AZ Series Photoresist Processing

<u>Standard Operating Procedure</u>

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 (campus phone), 617 636 6911 (cell phone).

For more information: AZ Electronic Material and the attached AZ 9200 resist data sheet

May 11, 2017.

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1. Material Requirements:

1.1 Equipment: Spin coater, hotplate or oven, tweezers, glass petri dish or beaker, pipette, two 1000 ml glass beakers

1.2 Chemicals: AZ series resist, AZ 400 K inorganic developer (pre diluted or full strength, both are available) or AZ Developer.

1.2.1 AZ series photoresist is a DQN resist dissolved in the flammable organic solvent PGMEA, 1-Methoxy-2-propyl acetate (CAS: 108-65-6); 58 %.

1.2.1.1 AZ series resist causes irritation to skin, eyes, nose, and respiratory tract. It is readily absorbed through the skin. Prolonged, repeated contact, inhalation, ingestion, or absorption through the skin, may cause toxic effects to internal organ systems.

1.2.1.2 AZ series resists are flammable and should by kept away from ignition sources. Baking spun resist on a hotplate is, however, acceptable.

1.2.2 AZ 400K inorganic developer is a potassium developer buffered to maintain an alkaline pH. It contains Potassium hydroxide, potassium borate (CAS: 20786-60-1) <15 %, 85% water.

1.2.2.1 **<u>Causes severe eye irritation.</u>**

1.2.2.2 Not irritating to the skin.

1.2.2.3 Prolonged and repeated exposure can cause kidney damage.

1.2.2.4 Not flammable.

1.2.3 AZ developer is an alkaline developer for AZ resists formulated to have a particularly low aluminum etch rate. It contains 1% sodium metasilicate.

1.2.3.1 Mild skin and eye irritation.

1.2.3.2 Not combustible.

1.2.3.3 No odor.

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

1.4 Personal Protective Equipment: Nitrile gloves and eye protection required for all procedures.

2.0 Procedure

2.1 Wafer preparation

Start with a clean wafer! Piranha or RCA clean, or ultrasound acetone and IPA clean as appropriate. **Note**: if doing a solvent clean, be sure to finish with a careful DI water rinse and follow up with air drying and a dehydration bake, or you may get very poor resist adhesion.

2.2 (Optional) Dehydration bake your wafers at 200 ºC.

2.2.1 Perform dehydration back on an aluminum foil topped SU-8 hotplate (5 min) or in the SU-8 convection oven (30 min).

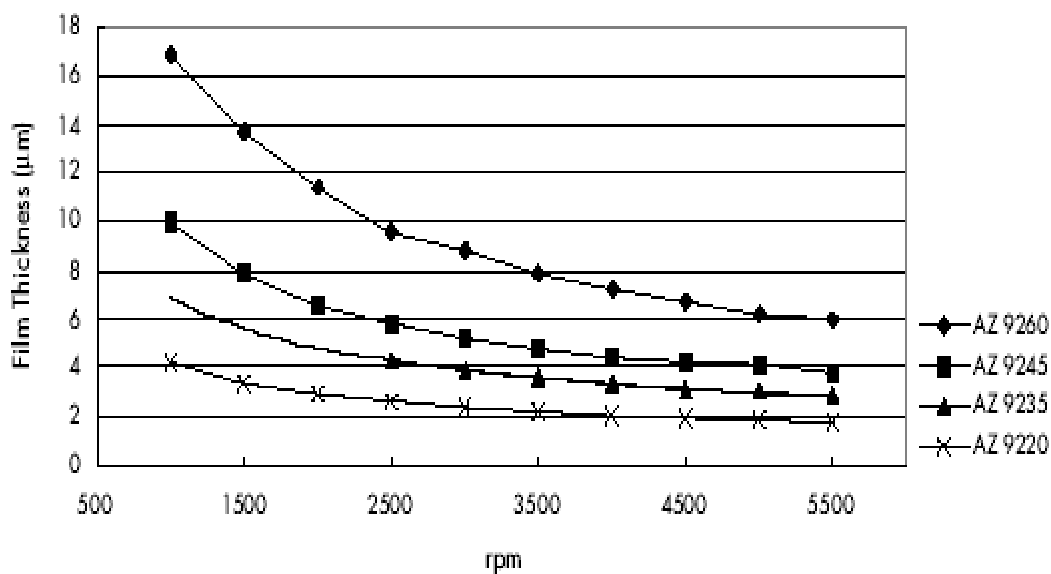
2.2 Spin coating

2.2.1 Dispense HMDS (MCC Primer 80/20) onto the wafer with a pipette. Spin the wafer at 2000 rpm or more for 30 seconds or more to completely dry off the HMDS. (This primes the wafer and improves adhesion of the AZ resist).

2.2.2 Dispense resist with a second, clean pipette (or pour from a small working bottles if easier) onto the wafer. Use sufficient resist to create a centered, circular puddle approximately half the diameter of the wafer.

2.2.3 Spread @ 500 rpm for 5-10 sec.

2.2.4 Spin: Ramp to final spin speed at a high acceleration rate (4s) and hold for a total of 60 seconds. See spin speed curve below.

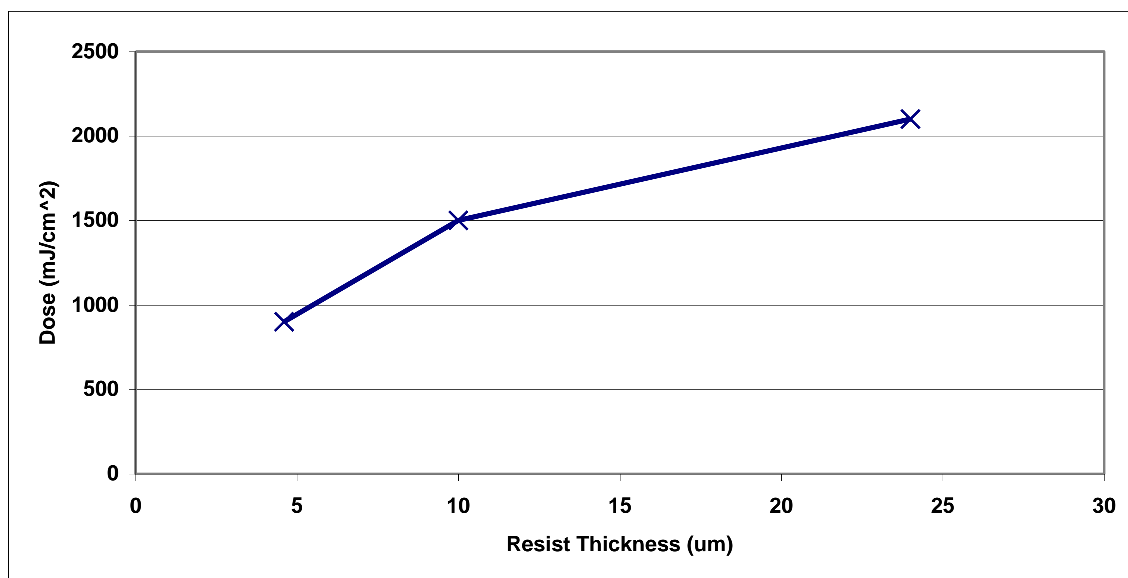


2.3 Soft Bake

Hot plate at 120 C. For a 5 micron film, bake for 3 mins. For a 10 micron film bake for 4 minutes. For a 20 micron film, bake for 6 minutes.

2.4 Exposure

The aligner gives approximately 40 mW/cm^2 exposure intensity between I and H line (calibrated to 20 mW/cm^2 at I-line). See chart on the next page for recommended exposure dose from the manufacturer vs film thickness. At 40 mW/cm^2, 1500 mJ/cm^2 is 37.5 seconds.



2.5 Post exposure bake
Not recommended for most applications

2.6 Develop
Inorganic AZ400K developer is recommended. Two formulations are available – pre-diluted or full strength. AZ developer can also be used if the wafer has aluminum on it – AZ400k rapidly etches aluminum, but AZ developer does not. Also TMAH developer (MF CD 26) can be used.

The full strength AZ400K developer should be diluted as 1 part developer to 3 parts DI water. The pre-diluted AZ400K can be used straight from the container. Make sure you know which you are using!

The AZ developer should be diluted as 1 part developer to 1 part DI water.

Use the developer only in a 1000 mL beaker labeled specifically for that developer. Rinse beakers should also be labeled for the specific developer (AZ400k, AZ developer, or MFCD26).

Do not mix MFCD26 and AZ400K glassware! Use dedicated AZ400K glassware only. Small amounts (ppm concentration) of TMAH will degrade the AZ400K.

- Develop for 2 mins (4.5 micron film) to 4 mins (20 micron film) while gently agitating. For masks with high loading (most of the resist is dissolved) longer times may be needed. Observe during develop – sometimes you can see the pattern fully develop if you have some large features.

After developing, rinse in a 1000 mL beaker of DI water for 2 minutes while agitating, second rinse in a second 1000 mL beaker of water for 2 minutes while agitating.

- Dry with air gun.

- Make sure to examine the resist after processing by eye and under the microscope to be sure it is fully developed. If it is not fully developed, additional develop time may be needed. This can vary depending on the thickness of the resist, and the geometry of the mask; a lightfield mask where much of the resist is removed may take longer to develop than a darkfield mask.

2.7 Removing AZ resist
AZ photoresist can be removed by using AZ 400T and 300T strippers or standard cleanroom solvents, such as acetone, photoresist thinner, or positive photoresist removers (such as Remover 1165).

3.0 Storage:

3.1 Store working bottles of AZ photoresists in photoresist cabinet. Store stock bottles in the refrigerator. Store upright in original containers in a dry area above 30-55ºF (-1-13 ºC). Allow to warm up to room temperature before opening. Keep away from sources of ignition, light, heat, oxidants, acids, and reducers.

3.2 Store AZ400K developer and AZ developer in the base cabinet.

4.0 Waste Disposal:

4.1 AZ resist

4.1.1 Solid waste of AZ resist should go in the solvent solid waste container.

4.1.2 Liquid waste for AZ resist should go in the mixed photoresist and solvent waste bottle.

4.2 AZ 400K / AZ developer

4.2.1 Solid waste should go in the acid/base waste container.

4.2.2 Liquid developer waste can be mixed with other alkaline waste – potassium hydroxide, Microposit developer, and MFCD 26 (TMAH) developer. The waste bottle should be HDPE.

5.0 Accident Procedures:

Tufts Emergency Services can be reached at x66911 (campus phone), 617 636 6911 (off campus or cell phone).

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 AZ series resist

5.1.1.1 **If inhaled**, remove individual to fresh air. If breathing is difficult, call Tufts emergency services, 617 636 6911 (cell phone). Consult physician if irritation occurs.

5.1.1.2 In case of **eye contact,** flush eyes with plenty of water for 15 minutes. **Get medical attention immediately**.

5.1.1.3 In case of **skin contact**, flush affected skin areas with water, and wash with mild soap and water. Remove contaminated clothing. Consult physician if exposure is extensive or irritation occurs.

5.1.1.4 **If ingested**, give water or milk to dilute stomach contents. Do not induce vomiting. Never give anything by mouth to an unconscious person. **Get medical attention immediately**.

5.1.2 AZ 400 K Developer or AZ developer

5.1.2.1 In case of **eye contact**, flush eyes with plenty of water for 15 minutes. **Get medical attention immediately**.

5.1.2.2 In case of **skin contact**, flush affected skin areas with water, and wash with mild soap and water. Remove contaminated clothing.

5.1.2.3 **If inhaled**, remove individual to fresh air. If breathing is difficult, call Tufts emergency services, 617 636 6911 (cell phone) give oxygen.

5.1.2.4 **If ingested**, give water or milk to dilute stomach contents. Do not induce vomiting. Never give anything by mouth to an unconscious person. **Get medical attention immediately**.

5.1.2.5 Get medical attention immediately for ingestion or breathing problems or if skin contact is extensive.

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, such as breaking a bottle on the floor, evacuate the lab and contact Tufts emergency services (x66911). 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.