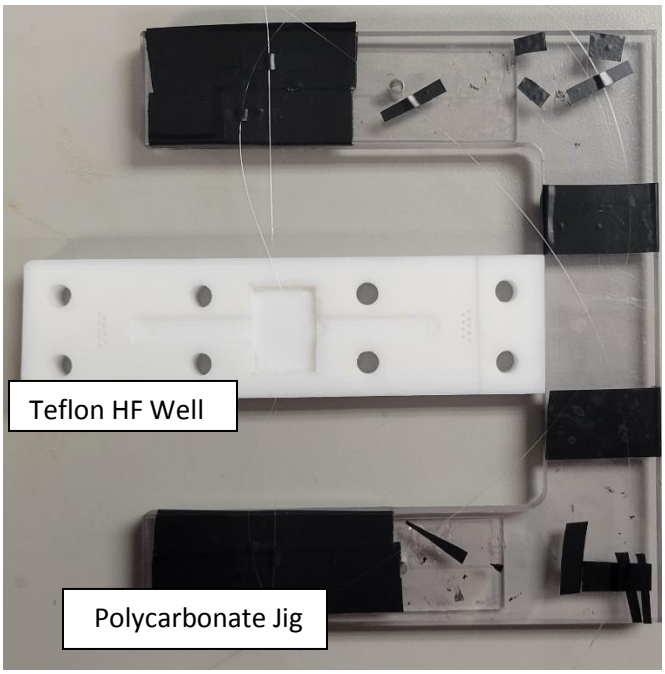
Name	Optical Fiber Etcher
Description	A process for etching optical fibers
Location	G2N – (Stored in E3X 4112)
Manufacturer	Designed and Fabricated in SIMSLAB
Serial No.	n/a
Model No.	n/a
SOP Creation Date	25-August-2016
SOP Created By	AbdulRahman/Krishna Iyer
SOP Revision Date	23-November-2022
SOP Revised By	Sophia Rahn/AbdulRahman Ghannoum
SOP Online Location	\\nasnieva\share02\Other - Lab Safety\SOP
Equipment Owner	SIMSLAB
Authorized Trainers	AbdulRahman Ghannoum
Support Technicians	-



Significant Hazards 	• Hydrofluoric acid (HF) is highly corrosive and toxic even in a dilute form, therefore any contact with skin or eyes must be treated as a medical emergency.
Administrative Controls	• Considered safe to operate alone for trained individuals

Engineering Controls	• Perform Etching on a certified wet bench
	  • Fume hood (plastic Sash Window)
	  • Ensure appropriate air flow

PPE Required	• Eye and face protection as appropriate (approved splash goggle or a full face shield) • A splash apron. • Gloves (neoprene or nitrile rubber). • Wear acid-resistant boots • No loose clothing or jewelry • Long loose hair is tied back • Access to Calcuim Gluconate Gel
Relevant Standards and Codes	None

Relevant MSDS	Hydrofluoric acid
Accident Procedure – Skin	**Skin:** As quickly as possible, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Immediately flush with lukewarm, gently flowing water. Limit flushing with water to 5 minutes if 0.13% benzalkonium chloride (Zephiran®) solution or 2.5% calcium gluconate gel is available. If these treatments are not available, continue flushing until medical treatment is available. A certain quantity of either prepared solution or the calcium gluconate gel be kept on hand at all times. Solutions should be replaced annually if not previously used. *CALCIUM GLUCONATE GEL:* Wearing chemical protective gloves, start massaging 2.5% calcium gluconate gel into the burn site. Apply gel frequently and massage continuously until medical attention is available. Quickly transport victim to an emergency care facility. Double bag, seal, label and leave contaminated clothing, shoes and leather goods at the scene for safe disposal.
Accident Procedure - Eyes	**Eyes:** Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for 15-20 minutes, while holding the eyelid(s) open. If a contact lens is present, DO NOT delay irrigation or attempt to remove the lens. Take care not to rinse contaminated water into the unaffected eye. DO NOT use benzalkonium chloride (Zephiran®) for eye contact. If sterile 1% calcium gluconate is available, limit water flushing to 5 minutes. Then, use the 1% calcium gluconate solution to repeatedly rinse the eye(s). Immediately transport victim to an emergency care facility. Continue flushing with water, neutral saline or 1% calcium gluconate during transport, if at all possible.
Accident Procedure - Ingestion	**Ingestion:** NEVER give anything by mouth if victim is rapidly losing consciousness, is unconscious or is convulsing. Have victim rinse mouth thoroughly with water. DO NOT INDUCE VOMITING. If vomiting occurs naturally, have victim rinse mouth with water again. Quickly transport victim to an emergency care facility.
Accident Procedure - Inhalation	**Inhalation:** Remove source of contamination or move victim to fresh air. If breathing is difficult, trained personnel should administer oxygen and 2.5% calcium gluconate, preferably with a doctor's advice. DO NOT allow victim to move about unnecessarily. Symptoms of pulmonary edema can be delayed up to 48 hours after exposure. If breathing has stopped, trained personnel should begin artificial respiration (AR) or, if the heart has stopped,
Emergency Shutdown Procedure	In case of Emergency, leave the room immediately, close fume hood if possible.

Pre-start Checklist

- Do not perform procedure unless fully trained
- Check that the space is clear around the system
- Do not perform etching if other are using the fume hood.
- Know safety procedures in case of emergency

Start-up/Operating/Shutdown Procedure

- In E3X 4112
    - Cut an appropriate length (80 cm) of the optical fiber (ThorLabs AFS 105/125Y)
    - Remove Polymer jacket in the mid region of the cut fiber (length: 4.5 cm)
        - Fiber stripper (ThorLabs T06S13) is used to form discontinuity in the polymer jacket
        - Region between discontinuity is immersed in acetone for 4 minutes (use soaked Kimwipes)
        - Soaking causes delamination of the fiber jacket, which can then be wiped away with Kimwipes
    - Prepare fiber ends to connect to LED light source and spectrometer (using ThorLabs BFTU)
    - Mount the prepared fiber to the custom jig made of polycarbonate
    - Perform an initial test using a light source and spectrometer to ensure appropriate transmission, ensuring the signal is not saturated.
    - Transfer prepared fixture in an enclosed container with the two plastic beakers that will be used, Teflon HF well, the spectrometer, laptop with appropriate software, and needed connectors (USB, ThorLabs BFTU)
- In G2N
    - Wear appropriate PPE to enter G2N
    - If the wet bench has any unidentified droplets wash the area well and then dry the area using G2N paper towels to ensure no traces of HF
    - Place jig (holding optical fibers) in the fume hood (wet bench)
    - Place the large and small beakers in the fume hood
    - Obtain the buffered HF and Tartrazine/HF mixture from the chemical storage cabinet and place it inside the fume hood.
    - Obtain the waste disposal bottle from the chemical waste tray (found under the spin coating bench in a tray) and place it inside the fume hood
    - Wear appropriate PPE for HF handling (Face shield, apron, neoprene gloves)
    - Connect the fiber to spectrometer and light source using BFTU
    - Position Teflon HF well such that the corners are within the black tape on the jig (as pictured above). This places the unjacketed portion of the fiber in the buffered HF
    - Using a pipette transfer buffered HF into the Teflon HF well, being sure to fill until fiber is immersed while avoiding spillage
        - If any spills do occur inside of the fume hood spray with water for **5** min
    - Allow it to etch for 20 minutes.
    - When the etch time is complete, using the DI water gun and the large beaker, lift the jig and wash it until half the beaker is filled then hold the jig over the sink and continue washing for another 3-5 min.
    - Dispose the wash DI water in the large beaker into the HF disposal bottle.

- Dispose of the used HF from the Teflon HF well into the disposal bottle
- Rinse the Teflon HF well with a dropper by putting wash water in and removing it with the dropper. Dispose of dropper water in HF-rinse bottle/beaker. Repeat 5 times.
- Wash the HF well in the sink for about 1 min.
- Rinse Teflon HF well with isopropyl alcohol and dry with nitrogen gun.
- Rinse fibers with isopropyl alcohol and dry with nitrogen gun.
- Place polycarbonate jig and Teflon HF well into the same position as the previous etch. Connect the fiber to the light source and spectrometer.
- Fill Teflon HF well with buffered HF- tartrazine mixture.
- Etch until 92% to 98% transmittance is observed depending on the target etch.
- Remove the jig from its position over the Teflon HF well (be sure to disconnect the fiber from the spectrometer and light source) and rinse the fibers for 5 minutes in running water. (You may perform a quick wash when the achieved loss is observed over the large beaker to avoid over etching.)
- After 5 minutes of washing of the fibers, pour the water down the sink and place the fiber on the jig aside.
- Dispose of the used HF from the Teflon HF well into the labeled polypropylene disposal bottle.
- Rinse the Teflon HF well with a dropper by putting wash water in and removing it with the dropper. Dispose of dropper water in HF-rinse waste bottle/beaker. Repeat 5 times or until no traces of Tartrazine is observed.
- Rinse Teflon HF well with DI water for about 3 min then with isopropyl alcohol and dry with nitrogen gun.
- Rinse fibers with isopropyl alcohol and dry with nitrogen gun.
- After 5 minutes of washing of the fibers, pour the water down the sink
- Clean the small and large beakers by running water for 5 minutes and pour the remaining water down the sink
- Rinse the small and large beaker with isopropyl alcohol and dry with nitrogen gun
- Return the buffered HF and waste disposal bottle to their appropriate storage space
- Remove the apron, face mask and gloves
- Return all equipment and apparatus the transfer box and back to E3X 4112

* This SOP shall be stored in a close and accessible location to the equipment/process to which it references.
**All employees to whom this Safe Operating Procedure applies must read and sign this document.

Optical Fiber Etcher

Name (print)	Signature	Date
