I. GENERAL RESPONSIBILITIES

The WCAM laboratories exist to provide a safe, productive, and open facility for research involving microfabrication. Since WCAM is a shared resource, all staff and lab members share responsibility for working cooperatively and keeping the labs safe and useful. All members have agreed to abide by the rules and policies found online in WCAM’s Chemical Hygiene Plan. Persons who break the rules may lose their lab or tool access privileges.

The rules in this document are a partial list highlighting some of the core responsibilities lab members must fulfill. For more complete information, see the online Chemical Hygiene Plan.

A. WCAM staff are responsible for providing a research environment in which:
   1. All members can work as safely as possible, considering the inherent dangers of research
   2. All members can expect equal access to tools and equipment
   3. All members can have equal expectations that tools and processes will be in good working order, with as much uptime and as little contamination as possible
   4. These rules are enforced as fairly and consistently as limited staff resources allow

B. All lab members are responsible for:
   1. Knowing the rules in this document
   2. Understanding the reasons for the rules
   3. Following the rules at all times
   4. Reminding each other of the rules when necessary
   5. Understanding and expecting the consequences for breaking the rules

II. ACCESS TO THE LAB AND TOOLS

A. Lab access
   1. To ensure that all members of the WCAM labs have the same understanding of lab safety rules and of their own responsibilities, all lab members must successfully complete online and on-site orientation training before being granted access to the labs.
   2. Since safety rules and other expectations evolve as new situations arise or new best-practice guidelines become available, all members must attend yearly renewal sessions if they wish to maintain their lab access privileges. Lab access may be suspended for members who fall six or more months behind in their renewal status.
3. To discourage unsafe behavior in the lab, which endangers everyone, WCAM staff may suspend or terminate a member’s access privileges in response to violation of safety rules or other lab rules.

4. Most microfabrication work requires a clean environment. Particle contamination can be minimized if all lab members have been trained in correct gowning procedures and other cleanroom protocols. To ensure that everyone using the lab has received such training, everyone entering the gown room must do so using his own UW ID card.

5. Equipment uptime and overall lab safety are improved by limiting lab access to trained members who have consistently demonstrated responsible behavior. To ensure that everyone using the lab is in good standing, everyone entering the lab area must do so using his own CRESS project and password.

6. Buddy System: In case of an accident or emergency, a person working alone is in more danger than one who can expect help; therefore, no lab member may work alone in the lab during off hours. Currently, the Buddy System is in force from 5:00 PM to 7:00 AM on weekdays, and all day on weekends and holidays.

B. Tool access

1. A tool’s uptime and reliability are improved if all users have the same understanding of its operation and of their own responsibilities; therefore, all tool training at WCAM is conducted by WCAM staff.

2. A tool’s uptime and reliability are also improved by limiting access to trained users who have demonstrated responsible behavior at that tool; therefore, no one may access any tool except through his own CRESS project and password.

3. Since equipment configurations can change, and new best practice procedures may be developed, members may be required to re-train on tools if they wish to maintain their access privileges.

4. To discourage improper use of tools, which can affect their availability for everyone, WCAM staff may suspend or terminate a member’s tool access privileges in response to violation of tool use rules.

C. Restricted areas

WCAM lab members are allowed free access to the gowning room, the central hallway, and the eight equipment bays in the lab. However, certain other areas of the lab are off limits to lab members due to safety issues or concerns about property control.

Inside the cleanroom, no user may enter any facility support chase. These are the narrow rooms between the equipment bays. The doors are clearly marked as leading to restricted areas.

Additionally, the following areas of WCAM are off limits to lab members: the chemical storage room; the supply room; the gas cylinder storage room; and the maintenance shop.

III. MATERIALS IN THE LAB

All lab members should be able to expect that the labs and tools have not been contaminated with materials which will inhibit their processes or affect their research. Therefore, WCAM maintains strict limits on which materials may be present in which parts of the lab. The current version of the approved materials list may always be found in the “Chemicals in the Lab” section of the WCAM Website.
A. Materials forbidden in all parts of the lab
1. **Food and drink**: these contaminate the lab and, worse, could expose users to dangerous chemicals through ingestion.
2. **Materials that generate particles**, such as paper, cardboard, wood, outerwear such as coats or jackets, backpacks, etc.: particles can destroy microstructures, and particle control is part of the definition of “cleanroom”. Note: the Gowning Room is part of the cleanroom!
3. **Chemicals that are not already approved** for use in at least one location in the lab.

B. Bringing your own chemicals into the lab

All lab members deserve to have access to information about which chemicals are in use in which parts of the lab, so that they can make their own informed decisions about exposure risks. Therefore:

1. Members must **consult with WCAM staff** before bringing privately-owned chemicals into the lab, even if that type of chemical has already been approved.
2. Members may bring their own chemicals into the lab if those chemicals are already approved for use in a tool to which the user has access. To be even more explicit: if the material you want to bring into the lab is *not* approved for use somewhere in the lab, you *may not bring it in at all*.
3. All chemical containers must clearly labeled with the contents, the owner’s name, and the date they were brought into the lab. Labels are available in the WCAM Gowning Room.
4. Every material permitted in the lab has a correct storage location; WCAM staff will show you where to store your chemicals, but **proper storage is the owner’s responsibility**.
5. Chemicals should never be carried around campus in open beakers, or in glass bottles, or generally even in plastic bottles; the right way to transport them is to bring them in their original, sealed bottles, and to carry the bottles in a rubber bottle transporter or original shipping packaging.

C. Materials in tools

All lab members should be able to expect that, when they use a tool, it has not been contaminated by unapproved materials which could affect their process. Therefore:

1. **It is every user’s personal responsibility** to check every material he wants to put into every tool.  
   a. The current list of approved materials is available on the WCAM Website.
   b. Even if your “common sense”, your groupmates, or your PI tell you a material is OK to use in a tool, that does not mean it is OK – you are still personally responsible for checking its status, and it is you, not they, who will be ejected from the lab if you contaminate a tool.
   c. You must **check whether your materials are allowed before you come to the lab or plan to use a tool**.
   d. Materials are seldom removed from the list of approved materials, so if your material is approved for the tool where you want to use it, you do not need to check that specific material for that specific tool again. But **if your process changed**, check your new materials.
   e. A common mistake is to overlook some of the materials you wish to put into a tool. **No material is “too obvious” to need checking**! For example, a user of the aligners in Lithography Bay must check to see if his substrate and photoresist are allowed, but must also check all materials on his mask.
f. Lab members are responsible for knowing which materials they are using: If you do not know everything about the sample you want to process, then you cannot correctly check it against the allowed materials list; and if you cannot check it against the list, you may not bring it into the lab at all.

2. Since research at WCAM deals with a very wide variety of materials, and since two materials which are otherwise similar may have very different contamination consequences, we must be very precise in defining allowed materials. Therefore, the exact material you want to use must be approved for the exact tool in which you want to use it.

For example, if graphite is allowed in a tool, that does not automatically mean that graphene is allowed in that tool; or if gold is allowed in one RIE plasma tool, that does not automatically mean that it is allowed in a similar etch tool.

3. Approving new materials:
   a. Since WCAM is shared by many different user groups, everyone whose work might be affected by a material’s presence in a tool deserves a voice in determining whether that material should be allowed in that tool. Therefore, only WCAM staff, in consultation with group managers, can authorize a material to be used in a tool.
   b. Corollaries: “I needed to do it for my project” is not a good enough excuse for contaminating a tool with an unapproved material. Neither is “my PI told me it would be OK…” The online list is the final arbiter.
   c. The process for requesting approval of a new material is described in the Chemicals in the Lab section of the WCAM Website.
   d. As noted above, approval of a new material may require discussion and therefore may take some time. Plan ahead.

4. Hazard communication:
   a. WCAM staff provide a complete and up-to-date collection of Material Safety Data Sheets in the WCAM gowning room and on the WCAM Website; all users are encouraged to read them.
   b. All users must clearly label all chemicals. This applies to chemicals in storage and in current use; see Labelling under Wet Chemistry, below.

IV. USING TOOLS

A. Training

1. WCAM provides a written operating procedure for each tool in the lab, available at the tool and online. Lab members are encouraged to consult the procedure at any time; but reading the procedure is not a substitute for training.

2. To schedule training on a tool, contact the WCAM staff member responsible for that tool, as listed in the Equipment section of the WCAM Website.

3. WCAM’s training protocol is designed to help lab members make safe, intelligent use of our tools. For most tools, training consists of the following three steps:
   a. A training session during which a WCAM staff member teaches you how a tool functions, what its capabilities are, how to operate it, and how it relates to your process flow. You will also learn about your responsibilities when using the tool, including
safety protocols you must fulfil. This is a good time to discuss your proposed process with staff.

b. After the training session, you will be granted one-time access to the tool in CRESS. You must complete a practice session during which you use the tool, develop facility with its correct operation, and check your familiarity with the material you learned in the training session.

c. After you complete your practice session, contact staff to schedule a demonstration session during which you operate the tool while a WCAM staff member checks your skills and knowledge.

If you pass your demo, you will receive access to the tool, subject to your continuing to demonstrate responsible use. If you do not pass your demo session, WCAM staff will help you improve your understanding of the tool so that you can do better next time.

4. Tips for successful demo sessions:
   - Plan ahead. Before you come for training, understand your project. Know what you want to accomplish, and how the tool can further your process requirements. If you have questions, talk to WCAM staff: we are here to help you!
   - Ask lots of questions during training.
   - Some things you are taught during training may sound trivially obvious to you, but they are being mentioned because experience shows that they are not obvious to everybody. So, pay attention and learn the material.
   - At your demo session, you may be required to know a lot more than just how to press buttons and run the tool. At a minimum, you must also demonstrate thorough understanding of the tool’s capabilities and limitations, and all required safety protocols.
   - You also need to show that you understand how the tool relates to the WCAM labs. For example, what aspect of the tool is interlocked in CRESS? What kinds of materials are not allowed in the tool, and why? And so on.

B. Scheduling Time on Tools

1. Most tools at WCAM are available for use without scheduling – if no one else is using the tool, and you have access to it in CRESS, you may just walk up to it and use it (but see below, “Monopolizing tools”).

2. Time on certain tools can be reserved through the LoCal online scheduling tool. If a tool can be reserved, there is a link to LoCal in its entry on the Equipment page of WCAM’s Web site. For more information on establishing a LoCal account, see our page on Scheduling Equipment.

3. Please do not schedule time on tools unless you actually need it. Do not sign up for slots just in case you might want them later!

4. If you have signed up for a session on a tool, it is your responsibility to be at the tool and ready to use it at the beginning of the scheduled session. If your sample requires processing before it can go into the tool you have scheduled, you need to have all that processing already finished before your scheduled session starts. Do not waste everyone’s time by
scheduling the metal evaporator (for example) and then using the scheduled session to do a plasma etch.

5. If your research needs change, and you will no longer need time you have reserved on a tool, please cancel it promptly so other lab members may sign up for it.

C. Lab Member Responsibilities Relating to Tools

1. Sharing tools:
   a. In general, the person who is using the tool must be the person who is logged into the tool in CRESS. This rule helps ensure that untrained users do not damage tools, which is bad for everyone.
   b. Some tools (mostly wet benches) can be shared: If someone else is logged into the tool, and you would be allowed to log into it in CRESS, you may share it. But if that person logs out, you should log in. And the two of you should talk to each other! If a tool may be shared, you will learn that in your training session.

2. Abusing tools:
   a. Forbidden materials: it is your responsibility to comply with the allowed materials list. See also “Materials in tools”, above.
      i. Certain materials are forbidden at certain tools because they pose a safety hazard: For example, corrosives are not permitted at solvent benches.
      ii. Some materials are forbidden at some tools because they could contaminate the tool, poisoning other users’ processes.
   b. Modifying equipment: Users may not change or modify tools, control software, or computers in any way.
   c. Skipping procedure steps: If the operating procedure for a tool lists a sequence of steps, you are responsible for completing (and understanding!) all steps.

3. Monopolizing tools
   a. In general, you may not log into a tool in CRESS unless you are currently using it. Even if the lab is empty and it seems no one else needs the tool, other lab members will see online that it is in use. Do not log into tools just to “save” them for later! Do not log into more tools than you can actually use at one time! There are a few specific exceptions to this rule. For example, in Litho Bay, you may log into one spinner, one exposure tool, and one solvent bench, since they are all part of the same workflow. You will learn the requirements for each tool during training.
   b. Some tools can be let run unattended (but see “Unattended tools”, below). If a tool may be left unattended, you will learn this during your training session. You may log into another tool while these tools are running. For example, while your recipe is running in the Tystar furnace, it is OK to go use the MA6 aligner.
   c. Please do not schedule time on tools unless you actually need it. Do not sign up for slots just in case you might want them later!

4. Unattended tools

   In general, if you are logged into a tool in CRESS, you must be present and using that tool. Some tools may be left unattended while they operate; if this is the case, you will learn about it during your training session.
There are some additional specific rules:

a. Hotplates: If the hotplate is turned on, and you have a container of liquid on it, you must remain at the hotplate. Do not put plastics on the hotplate (and remember, the cleanroom wipers are made of plastic!)
b. Plasma systems: If you have a live plasma in a tool, you must remain in the bay with the plasma tool.
c. E-beam tools: If the high voltage is on, you must remain at the e-beam tool.
d. Wet benches: You may leave materials unattended if you need to perform a long etch: Put your materials at the back of the bench, and make certain your label includes a date when you will return. The decks of the wet benches are not to be used for storing chemicals or materials not currently in use for a process.

5. Reporting tool issues
   a. Logbooks: All users must fill out all required sections of tool logbooks, honestly and completely, each time they use a tool.
   b. Failures: Report failures and other tool issues to staff. Otherwise, we won’t know we need to repair them.

V. WET CHEMISTRY

A. Personal Protective Equipment (PPE)

1. To protect themselves from accidental exposure to harmful chemicals, users are required to wear full PPE when interacting with a corrosives bench in any way.

2. Because regular cleanroom suits and gloves do not provide adequate chemical protection, full PPE includes a face shield, chem gloves, and a chem apron in addition to regular gowning.

3. In order for the PPE to protect you, you must use it properly. Therefore, detailed information on how to use these items of PPE is part of your wet bench training.

4. In order to minimize the extent to which lab surfaces outside the corrosives benches are contaminated with dangerous chemicals, your training at corrosives benches includes detailed rules about the use of chemical-resistant gloves, including what may be touched while wearing them and what may not.

B. Handling chemicals

Wear full PPE while moving jugs of corrosives between wet benches and storage cabinets. Carry the jug with two hands, and use two hands for pouring. Do not touch chem cabinet doors or door handles with chem gloves.

C. Labeling

All lab members have the right to know which chemicals are in use in the work area we all share. Therefore:
1. **All secondary containers used for chemicals must be properly labeled.** A secondary container is any container other than the one in which the chemical came from the manufacturer. For example, if a chemical is poured into a beaker, the beaker is a secondary container and must be labeled.

2. Chemical container labels must be readable and **must include the name of the chemical’s owner, and the name of the chemical.** Labels such as “ETCH” or “RINSE” are not sufficient because they do not identify the chemical.

3. If the secondary container will be left unattended for an extended period, as for example in an overnight etch step, the label must also include the date when the chemical’s owner will return.

4. WCAM provides removable labels for use on secondary containers. Lab members may provide their own permanent labels. In fact, in the interest of obtaining good process results, lab members are strongly encouraged to permanently label secondary containers and to use those containers only for that chemical and its associated process step.

**D. Spill management**

*See Chemical spill management under Emergency response, below.*

In general, lab members are not responsible for cleaning up or neutralizing a chemical spill, but should attempt to contain or control the spill if they can do so safely. Detailed training on spill response is provided during training on wet benches. The information in this document is only a brief summary and is not a substitute for proper training.

**E. Waste disposal**

Each chemical material allowed in WCAM has a proper disposal method, which all lab members are responsible for knowing and following. Specifically:

1. DI sinks: Sinks that have DI water faucets may not be used to dispose of anything except water and low-normality aqueous photoresist developers. NO SOLVENTS OR CORROSIVES!

2. Solvents: All solvents must be disposed of either in a drain marked SOLVENTS, such as those in the metal solvent benches, or in one of the square plastic waste carboys found in Litho Bay, Wet Chem Bay, and Teaching Bay.

3. Corrosives: Strong acids and bases may be discarded by pouring them down the plastic drain of the wet bench where they were used. Flush them with plenty of water. Follow the instructions you received during wet bench training with respect to rinsing your secondary chemical containers before removing them from the chemical bench.

**VI. CRESS**

CRESS, the Cleanroom Equipment Security System, performs many administrative functions. Some that are of most importance to lab members include:

4. **CRESS tool functions:**
   a. **CRESS communicates tool status:** You can tell if a tool is up, down, in use, or in maintenance. The information is displayed on the light tower at the tool, at the CRESS PC in the bay, on the monitor at the lab entrance, and on the [WCAM Website](#).
b. **CRESS verifies training and access:** If a tool is connected to CRESS, you may not use it in any way unless you are authorized through CRESS. You may lack CRESS access to a tool either because you have not been trained on it yet, or because your access has been suspended due to a rules infraction.

c. **CRESS manages billing:** Full information on WCAM charges may be found in the Fees section of the WCAM Website.

d. **CRESS interlocks the tools:** In all cases, there is some aspect of the tool that will not work unless you are logged in via CRESS. Details are part of your tool training.

5. **CRESS informational functions:** Lab members can use CRESS to update their passwords, review their billing statements, and contact staff with questions or comments.

### VII. CLEANLINESS AND COOPERATION

The WCAM labs are a shared research environment, in which many research groups enjoy the benefits of access to tools and processes at a small fraction of their actual cost. All lab members are responsible for helping maintain the usefulness of the labs.

**A. Entering and gowning**

All lab members are responsible for following the lab access rules, the correct cleanroom gowning protocol, and the protocols for preparing material so that it is clean enough to enter the cleanroom, as taught during orientation.

**B. Working in a shared environment**

Everyone uses the lab together, and everyone has a right to equal access. No one has special privileges, such as monopolizing tools, leaving the work area in a mess, or being immune from lab rules.

**C. Documenting your work**

A cardinal rule for research: If you do not record the details of your work, you may as well not do it at all. WCAM staff are happy to help lab members improve their results, but if you have not kept good documentation on what you have done, it will be difficult to discuss your process intelligently.

**D. Cleaning up**

It is everyone’s responsibility to leave the work area clean for the next user. Store your samples and materials properly when you are not in the lab using them; don’t just leave them lying around. If your process is inherently messy – like PR coating, or wet chemistry – leave the area at least as clean as you found it, or preferably cleaner.

### VIII. EMERGENCY RESPONSE

**A. Chemical spill management**

In general, lab members are not responsible for cleaning up or neutralizing a spill, but should attempt to contain or control the spill if they can do so safely. Detailed training on spill response is provided during training on wet benches. The information below is only a brief summary and is not a substitute for proper training.

In accordance with UW safety practices, WCAM distinguishes among three types of spills:
1. In case of a chemical spill which is only on the floor of the lab, and not on a person, a lab member should:
   a. Alert other lab members in the bay, so they know not to step in the spill
   b. Close off the bay, using the yellow chains provided by WCAM
   c. Contain the spill, if this can be done safely, using spill pillows and pigs, and following training received from WCAM staff
   d. Inform WCAM staff

2. In case of a chemical spill which is on a lab member’s chem apron, but not on the member’s skin or cleanroom suit, a lab member should:
   a. Carefully remove the apron at once
   b. Do not return the apron to the apron to the hanger rack! Instead, put the contaminated apron in the wet bench where you were working, because that area is already contaminated by the same chemical spilled on the apron
   c. Inform WCAM staff

3. Any chemical spill which is on exposed skin or on a lab member’s cleanroom suit should be treated as an emergency. Response during the first few moments of exposure can be more important than later medical care. Follow the training you received during instruction on the wet bench.

   Following this kind of spill, a lab member should:
   a. Watch for panic! People behave oddly when frightened or stressed. Try and help the victim as much as possible while avoiding becoming contaminated or injured yourself.
   b. Help the victim to the safety shower or eye wash, as appropriate. Follow training you received on how to use these safety tools.
   c. In the shower, the victim should strip completely, and should avoid rubbing exposed areas, which can spread the contamination and increase tissue damage
   d. Follow your training on how long the victim should remain in the shower for different types of spills, and whether to apply acid burn cream.
   e. While the victim is in the shower, a lab member should contact emergency services. Follow your training on how to interact with emergency personnel.
   f. When contact has been established with emergency services, and the victim has spent the recommended amount of time at the shower or eye wash, help the victim leave the lab to meet emergency personnel.
      i. Leave all contaminated clothing and other material behind in the lab. The victim’s wallet or underwear are much less important than his health.
      ii. Offer the victim a robe, slippers, blanket, etc. from the WCAM safety cart.
      iii. If possible, remember to bring a copy of the MSDS for the spilled material with you to the emergency room; these are available in the central hall of WCAM.
      iv. Stay with the victim until emergency personnel arrive. If possible, go with the victim to the emergency room and help report the details of the exposure.
   g. Inform WCAM staff

B. Exhaust failure


If there is a malfunction in one of the hazardous exhaust systems supporting WCAM, alarms will sound on affected tool; you will learn about this during training. When these alarms sound, lab members must:

a. Stop working at once. *Do not stay to do just a little more processing!* Your health is more important than your sample!
b. Clean up your work area, making sure any sources of hazardous vapor are contained
c. Leave the lab by the normal ungowning process.
d. Report the problem to WCAM staff.

C. Fire or gas alarm

If the fire alarm or toxic gas alarms in the lab are triggered, evacuate the lab immediately! *Do not stay to do just a little more processing!* Your health is more important than your sample! When these alarms sound, lab members must:

a. Stop working at once. *Do not stay to do just a little more processing!* Your health is more important than your sample!
b. Do not take the time to clean up or turn off tools.
c. Do not take the time to ungown or to log out of the lab.
d. Exit quickly but carefully through the nearest evacuation exit, which you learned about during your lab orientation and training. Follow the evacuation signs to the meeting point. Do not leave the meeting point until WCAM staff have checked that everyone is safe.
e. Do not re-enter the lab until instructed to by WCAM staff.

IX. VIOLATIONS AND PENALTIES

When a lab member fails to live up to his or her responsibilities, WCAM staff will meet with them to discuss the problem, describing how they can correct their behavior. In most cases, a warning is sufficient encouragement for conscientious research to improve behavior.

However, in some cases a lab member may repeatedly exhibit the same kind of faulty behavior, or a pattern of different kinds of faulty behavior, even after this discussion. In these cases, the best corrective mechanism available to WCAM is to suspend the lab member from the tool where the infraction occurred. The researcher’s PI will be informed.

In all cases of safety violations, the lab member will be suspended from the lab as a whole. The researcher’s PI will be informed.

Repeated infractions may result in progressively longer suspensions. More serious infractions, such as those that involve safety or that affect other lab members’ research, may result in longer suspensions. The length of suspension will be determined by WCAM staff, taking into consideration the seriousness of the offense, the frequency of past offenses, and other extenuating factors.

As noted above, all lab members are required to attend an annual safety training renewal session if they wish to maintain their lab access privileges. These sessions are offered at a variety of times to
accommodate varying schedules. Lab access may be suspended for members who fall six or more months behind in their renewal status and fail to make other arrangements.