Cleanroom's Safety & Protocols

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Purpose of Safety and protocol

- Promote Successful Cleanroom Operations
- Ensure Safety in the Clean Environment
- Provide Operational Conditions that Meet Process & User Needs

Perspective

The protocol provides

basic awareness and general guidelines

for cleanroom users.

Successful cleanroom operation relies on

each user's understanding, participation

and self discipline.

The success of each user relies on

trust, understanding and shared responsibility among all users.

What is a Cleanroom?

A clean environment designed to reduce the contamination of processes and materials. This is accomplished by removing or reducing contamination sources.

Types of Contamination

- Particulate
  Dust, skin, hair, makeup…
- Chemical
  Oil, grease, metal ions, perfume…
- Biological
  Bacteria, fungi, rodents???
- Radiation
  Ultraviolet light…

Particle Characteristics

- 50 micron particles are visible
- Average human hair is about 100 microns
- Time to fall 1 meter in still air
  - 33 seconds for 10 micron particle
  - 48 minutes for 1 micron particle
- Humans generate $>1x10^5$ particles per minute when motionless
- Humans can generate $>1x10^6$ particles when walking in the cleanroom

Contamination Sources

- People ~75%
- Ventilation ~15%
- Room Structure ~5%
- Equipment ~5%
  - Contamination from personal

Action	Ordinary clothes	Clean room clothes
Sitting	500,000	15,000
Standing up	2,500,000	80,000
Walking slowly	5,000,000	150,000
Running	10,000,000	300,000

particles of >0,.5um dia. generated/minute from the human body

Contamination control - Gowning

- Proper gowning order
  - Shoe covers
  - Face mask
  - Hair cover
  - Hood (Special case)
  - Coverall (Bunny Suit)
  - Knee-high Booties
  - Gloves
  - Safety Glasses

Materials and Supplies

- Do Not carry non-cleanroom items into the cleanroom
- Do not carry cleanroom items out of the cleanroom
- Do not use pencils or erasers
- Paper should be kept in a plastic sleeve
- Do Not cut the cleanroom wipers
- Clean everything you carry into the cleanroom

Chemicals & Acids

- Always read MSDS for every chemical you use
- New chemicals into the cleanroom requires permission
- Large quantities of chemicals must be stored outside the cleanroom
- Proper labeling with their contents and Hazard Classification
- Unattended chemicals and experiments should be labeled with the owners name, immediate contact number, list of all chemicals involved, and estimated time of return or completion.
- **Always Add Acid to Water (AAA)**

Chemicals .....

Acids : HF, BHF, $H_2SO_4HNO_3$ and HCl

Bases : H_4OH, KOH, NaOH, TMAH & Developers

Oxidizers: H_2O_2, $Na_2S_2O_3$, $(NH4)_2S_2O_8$ and HNO_3

Solvents: Cleaning Solvents,
Photo & e-beam resists
Resist Removers
Developers
Resist thinners

Working with Hydrofluoric Acid

- Never work alone or after hours with HF
- Familiarize with MSDS & SOP
- Never heat HF
- Personal Protective Equipment
  - Eye Protection
    - Safety Goggles and a Face Shield
  - Gloves
    - Neoprene
    - Nitrile
  - Body Protection
    - Lab Coat/Cover all, Acid Resistant Apron and closed toe shoes

Hydrofluoric Acid
Chemical Properties & Hazards

- **Reactive:** Glass (SiO2), concrete, enamels, glazes, rubber and many organic compounds
- **Reactions with metals:** Generates hydrogen gas which could pose an explosion hazard

- Poison! Extremely corrosive liquid and vapor that can cause severe injury via skin and eye contact, inhalation or ingestion.
- Mechanisms
  - Corrosive Burns- from free H+ ions
  - Chemical Burns- from penetration of fluoride ions

Hydrofluoric Acid- First Aid

- **Skin Contact**
  - Move to nearest wash station, rinse/flush with water and remove contaminated clothing
  - Apply calcium gluconate gel to the affected area using clean gloves
- **Eye Contact**
  - Immediately flush eyes with water Irrigate eyes with calcium gluconate solution (DO NOT PUT CALCIUM GLUCONATE GELS IN EYES)

Hydrofluoric Acid- First Aid

- **Ingestion**
  - Immediately drink large amounts of water
  - If available, milk, antacid tablets can also be administered
- **Inhalation**
  - Move the affected person to fresh air and keep affected person warm and comfortable
  - If breathing stops, begin CPR or use an inhalator

  - Call emergency number and medical assistance
  - Carry the MSDS to the Health center

Chemical Handling

- **In case of small spill**
  - Inform all users in the cleanroom
  - Clearly mark the affected area
  - Use appropriate absorbent material to clean up the spill
- **In case of large spill**
  - Inform all users in the cleanroom
  - Clearly mark the affected area and evacuate
  - Contact cleanroom staff immediately

Compressed Gases & Cylinders

- All Cylinders Must be Stored and Secured in a Approved Gas Cylinder Rack
  - Double Chained
    - Top and Bottom

Regulators

- Make Sure That the Regulator has the Proper CGA Connection for the Valve Outlet
  - The Regulator CGA # Must Match the Gas Cylinder CGA #
- Do Not Over Tighten the Regulator When Attaching it to the Gas Cylinder Outlet

Fire Safety

Fire extinguisher classes:
A, B, C, D

You Should Know compatibility
(Fire type to Extingusher Class)

Attend Tomarrow Fire Drill

Facility use

- All users must be trained before using any equipment
- All equipment use should be scheduled
- If you are unable to use scheduled time please communicate at least one day in advance
- It is every users responsibility to report damaged or malfunctioning of UNIT
- It is every users responsibility to properly operate and clean each piece of equipment & work bench that they use
- **A single user can have huge Impact on overall process of the device**

In Case of Emergency

- Always follow the rules
- If an emergency requires evacuation, leave the cleanroom immediately, **do not stop to un-gown**
- Inform other users before leaving
- Call the emergency Numbers displayed at Process **UNITS & WET BENCH**

Violations of Rules

- **First time**
  - Warning
  - Report to Advisor
- **Second time**
  - Suspension of access
  - Report to Advisor
  - Retraining may be required
- **Third Offense**
  - Suspension of access
  - Report to Advisor
  - Access will not be renewed until an acceptable resolution is reached between Advisor and Facility Head
  - Cleanroom Protocol re-training will be required

Conclusions

- Contamination control is a continuous battle
- User behavior has a critical impact on contamination
- Proper procedures must be followed at **ALL TIMES**
- Think about your actions! Be an active participant
- Make sure others follow procedures as well; nothing wrong with pointing out mistakes
- Make sure wet-bench exhaust is **TURNED ON**
- **SAFETY OF YOU & YOUR CO-WORKER is most Important**

THANK YOU

- Hydrogen peroxide, H_2O_2
- Sodium persulfate, $Na_2S_2O_3$
- Ammonium peroxidesulfate, $(NH4)_2S_2O_8$
- Nitric acid, HNO_3

Cleaning solvents: Methanol, ethanol, IPA, acetone.
Resists for optical and e-beam lithography.
Resist removers: Shipley Microposit Remover 1165 (NMP), MEK, DEK, and acetone.
Developers: Toluene, xylene, MIBK, and XP SU-8.
Resist thinners: Anisole, EC-solvent, cyclopentanone, and chlorobenzene