

PMMA Resist Processing for E-Beam Lithography

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: www.microchem.com

PMMA photoresist is typically used for e-beam lithography, several viscosities are available. Please use type A resists to avoid the chlorobenzene found in type C resists. This procedure describes spin on, bake, and develop procedures for PMMA. Exposure requires an ebeam lithography tool.

This SOP assumes you are already familiar with contact lithography.

Revised: December 18, 2017

1. Material Requirements:

1.1 Equipment: Spin coater, hotplate or oven, tweezers, several glass beakers, disposable pipets

1.2 Chemicals: PMMA resist, IPA, MIBK (Methyl Isobutyl Ketone) 1:3 solution, Toluene

Hazards associated with chemicals:

PMMA resist is a combustible liquid and vapor. It causes irritation to eyes, nose, and respiratory tract. Prolonged, repeated contact, inhalation, ingestion, or absorption through the skin, may cause toxic effects to internal organ systems.

Isopropanol, Toluene and MIBK 1:3 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.

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

1.3 Personal Protective Equipment: Nitrile gloves and eye protection for all procedures. When working in the fume hood, also wear trionic gloves. Apron and face shield are not required.

2.0 Procedure:

2.1 Wafer or substrate preparation

Piranha clean or ultrasound acetone and IPA clean (see Piranha clean SOP). Recall that substrates must be conductive so Si is recommended.

2.2 Dehydration bake your wafers at 200 C.

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).

2.3 Spin coating – Conduct in “Dirty” Spinner

2.3.1 Using a disposable pipet, dispense resist (up to 8mL for a 100mm wafer)

2.3.2 A 5 step spin is recommended

4 sec ramp to 500rpm

8 sec hold at 500rpm

4 sec ramp to final speed

45 sec hold at final speed

4 sec ramp to 0rpm

2.3.3 To determine final spin speed, consult MicroChem datasheets.

2.3.4 Bi-layer PMMA processes may be useful for improved liftoff performance, again, consult the MicroChem datasheet

2.4 Pre Bake

Hot plate: 180C for 60 - 90 sec

OR

Convection Oven: 170 C for 30 min

2.5 Exposure:

Exposure can be conducted in the Tescan VEGA3 SEM. We will write an EBL exposure SOP in the near future.

2.6 Development:

Place sample in MIBK 1:3 solution for 60-90 sec

Immediately transfer to IPA for 30 sec

Dry with nitrogen gun

2.7 Remove PMMA

If desired, Toluene easily removes PMMA. Using appropriate glassware, rinse your substrates in DI water and blow dry.

3.0 Storage:

3.1 Store PMMA resist upright in original containers in the photoresist storage cabinet above 10C (50F). Do not refrigerate. Keep away from sources of ignition, light, heat, oxidants, acids, and reducers. Shelf life is 13 months from date of manufacture.

3.2 Isopropanol, Toluene and MIBK 1:3 are found in the solvent storage cabinet.

4.0 Waste Disposal:

- 4.1 Solvent waste (MIBK 1:3, toluene, PMMA resist and 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 Accident Procedures:

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 PMMA, IPA, Toluene or MIBK 1:3

5.1.1.1 Skin contact: Rinse for 15 minutes with water. Contact Tufts health services and inform the lab directory and Tufts health and safety office.

5.1.1.2 Eye contact: Rinse for 15 minutes. Contact Tufts health services and inform the lab directory and Tufts health and safety office.

5.1.1.3 Ingestion: Do not induce vomiting, gently wipe or rinse inside of mouth with water. Contact Tufts health services and inform the lab directory and Tufts health and safety office.

5.1.1.4 Inhalation: Remove to fresh air. Contact Tufts health services and inform the lab directory and Tufts health and safety office.

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 chemical one spill, do this. Notify the Tufts emergency services (x66911) immediately. Also notify the faculty advisor.

5.2.2.2 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.