petri dish with acetone and one with isopropanol and cover both dishes.

2.4.1.3 Use wafer tweezers to put the wafer in the acetone.

2.4.1.4 Leave the wafer in the acetone until the liftoff is complete. Agitation will decrease the time required. The time required will vary with the film stress and thickness. Be sure that the acetone does not completely evaporate, and replenish as is necessary.

2.4.1.5 Once the liftoff is complete, transfer to the wafer to the Petri dish with isopropanol and agitate for 2 minutes.

2.4.1.6 Use wafer tweezers to remove the wafer from the isopropanol. Spay the wafer with DI water and blow dry with the air gun.

2.4.1.7 Inspect the wafer under a microscope to ensure that the liftoff is complete.

2.4.1.8 Additional time may be required if the liftoff is not complete.

2.4.2 Liftoff with ultrasonics

2.4.2.1 Pour some acetone into the bottom of a glass beaker large enough to hold the entire wafer (beakers larger than 1500 mL will not fit in the sonicator). Use enough acetone to completely cover the wafer.

2.4.2.2 Fill the sonicator with enough DI water to ensure the water level in the sonicator will be above the acetone level in the beaker.

2.4.2.3 Turn on the main power to the sonicator.

2.4.2.4 Use the "Select Option" button to switch between modes.
2.4.2.5 Set the "Set Temp" to 20° C to ensure that the acetone will not be heated.
2.4.2.6 Set the "Set Sonics" to the desired time for the sonication.
2.4.2.7 While on the "Set Sonics" screen, press "On/Off" to activate the sonication.
2.4.2.8 The "On/Off" button can be used to end the process early, otherwise the process will end after the time prescribed in "Set Sonics" has passed.
2.4.2.9 Remove the glass beaker containing the acetone and wafer from the sonicator.
2.4.2.10 Remove the wafer from the acetone, rinse with isopropanol, rinse with DI water, and blow dry with the air gun.
2.4.2.11 Inspect the wafer under a microscope to ensure that the liftoff is complete.
2.4.2.12 Additional sonication may be necessary if the liftoff is not complete.
2.4.2.13 Turn off the main power to the sonicator.
2.4.3 Dispose of the acetone and isopropanol in the solvent waste container.
2.4.4 Rinse the glass beakers and Petri dishes with acetone and dump it into the solvent waste container.
2.4.5 Rinse the glass beakers and Petri dishes with isopropanol and dump it into the solvent waste container.
2.4.6 Rinse the glass beakers and Petri dishes with DI water and dump it into the solvent waste container.

3.0 <u>Storage:</u>

3.1 The acetone and isopropanol should be stored in a closed, capped bottle in secondary containment in the solvent cabinet.
3.2 Acetone and isopropanol squirt bottles stay in the hood.

4.0 <u>Waste Disposal:</u>

4.1 Solvent waste (acetone, isopropanol)
4.1.1 Wipes are disposed of in the solvent trash can.
4.1.2 Liquid waste and rinse water are collected in the solvent waste bottle.

5.0 <u>Accident Procedures:</u>

5.1 Contact: Read MSDS prior to working with any chemical to familiarize yourself with the symptoms of exposure and recommendations for treatment.
5.1.1 Solvents
5.1.1.1 Skin contact: Flush with water.
5.1.1.2 Eye contact: Flush with copious amounts of water for 15 minutes.

5.1.1.3 Ingestion: Do not induce vomiting. Give large amounts of water.

5.1.1.4 Inhalation: Remove to fresh air. Resuscitate if necessary.

5.2 Spill:

5.2.1 If a small, contained spill occurs, such as inside the hood, wipe it up with chemical wipes and dispose of in the appropriate trash container.

5.2.2 If a large spill occurs that you are not comfortable cleaning up:

5.2.2.1 If it is a solvent spill, make sure that there are no ignition sources (open flames, hot filaments…most likely there will not be any), evacuate the room, close the door, and allow solvent to evaporate. Notify the Tufts emergency services (x66911) immediately. Also notify the faculty advisor.

If at any time you feel a situation is dangerous, do not hesitate to call the safety office (x73246, Peter Nowak) or the faculty supervisor (x72210, Robert White).

Report all accidents (injuries, major spills, fires) to the safety office at x73246 (Peter Nowak) and the faculty supervisor at x72210 (Robert White). For emergencies, call Tufts Emergency Services at x66911.