Cleanroom Protocol and Safety

WVU Shared Research Facilities
2011

Training Overview

- Cleanroom Overview
- Contamination Control
  - Gowning
  - Carrying items in
- Entrance Requirements
- Rates
- Safety
  - Rules
  - Evacuation
  - Chemicals

Cleanrooms

- A cleanroom removes contaminates from air, water, and lab services, like nitrogen and possibly chemicals
  - Particulates in air and water
  - Chemicals and Gases
  - Temperature
  - Humidity
  - Light (particularly UV)
  - Vibration
  - Electromagnetic Fields

Cleanroom Classifications

- Typically classifications:
  - Class 10,000-Class 1
- Classification number:
  - # of particles of size 0.5 micron per a cubic foot
- Typical cleanrooms:
  - Class 10,000, 1,000 and 100 rooms
  - Class 10 and Class 1 areas

Internal Cleanroom Contaminates

Cleanrooms are built to minimize internal sources of contamination by:

- Using non-particle generating surfaces
- Building clean to eliminate particle during construction
- Self cleaning airflow

Outside Contamination

- Chemicals and gases carried into the room.
- Lab equipment and items brought into the room.
- The largest source of contamination is people.

User Created Contamination

- An average person will generate 5,000,000 ppm by walking at 2 mph.
- Standing still a person will generate 100,000 ppm .
- Sources of contamination
  - Lint
  - Hair
  - Dead skin cells
  - Oil
  - Perspiration
  - Spittle
  - Smoke

WVU Gowning Procedure

- Outside Gowning Room
  - Tacky matt (3 steps per a foot)
  - Blue booties
- Inside Gowning Room
  - Tacky matt
  - Bouffant caps
  - Beard guard (for facial hair)
  - Coveralls
  - Boot covers
  - Nitrile gloves
- Inside Photolithography room (Class 100)
  - Face mask or beard guard

Taking items into the cleanroom

- Items must be cleanroom approved materials.
- All items must be thoroughly cleaned and rinsed with DI water(unless prepackaged in a cleanroom environment)
- Items must be wiped down with a 10% IPA solution in gowning room.
- There is limited storage in cleanroom for labware and substrates.

Banned Substances

- Wood products (this includes paper)
  - If item MUST be taken into cleanroom, then use a sealed bag
- Graphite (i.e. Pencils)
- Markers
  - Use scribes if possible
- Tape or adhesives
- Paint
- Cosmetics (Perfumes and Makeup)

Entry into the WVU Cleanroom

- All users must have attended
  - SRF General Lab Safety Training
  - SRF Chemical Safety Training
  - Cleanroom Protocols and Safety Training
- Register on FOM
  - fom.wvu.edu/fom
- Daytime access: 8:00-5:00 M-F
- WVU ID required for access

Cleanroom Equipment Training

- Sign up for equipment training on the FOM software
- Don't learn too many instruments at one time
  - Check with your advisor on which instruments you need to learn first
  - Master tools first before proceeding to the next tool
- Don't ask for training too far in advance
- Practice! Practice! Practice!
- If you need staff assistance after training, please contact a staff member at least 2 days in advance before reserving the tool.

Cleanroom Rates

Semesterly fee per user

- Summer 2, 2011 (July 1-Agust 15) $475
- Fall 2011 (August 16-December 31) $950
- Spring 2012 (January 1- May 15) $950
- Summer 1, 2012 (May 16- June 30) $475

What is provided in the Cleanroom

- Gowning materials
- Cleanroom Wipes
- Cleanroom Tape
- Cleanroom Notebook
- Pipettes for spinning applications
- Standard Cleanroom Chemicals
- Standard source materials for deposition tools
- Use of hotplates, ovens, and ultrasonic bath
- Limited storage space

Current Standard Chemicals

- Acetone, Methanol, and Isopropanol
- HF, HCl, Sulphuric, Phosphoric, and Nitric Acids
- Summa Clean
- Buffered Oxide Etchant
- AZ photoresists
- SU-8 Resists
- PMMA
- Associated AZ, SU-8 and PMMA strippers and developers

This list is subject to change.

What you must provide

- Glassware and other labware
- Storage boxes
- Tweezers
- Substrates and holders
- Photolithography masks
- Approved specialty chemicals (typical sources are AZ, Transene, JT Baker, and MicroChem)

Cleanroom Behavior

- Always wear proper garments when entering
- No hanging out
- No guests
- Do not touch other people's experiments
- Clean your work area when done
- Do not work with chemicals or equipment you are not trained for

Cleanroom Dress Code

- No contact lenses
- Wear pants that cover the legs, no shorts
- No open toed shoes or sandals, feet must be fully covered
- No make-up or perfume

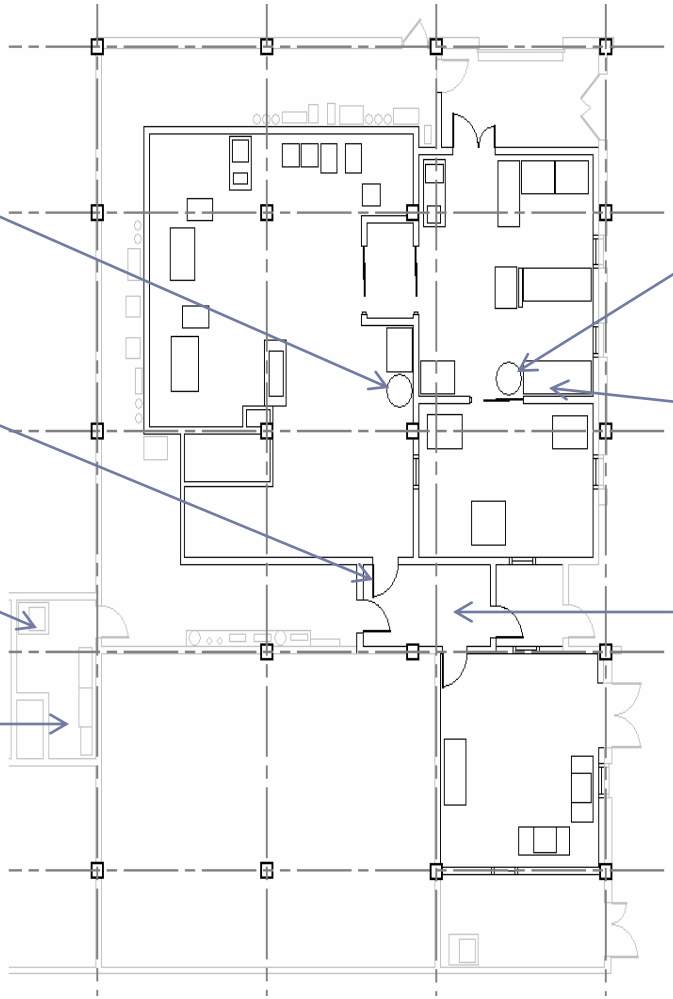
Personal Safety Equipment

- First Aid Kit
  - Located in gowning room
- Spill Kits
  - Located on top of Acid Hood
  - Located chemical storage room
- Eyewash and Shower Station
  - Next to Acid Hood in Wet Processing Room
  - Next to Solvent Hood in Dry Processing Room
  - In hallway outside G75E
- Chemical Hygiene Plan
  - Located in Gowning Room

Evacuation

- **In case of Fire or Chemical Spill all users should evacuate the entire Cleanroom immediately!**
- Do not stop to ungown
- Use the shortest, unobstructed path to the exterior of the building
- Stationary leaves of the automated doors will swing open for emergency egress when pushed or pulled
- Only if it is safe to do so, users should turn off or unplug hotplates, ultrasonic bath or equipment before evacuating

WVU Cleanroom



Types of Chemicals in Cleanroom

- Polymers- includes photoresists, SU-8 PMMA, HMDS
- Developers- includes AZ 400K and AZ 300 MIF
- Solvents- Acetone, Methanol, Isopropanol, SU-8 Developer, MIBK, Resist Strippers
- Acids- Hydrofluoric, Hydrochloric, Sulfuric, Phosphoric, Nitric
- Etchants- Gold Etchant, Chrome Etchant, Buffered Oxide Etchant (BOE), Preferential Silicon Etchant (PSE)
- Bases- Hydrogen Peroxide, Ammonia Hydroxide

Material Tracking Form

- A material tracking form and MSDS must be submitted for approval before any chemical is brought into the cleanroom.

sharedresearchfacilities.wvu.edu/forms/srfForms.html

- Recommend checking for approval before purchasing the chemical.

Chemical Storage

- Bulk Chemical storage is in room G55A1 (off the main equipment chase)
  - Yellow cabinet is for solvents and developers
  - Blue cabinet is for acids and etchants
  - Small blue cabinet is for Nitric Acid
  - Small yellow cabinet for oils

Chemical Path

- Once a chemical bottle is taken into the cleanroom, it is stored under the proper hood, until completely used.
  - Photolithography Room
    - Spinner hood- Resist and HMDS
  - Wet Processing Room
    - Developer hood- developers only
    - Solvent hood- Acetone, alcohols and strippers
    - Acid hood- Acids and etchants on left, waste on right
    - Spare hood (right hand)- Bases

Chemical Disposal

- Waste jars for all chemicals except:
  - AZ photoresist developer (300MIF and 400K)
  - Properly aspirated acids
- Solid Waste
  - Waste jar for photoresist contaminated pipettes located under spinner hood
  - Waste receptacles for used wipes in hoods and on machines

Photoresists and Polymers

- *Use:* Generating patterns and masking materials
- *Hazards:* Highly Flammable. Irritant to nose, throat, and lungs. Bad for gastric tract, nervous system, liver and kidneys. Can be carcinogenic, mutagenic, and fetomutogen.
- *Required PPE:*
  - Nitrile gloves
- *Spill:* If smaller than 2" diameter, clean with Acetone

Resist Developers

Use: To develop photoresists and e-beam resist

Hazards: Solvent based developers are flammable. Irritant to eyes, skin and gastric tract.

Required PPE:

- Nitrile gloves

Spill: If smaller than 12" in diameter, use spill kit

Waste: AZ developers (300MIF and 400K) may be emptied down the sink with copious amounts of water.

Solvents

- *Use:* Degrease or stripping polymers.
- *Hazards:* Highly Flammable. Irritant to skin, eyes and lungs. Bad for kidneys and liver. Can be carcinogenic, mutagenic, and reproductive effector.
- *PPE:*
  - Nitrile gloves
  - Orange protective gloves for "ene"-ending chemicals
  - Splash protective goggles with face shields when heating on a hotplate
- *Spill:* If smaller than 12" in diameter, use spill kit

Acids

- *Use:* Removing dielectrics and heavy metal ions.
- *Hazards:* Can cause thermogenic reactions. Corrosive to skin, eyes, mucous membranes, and lungs. Long term exposure can cause teeth and bone problems.
- *Required PPE:*
  - Orange protective gloves
  - Splash protective goggles with face shield
  - Acid apron for HF, piranha bath and heating acids
- *Spill:* If smaller than 12" in diameter, use spill kit

Acid Disposal

- Any acid or acid mixture that has etched metals must be stored in a waste jar. Make sure acid process has cooled before capping jar.
- Acids can be aspirated
  - To use the aspirator
    1. Make sure the aspirator is firmly attached to the faucet
    2. Turn the faucet on full flow
    3. Use the aspirator tube to suck acid. Aspirate the surface of the acid
    4. Be careful when removing aspirator to avoid backflow
    5. Fill beaker with water and reaspirate
    6. Turn off aspirator

Hydroflouric Acid

- Indistinguishable from water in both sight and smell.
- Does not attack skin immediately, but is absorbed through it.
- Attacks underlying tissue.
- Takes up to 48 hours to feel pain.
- 2% dermal exposure is fatal.
- Use Calcium Gluconate immediately if exposed and go to emergency room.

Dangerous Acid Combinations

- Aqua Regia- Nitric and hydrochloric acid
  - Used for aggressive cleanings
  - Thermogenic reaction, which produces fumes
- Piranha Bath- Sulfuric Acid and Hydrogen peroxide
  - Used for aggressive cleanings
  - Thermogenic, bubbles aggressively and spits
  - Strips off flesh like a "piranha"
- Check with Cleanroom staff if this is your first time

Etchants

- *Use:* Etching silicon or metals.
- Premixed acids, do not add water.
- *Hazards:* Corrosive to skin, eyes and lungs. Can cause breathing problems or nerve damage.
- *Required PPE:*
  - Orange protective gloves
  - Splash protective goggles with face shield
  - Acid apron for heating etchants
- *Spill:* If smaller than 12" in diameter, use spill kit

Bases

- *Use:* Piranha Bath or cleanings
- *Hazards:* Can cause fire if in contact with combustible material. Burns skin, eyes and digestive tract. Bad for kidneys and liver. Can be mutagenic.
- *Required PPE:*
  - Orange protective gloves
  - Splash protective goggles with face shield
  - Acid apron for heating or mixing
- *Spill:* If smaller than 12" in diameter, use spill kit