

Silk (Fibroin) Processing

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 silk processing see:

Kise, M. A. Silk Fibroin Dispergation. *Textile Research Journal*, Vol. 5, No. 9, 401-415 (1935)

Revised: April 15, 2008

1. Material Requirements:

1.1 Equipment: Any approved container in cleanroom.

Note: Any chemical containers including PMP, PC, PP, PS, PVDF, PTFE and any non-water soluble polymer is permitted. Other containers should be approved through the faculty supervisor prior to use.

1.2 Chemicals: Fibroin (from *Bombax Mori*; [Silkworm])

1.2.1 Hazards associated with chemicals:

1.2.1.1 Silk elicits no immune response and is considered safe for all modes of exposure including ingestion.

1.3 Engineering Controls: Purified silk [fibroin] must be handled to minimize particle contamination. Filtration through 0.45 micron membranes is recommended, but only required if one's sample has *not* been centrifuged to remove host organism debris. I.e. when silk is prepared for a clean room preparation one must minimize particulate matter. The most direct method is to filter the silk solution under chaotropic conditions through a minimum of a 0.45µm filter membrane. This process will assure that debris from the silkworm is not included in clean room preparations of fibroin and is required prior to using such a substance in the clean room.

1.4 Personal Protective Equipment: Full clean room garb is required for use of fibroin in a clean room environment. Be sure to wear protective eyewear and full clean room garb prior to use in order to preserve the clean room environment. The fibroin [silk] poses no known health risks through any means of exposure.

2.0 Procedure:

Complete all processes in Cleanroom

2.1 Prepare silk solutions before entering clean room

2.1.1 5 mL of solution is sufficient for spin coating on a four inch wafer.

2.2 When spin coating silk be sure to use the 'dirty' spin coater (SU-8 spin coater)

2.2.1 See Laurell Spinner SOP for more information on spin coating

2.2.2 Start at 200 rpm for 3 s

2.2.3 Go to 500 rpm in 3 s

2.2.4 Spin at 500 rpm for 2 s

2.2.5 Ramp to 500-5000 rpm in 3 s

2.2.6 Then spin at 500 – 5000 rpm for 10 – 45 s depending on the film thickness desired. For 6 % wt silk solution, a 500 rpm, 10 second spin results in approximately 500 nm thick films.

2.3 The silk thin film can be air dried in a desiccator with desiccant for 72 hours (recommended) or dried more rapidly using a 65°C hotplate bake (4 minutes) followed by a 65°C oven bake (4 hours). Results for the faster, higher temperature bake may be inferior.

2.4 When finished, clean exposed materials with water and fab wipes to remove silk residue from tools. Then clean with isopropanol and fab wipes. Dispose of fab wipes in solvent waste.

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3.0 Storage:

3.1 Fibroin should be stored in a clean room approved container under refrigeration when not in use. Lack of refrigeration will result in silk self-assembling over the course of days to weeks into a gel.

4.0 Waste Disposal:

4.1 Fibroin [silk]

4.1.1 Solid waste for this chemical should go directly into uncontaminated trash unless other hazardous chemicals have been used in conjunction with the fibroin [silk]. Fibroin [silk] is a protein and poses no health or environmental issues and is readily biodegrades over time.

4.1.2 Liquid waste for this chemical should be placed into approved containers. Provided that such containers are unavailable, one can place waste into any plastic or glass container.

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 Chemical one:

5.1.1.1 Skin contact: Wash exposed area with water for 15 minutes

5.1.1.2 Eye contact: Wash eyes with water for 15 minutes

5.1.1.3 Ingestion: No adverse effects should result. Contact health professional if any symptoms persist.

5.1.1.4 Inhalation: Remove exposed individual from area and contact health professional 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 large **Fibroin [silk]** spill, Wipe spill up with absorbent material and dispose of in appropriate disposal container. Note that the material used to clean up the spill is likely more hazardous than the silk. Accordingly, use this material's MSDS to determine the proper disposal location. 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.