

Shadow Nanosphere 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.

Chen, J., P. Dong, et al. (2013). "Controllable fabrication of 2D colloidal-crystal films with polystyrene nanospheres of various diameters by spin-coating.", Applied Surface Science, v 270, pp 6-15.

Revised: April 29, 2013

Goal:

Deposit, dry, and fix a close-packed monolayer of polystyrene nanospheres on a substrate for use as a deposition/etching mask.

Warnings:

The chemicals you are working with here are not acutely hazardous. However, all processing (including hotplate bakes) must be done in the fume hood, as the fumes released during processing have long term health effects.

1. Material Requirements:

1.1 Equipment: Spin processor, photoresist hotplates, wafer tweezers, small glass or plastic container, precision pipette with disposable tips

1.2 Chemicals: polystyrene nanospheres in water suspension, isopropanol, Triton X-100

1.2.1 Hazards associated with chemicals:

1.2.1.1 Polystyrene nanospheres have no known health risks, but contact should be avoided. Prepared mixtures may contain benzene or other hazardous chemicals.

1.2.1.2 Isopropanol is a volatile, flammable solvent. Avoid heat sources. Do not breath fumes. Conduct processing in the fume hood.

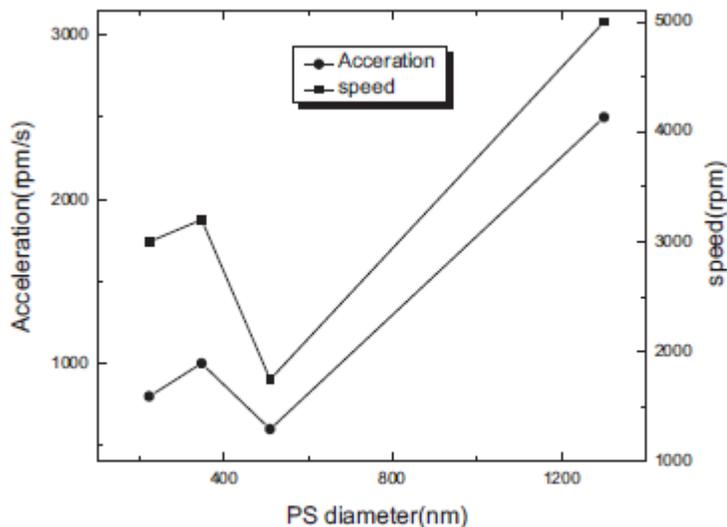
1.2.1.3 Triton X-100 is a toxic surfactant. Avoid heat sources. Avoid skin contact. Do not breath fumes. Conduct processing in the fume hood.

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

1.4 Personal Protective Equipment: Nitrile gloves, chemical apron, and eye protection are required for all procedures.

2.0 Procedure:

- 2.1 Use clean substrate. Cleaning procedure will vary with substrate material.
- 2.2 Prepare nanosphere mixture in a small clean container. The initial recommendation is a 50/50 mix of isopropanol and nanospheres in water suspension. A precision pipette can be useful here.
- 2.3 Mount substrate in the “dirty” spinner. Do not use the clean spinner.
- 2.4 Program the spinner. Suggested speed and acceleration values are shown below.
- 2.5 Dispense the nanosphere mixture onto the substrate. Start the spinner.
- 2.6 Remove substrate. Clean spinner according to Spinner SOP.
- 2.7 Some references recommend drying in nitrogen and/or annealing on a hot plate for a period of 5 to 30 seconds at 100°C to 150°C. Annealing may fix the mask in place by fusing the spheres together.
- 2.8 A small amount (1:400) of Triton X-100 may be added to the nanosphere/water/isopropanol mix to improve wetting to the substrate.



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3.0 Storage:

- 3.1 Suppliers recommend storing the nanospheres at 4°C. Do not freeze.

3.2 Isopropanol is stored in the solvents cabinet.

3.3 Store Triton X-100 in a tightly sealed container in a well-ventilated location.

4.0 Waste Disposal:

4.1 Nanosphere mixture, isopropanol, dilute Triton X-100

4.1.1 Solid waste should go in the solvent/photoresist trash.

4.1.2 Liquid waste should go in the solvent/photoresist liquid 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 Polystyrene nanospheres in water with benzene

5.1.1.1 Skin contact: Wash skin with deluge of water for at least 15 minutes.

5.1.1.2 Eye contact: Flush eyes with flowing water for at least 15 minutes.

5.1.1.3 Ingestion: If swallowed, **DO NOT INDUCE** vomiting. Give 8 oz. of water or milk to drink. Call a physician or the POISON CONTROL CENTER immediately. Never give anything by mouth to an unconscious person.

5.1.1.4 Inhalation: If breathing is difficult, contact emergency personnel.

5.1.2 Isopropanol

5.1.2.1 Skin contact: Wash with soap and water.

5.1.2.2 Eye contact: Flush eyes with flowing water for at least 15 minutes.

5.1.2.3 Ingestion: Wash out mouth with water. Contact physician.

5.1.2.4 Inhalation: Remove to fresh air. If breathing is difficult, contact emergency personnel.

5.1.3 Triton X-100

5.1.3.1 Skin contact: Wash off with soap and plenty of water. Consult a physician.

5.1.3.2 Eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

5.1.3.3 Ingestion: Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5.1.3.4 Inhalation: If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

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: 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.