



uOttawa

# University of Ottawa USER and SAFETY MANUAL

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Centre de Recherche en Photonique  
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NanoFabrication Facility  
USER and SAFETY MANUAL  
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## Section 1

## LABORATORY RULES

**In an emergency – contact University Safety at 5411 and a lab supervisor.**

**Lab supervisors: Ewa Lisicka (ext. 7223), Tony Olivieri (ext. 7221).**

**Jeremy Upham (ext. 7139):** As Dr. Boyd's lab manager, he is primarily responsible for the Samco RIE etcher tool in 333B as well as the Zeiss Gemini 500 SEM in 329.

**and Chris Valdivia (ext. 3978):** As Dr. Hinzer's lab manager, he is responsible for the Bruker AFM in 329 and the Solder reflow unit in 330.

- **Only authorized persons** are allowed to work in the NanoFabrication Facility. All visitors must be pre-approved (Ref 1, User Access to CRPuO laboratories, <https://photonics.uottawa.ca/user-access> ) and escorted by an administrator while in the laboratory.
- **Authorized persons** are those that have completed their registration (Ref 2, Internal Users Registration form, <https://crpuo.typeform.com/to/anMKRF> ), which has been approved by the lab managers, as well as completed their lab safety training, WHMIS training and have accepted the safety protocols in this manual.
- Users will only use equipment for which they have received training. Instruction is given by a qualified member of the laboratory staff. There is no student-on-student training; only training by an administrator is accepted.
- **After-hours access:** most authorized users have access to the core labs between 8:30am and 5pm. Certain exceptions can be made, providing that the user:
  - 2-3 years experience working in a nano-fab/clean room environment (experience will be assessed by lab managers on an case by case basis);
  - Has informed someone that they are going to be working in the lab outside of normal hours;
  - Has specified the tool they are going to use for booking purposes;

- Equipment Training Procedure:  
Although every tool is unique, the general training process is as follows:
  - An administrator will show the user how to operate the tool from start up to shut down.
  - Time permitting, the user being trained can use the tool while being supervised.
  - One week (or longer) after the final training session, the new user will be expected to fully operate the tool with supervision, but minimal guidance.
  - If the user demonstrates that she/he can operate the tool properly, they will be “signed off” as an official user.
  
- Authorized users will be provided with a link to register themselves for the CRPuO online booking system. Users must make a reservation through the online booking system in order to use the facilities. Bookings can be cancelled up to 24 hours prior to reservation time.
  
- If the user no longer requires the facilities for the timeslot booked, please cancel the reservation to provide other users with the available timeslot. After not doing so two times, the user’s reservation privileges will be revoked.
  
- If you must cancel your booking less than 24 hours in advance, you must email one of the following people: CRPuO administrator, Tony, Ewa, Jeremy or Christopher. (only they have administrative access to Skedda)
  
- Only book tools for the amount of time needed. Failure to show up one hour after the reserved timeslot can result in losing the timeslot.
  
- If there is a problem with the booking system, please inform a lab supervisor and contact [crpadmin@uottawa.ca](mailto:crpadmin@uottawa.ca).
  
- For safety reasons working alone should be avoided. When working with hazardous materials or equipment at least one other person **must** be present in the lab.
  
- Cleanroom suits, boots, hood, and safety glasses must be worn at all times. Shorts, open toed shoes, outdoor shoes, hi-heel shoes or being shoeless is **NOT** permitted.

- Backpacks, bags, purses, etc. are **NOT** permitted in the vestibule.
- **No food or drinks** of any kind will be brought in or consumed in the laboratory.
- Read **ALL** signage posted outside and inside of the labs.
- **Know the chemicals** you are going to be working with, and how they react to other materials in the area. **READ** the MSDS for each chemical you are using. Supervisors should be notified before users intend to work with hazardous chemicals.
- **SOP: Standard Operating Procedure**  
SOP's are continuously updated. Please refer to these and become familiar with them before starting a process.
  - If an SOP does not exist, it's up to the user to create one;
  - It must be approved by a lab manager before proceeding.
- **Labeling of chemicals** while in use and in storage is **REQUIRED**. Wetbench label tags are available. Bottles should be identified with your **name, date, contents, and any relevant cautions**. Proper WHMIS workplace labels should be firmly attached. Bottles should be stored in the appropriate chemical storage cabinet.
- Most labware (including beakers, tweezers etc.) has been assigned for specific uses and areas. Do not remove labware from their designated areas. Use accordingly or ask if in doubt. If you need new labware please ask.
  - Sheets: There are labware request spreadsheets posted inside each of the Core labs. Please use them.
- **DO NOT** remove any items from the labs.
- Most processing equipment has logbooks. Each user will sign in the log giving the date and time he or she uses the equipment and other requested information.
- **DO NOT** attempt equipment repairs. In the event that equipment fails to perform correctly, immediately notify the lab staff and note problem in log book. Leave a note on the equipment, including time, date and failure symptoms.
- Any new materials or processes must be approved by the lab manager.

- **PPE.** The appropriate **Personal Protective Equipment** must be worn when dispensing or working with chemicals.
- **Rushing causes accidents.** Work at a safe deliberate pace. Pre-plan your experiments. Be aware that others around you may also be working with hazardous materials.
- **Clean up after yourself.** All users are responsible for maintaining cleanliness in the laboratory and properly disposing of consumed chemicals or other waste. Wetbench counters, basins, beakers, etc. must be thoroughly rinsed and washed after use. Test counters with PH paper. The general rule for beaker and bottle rinsing is to dump rinse 3 times, then rinse thoroughly with DI water. Hang on rack to dry, or dry with N<sub>2</sub> gun. Wet wipes should be thoroughly rinsed and left to dry overnight, they can then be disposed of as general waste. In addition, there are cleaning products in the clean room. All users are expected to help clean the floors, the countertops, wipe up around the general area and take out the garbage. Plan your work so that you have time to clean up properly. Users must not leave papers, documents and notebooks lying around, as there is a bookshelf available for binders and notebooks in room 333.
- All items coming into the lab must be cleanroom compatible and properly wiped down.
- **Please make arrangements in advance** if you are going to require technical assistance for your work, as drop in requests may not be attended to.
- The valves for equipment that uses CDA, N<sub>2</sub>, or vacuum **MUST** be closed when you are finished with the tool.
- Tools, equipment and consumables are supplied by CRPuO depending on cost and usage, with the exception of certain metals (Au, Pt and other expensive materials such as cytop, Espacer and Zep).
- Some garments are disposable. Try to limit waste. i.e. bouffant coveralls and shoe covers are disposable but can still be used multiple times.

### **IMPORTANT NOTE ON SAFETY**

Some of the labs use deadly chemicals, gases and products. While you may not be using them, you are still at risk. Pay attention to all smells and sounds.

## Section 2

## **RESTRICTIONS**

### **2.1 Gowning**

- The wearing of contact lenses in the lab is discouraged due to the hazard of trapping chemicals in or under your lenses. If you choose to wear contact lenses in the lab, you do so at your own risk and we strongly suggest you wear “chemical splash goggles” at all times when in the laboratory. All laboratory users **MUST** wear protective eyewear at all times when in the labs.
  
- For reasons of safety, radios or headphones are not allowed in the labs. Safety goggles and face shields must be worn while handling hazardous chemicals. Acid resistant smocks must be worn when handling acids. Under certain circumstances, such as in the presence of UV sources, further specialized eyewear may be required. Contact the lab supervisor if you anticipate this need. If your suit/boots or gloves become torn, let the lab supervisors know so that they may be replaced.
  
- Cleanroom “regulars” (users who use the cleanroom once a week or more) are permitted to claim a launderable coverall and booties set. Each coverall and booties sets are numbered. There is a sign out sheet posted on the wall to sign out or claim a set. By claiming a set, you will be the sole user of this set. You will be responsible for maintaining the set, i.e. wash it regularly, once or twice a month or as needed.

### **2.2 Cell Phone Usage**

Cell phones should not be used when operating equipment.

### **2.3 Working Alone**

As mentioned above, for safety reasons working alone should be avoided. Someone should always be within call when a laboratory procedure is being performed. For work with hazardous materials or procedures the supervisor has the right to require that at least one other person be present.

### **2.4 Use of Equipment**

Lab users will **ONLY** use equipment on which they have received training. The persons who are allowed to give training are as follows:

Tony Olivieri - [ton.olivieri@gmail.com](mailto:ton.olivieri@gmail.com), Room 316, EXT 7221

Howard Northfield, [howard.northfield@uottawa.ca](mailto:howard.northfield@uottawa.ca), Room 316, EXT 7221

Ewa Lisicka-Skrek, [ewa.lisicka@uottawa.ca](mailto:ewa.lisicka@uottawa.ca), Room 318, EXT 7223  
Choloong Hahn, [choloong.hahn@gmail.com](mailto:choloong.hahn@gmail.com), Room 318, EXT 7223  
Jeremy Upham, [jupham@gmail.com](mailto:jupham@gmail.com), Room 118, EXT 7325  
Chris Valdivia, [christopher.valdivia@uottawa.ca](mailto:christopher.valdivia@uottawa.ca), Room 360, EXT 3978

Each tool has a posted list of users who are authorized to use the tool. Instruction is given by a qualified member of the laboratory staff. Proof of training must be demonstrated to the Lab supervisor and lab managers. The appropriate paperwork must be completed and submitted to the Research Administrative Assistant in ARC 350 before access to the equipment is granted. In order to use the equipment all authorized users must reserve their timeslot through the CRPuO online booking System. Access to the booking system will be granted once all aforementioned lab and safety training is completed.

## 2.5 Cleanroom practices

Wood, cardboard, pencils and regular paper are some of the items restricted from the cleanroom. Only pens and special cleanroom paper and cleanroom notebooks are allowed. Cleanroom approved paper is available in limited quantities in room 333B. Any items coming into the lab must be wiped down in the gowning area. Avoid touching your face with the vinyl or nitrile gloves on – replace your gloves if you do so.

## 2.6 “Hazardous Acids in Use” Sign

Always check the sign posted on the door to room 333A (yellow room) before entering. If the “Hazardous Acids in Use” sign is up, you are not to enter the room unless the person using the hazardous acids gives you permission to do so. Always knock first and ensure you have their attention.

## **First Aid**

Injuries, such as minor burns and cuts can be treated with the first aid kit. If you use any items please let the lab supervisor know as soon as possible. The First Aid kits are located in lab 329. The first aid kit can be removed from the wall if necessary. The following people hold Emergency Level Safety Oriented First Aid:

<b><u>Name</u></b>	<b><u>Telephone</u></b>	<b><u>Room No.</u></b>
Ewa Lisicka	X 7223	318
Tony Olivieri	X 7221	316

## Section 3

## CHEMICAL SAFETY

### **3.1 Chemical Information and Reference Materials Risk Assessment:**

A large number of chemicals are used in the Core labs. Materials Safety Data Sheets (MSDS) are required for every chemical in the lab. MSDS are in binders located in the White Clean Room in ARC 333B, and can be found online (Ref 3, <https://orm.uottawa.ca/whmis/lab/msds>). A chemical inventory list is posted on the door to 333A. Any new chemicals coming in or emptied out must be updated on this sheet. Lab users should familiarize themselves with the chemicals that they plan to use in their research. Do not use any chemical without first reading the MSDS. If a chemical you need is not listed in the Chemical and Materials inventory, you must:

- Contact the lab supervisor to get approval to bring the chemical into the lab.
- Make sure an MSDS is ordered at the time the chemical is ordered.

Chemicals cannot be brought into the lab until an MSDS sheet is on file in the MSDS binders. MSDS sheets should be given to the lab supervisor when received.

All chemicals stored in containers must have proper WHMIS labels (either Manufacturer's or Workplace) stating its contents and dated. Chemicals for a dedicated user are designated as "special chemicals" and are inventoried separately from standard chemicals. Special chemicals should be ordered in minimum volumes, reducing high disposal costs. Your account will be charged for disposal costs of any special chemicals you bring into the NanoFab lab. Lab member "formulations" must also bear a "Special Chemical Formula" label detailing contents and percentages

### **3.2 Protecting Yourself/PPE**

Prior to working with chemicals, make sure you are properly protected. You **MUST** wear chemically rated gloves, goggles, a full chemical resistant smock and a face shield. Only authorized persons can work with dangerous chemicals (a list of those persons can be found on the acids fume hood in room 333A). If gloves, smocks, or face shields aren't readily available near your location, contact the lab managers and the necessary items will be provided.

#### **3.21 Gloves:**

The vinyl/nitrile gloves are not of sufficient strength to protect against chemical burns or solvents.

**Caution:** A common problem with all gloves is dermatitis from the

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moisture held against skin while wearing gloves. If you have problems with dermatitis please report the problem to the lab supervisor.

### **3.3 Transporting Chemicals Through the Lab**

Chemicals for the lab are stored in special cabinets. All FLAMMABLE chemicals are to be stored in the solvent fume hood cabinets. After removing any item from the cabinets make sure the doors are closed. Wet Bench sliding doors must always remain closed for safety reasons. If you cannot locate a chemical listed on these inventory sheets contact the lab supervisor.

Be sure to check that there are no bottles of the chemical you need in your area before bringing in and opening new ones.

Never draw from the main bottles, always be sure to pour into smaller bottles or vials. Never put anything back into the main bottles which it was taken from.

### **3.4 Working with Chemicals**

Always work at an Exhausted wet process station! Wet process stations are exhausted, with face velocities greater than 80 feet/minute. Do NOT adjust the back sashes. They are set by Facilities Department. This assures proper exhaust velocity.

#### **3.41 Dry Chemicals**

When measuring out chemicals never pour a chemical back into its reagent bottle. This can contaminate the remaining chemical in the bottle. When removing dry chemicals, pour them out when possible. Scoop only when necessary and use freshly cleaned spatulas. If you pour out too much, instead of throwing the excess away, you might want to store it in a clean, labeled container for your use later.

#### **3.42 Solutions**

- Forbidden Chemicals - Only admins (or special users) can use these:
  - Hydrofluoric Acid (HF)
  - Potassium hydroxide (KOH)
  - Tetramethylammonium hydroxide (TMAH)
  - Piranha Solution ( $\text{H}_2\text{SO}_5$  or  $\text{NH}_4\text{OH}$ )
  - Aqua Regia ( $\text{HNO}_3 + 3\text{HCl}$ )
  - RCA Processing Station

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- Always place fuming containers toward the back of the fume hoods where there is maximum exhaust. If you must leave an area with a process in progress, make absolutely sure that you fill in the work sheet. Please indicate what is in beakers when in active use. Simply put a labelled wipe under the beaker with chemical name and user name.

**WARNING: “UNATTENDED PROCEDURE IN OPERATION”.**

These sheets are available in the NanoFab lab. That is, make sure you leave your process clearly labeled with your name, the date, time, your expected time of return, where you can be reached (if you will be gone more than 10 minutes) and the chemicals involved. Do not leave chemical processes unattended unless absolutely necessary.

### 3.5 Chemical Disposal

When you are through with your process, clean up completely. Chemicals are **NOT** to be dumped down the drain. Proper disposal procedures:

- Dispose of special mixtures when you anticipate that they will no longer be required.
- Organic Solvents, such as Acetone, Isopropanol, and Methanol may be stored together for hazardous waste disposal.
- Chlorinated organic solvents must be stored separately for hazardous waste disposal. Make sure it is a solvent and that waste bottles are not overfilled. Obtain a WHMIS workplace label and enter the summary of contents to the peel- off label and place it on the bottle.

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### **3.6 Chemical Exposure**

If you are exposed to chemicals, the first thing you must do is to immediately remove all affected clothing. Flush the affected areas with water for 15 minutes, not less. Use the emergency shower and/or eyewashes as necessary. The location of the safety showers and eyewashes are clearly marked with signs and identified on a map that follows this safety section. Memorize the locations of the safety shower and eyewashes.

Contact a staff member after you have flushed the exposed area with water. All injuries occurring in the NanoFab lab must be reported to the Health and Safety Department office within 24 hours.

Exposure of the eyes requires flushing with water for at least 15 minutes. As a precaution, all exposures to the eye will require a visit to an emergency room for a check up. Contact a staff member as soon as possible for assistance or call **5411**.

### **3.7 Chemical Spills**

Chemical spills will be cleaned up by NanoFab lab staff. A spill kit is located in 333A in a yellow bag beside the acid fume hood, under the oven bench. These kits contain the needed materials to safely cleanup a spill.

Instructions are included in each spill kit. The following people have been trained on chemical spill clean up. In case of a chemical spill you **MUST** seek help from one or more of the following people:

<u><b>Name</b></u>	<u><b>Room</b></u>	<u><b>Telephone</b></u>
Ewa Lisicka	318	X 7223
Tony Olivieri	316	X 7221

**Report all spills to the lab supervisor.**

## **Section 4            DISPOSAL OF HAZARDOUS OBJECTS**

### **Broken Glassware**

Broken glassware should first be rinsed thoroughly if necessary, then disposed of by depositing in the plastic pail.

Contact a staff member if you need help disposing of broken glass.

### **Wafers**

Check with the Lab supervisor before throwing away whole wafers. They might be recycled or used as dummies for other operations. Wafers and broken wafers are disposed of in the same pails as broken glass.

### **Needles and Razor Blades**

Needles and razor blades should be disposed of in the containers labeled “sharps” provided throughout the NanoFab lab. If these plastic containers are full, contact a NanoFab lab staff member and they will be emptied. Do not dispose of needles or razor blades in the waste cans!

### **Broken Thermometers**

Because of the danger of metallic mercury, broken thermometers should be disposed of properly. Contact a staff member for assistance if you break a thermometer.

### **5.1 Handling Gas Cylinders**

Cylinders of both toxic and non-toxic compressed gases are in use throughout the lab. Lab users are not allowed to install or disconnect these cylinders. All compressed gas cylinders are to be handled by trained staff. There are several reasons for this policy. Some gases are toxic. Some gases in these cylinders are at high pressures, some as high as 3000 psi. Regulators are designed to handle specific gases and can explode if not properly chosen. Improper installation or purging will contaminate a full bottle of gas. Some of our etching gases cost hundreds of dollars and their loss or contamination is very costly. Gas cylinders must be chained and strapped down at all times.

### **5.2 Toxic Gases**

All toxic, flammable or corrosive gases are kept in exhausted steel gas cabinets.

List of toxic gases:

- Oxygen
- Argon
- Tetrafluoromethane
- Helium
- Sulfur hexafluoride
- Hydrogen
- Methane
- Nitrogen
- Chlorine
- Boron Trichloride
- Liquid Nitrogen
- Ammonia
- Hexamethyldisilazane vapour

Most of these gases have a characteristic odor. If a gas leak is suspected, the lab **MUST** be evacuated. If you notice an unusual odor, leave the lab and immediately report it to the staff so an evacuation announcement can be made. If no staff is available, call **5411**.

## Section 6.

## FIRE HAZARDS

### 6.1 Fire Prevention

Fires in the lab can result from many causes including ignition of flammable gases or solvents, and combustion of materials. Use care when using heat lamps or heating flammable solvents on hot plates.

Always use a water bath to transfer heat to flammable solvents when using a hot plate. Avoid water around electricity and use common sense when working in the lab.

### 6.2 Laboratory Fires

Before using any chemicals you should make yourself familiar with all the potential fire hazards associated with the chemical. This information will be found on the MSDS in the fire and explosion and reactivity sections. The information will include the decomposition products, critical temperatures, and the most applicable type of fire fighting equipment to be used should a fire get started.

If a **small fire** does start in a lab and is contained in a beaker, flask or other small container, you may attempt to extinguish the fire with the proper fire extinguisher or by smothering it. Call for help from others in the area while doing this so they are aware of the fire and ready to take action if your attempt is not successful. After the fire is out, immediately report the fire and your action to University Safety at 5411.

**Major Fire Emergencies:** (Ref 4, Pg. 3 of University of Ottawa Laboratory Safety Manual)

In the event of a major fire beyond your control:

1. SHOUT "FIRE, FIRE, FIRE" and pull the nearest fire alarm.
2. Attempt to rescue persons in immediate danger. Do not endanger yourself.
3. Evacuate personnel from the area. Leave fume hoods on. Close, but **DO NOT** lock the door.
4. Do not attempt to fight a major fire on your own.
5. Fire extinguishers are to be used to assist you in getting out safely.
6. **CALL EMERGENCY EXT.5411.** Give location and details. Remain available in case further information is required.

## **Classes of Fire**

**A Class** – ordinary combustibles such as wood, paper, cloth, plastic, etc

**B Class** – flammable and combustible liquids

**C Class** – charged electrical fires

**D Class** – combustible metals”

Fire extinguishers are located at the Emergency Exits. These are Type 5- BC (Carbon Dioxide) extinguishers capable of extinguishing fires of flammable liquids or electrical equipment (not paper) without damaging equipment. Use water to extinguish paper fires.

The campus Safety Department regularly checks fire extinguishers. Report any use of a fire extinguisher to that office immediately.

NanoFab lab users are not expected to be fire fighters and should evacuate the building when a fire threatens safety.

For fires, call the University of Ottawa emergency number **5411** and evacuate the lab. In all cases fill out a University of Ottawa Injury/Incident report.

## **Section 7**

### **ELECTRICAL SAFETY**

All electrical power wiring is to be done by the University of Ottawa Maintenance staff. Learn the locations of the circuit breakers required by the equipment you use. In case of electric shock of someone in the lab, do not touch or grab them. Do not attempt to shut off power on the system, use the circuit breakers or unplug the equipment in the service chases. Report all electrical problems to staff.

## **Section 8**

### **LAB EVACUATION PROCEDURES**

When the building fire alarm sounds, you **MUST** evacuate the Labs and the ARC Building. The Evacuation Procedures is as follows:

- Secure your process and leave the lab quickly.
- Exit out of the labs by the Main Entrance
- Once you are out of the NanoFab lab and in the hallway, turn left (note the illuminated **EXIT** sign) and leave the area through stairway.
- Proceed down the stairway until you reach the outside door and exit the building.
- Once outside meet in front of the ARC Building.

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If there is an emergency in the lab (volatile or toxic materials fire or toxic gas leak)

- Call 5411 and inform the Safety Office of the situation
- Evacuate the lab (evacuate other lab users as you leave)
- Find the nearest exit

## ***References***

1. User Access to CRPuO laboratories, <https://photonics.uottawa.ca/user-access>
2. Internal Users Registration form, <https://crpuo.typeform.com/to/anMKRF>
3. WHMIS For Lab Workers, Material Safety Data Sheets (MSDS), <https://orm.uottawa.ca/whmis/lab/msds>
4. University of Ottawa Laboratory Procedures And Safety Manual, <https://orm.uottawa.ca/sites/orm.uottawa.ca/files/files/laboratorysafetymanual2014-final-1.pdf>

## Statement of Understanding

### University of Ottawa USER and SAFETY MANUAL

I, \_\_\_\_\_, hereby acknowledge and declare that:  
Print Name

- (i) I have received, read and understood the rules and procedures outlined in the USER and SAFETY MANUAL of the Centre for Research in Photonics of the University of Ottawa.
- (ii) I agree to conduct my activities in accordance with the Centre for Research in Photonics' rules and procedures and understand that breaching these standards may result in disciplinary action such as suspension or revocation of access to laboratories.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

\*Please return the signed Statement of Understanding within one week of receiving the User and Safety Manual. No access to the labs will be granted prior to reception of this document.