



# **Micro/Nano Technology Center Orientation and Safety Training**

University of Louisville

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# This Orientation

- Is going to teach you basic rules and regulations, preventative safety measures, and how to respond to safety incidences.
  - This presentation will be available online:  
<http://louisville.edu/micronano/users/lab-safety>
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# Responsibilities

- As a user of the MNTC facilities you must follow all of the rules listed in the presentation.
  - If you fail to follow these rules, consequences can happen – including the potential loss of facility access.
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# **GENERAL RULES**

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# MNTC Cleanroom Access

- ◎ To enter the cleanroom you should complete:
    - General Lab Safety Training (DEHS - required)
    - Hazardous Waste Safety Training (DEHS - required)
    - Safety Training followed by a Safety Quiz (MUST pass)
    - Users must provide a Speedtype number and complete a process review with a staff member.
    - Process Specific Training (Provided by the MNTC Staff)
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# MNTC Cleanroom Safety

- ⦿ Only trained individuals may enter the cleanroom.
  - ⦿ All equipment usage must always be logged both digitally and in logbooks where applicable.
  - ⦿ In order to use equipment you must be a certified user through FOM.
  - ⦿ Review Safety Data Sheets (SDS) for any chemicals you may use.
  - ⦿ Check any item used (especially gowns and PPE) for contamination before use.
  - ⦿ Do not bring non-essential items into the cleanroom.
  - ⦿ NEVER, EVER WORK ALONE!
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# Cleanroom Integrity

- ⊙ No food, drinks, smoking, chewing gum or pencils.
  - ⊙ No worn powders (i.e. powdered makeup)
  - ⊙ Only necessary items are allowed in the cleanroom (such as laptops, notebooks, pens, and samples)
  - ⊙ Items not necessary for work can be stored in the gowning room (such as coats or backpacks)
  - ⊙ New Chemicals should not be brought into the cleanroom without written permission from MNTC staff
  - ⊙ **Leave it cleaner than you found it!**
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# Appropriate Attire

- ⦿ Contacts can be a safety concern.
  - ⦿ Full length pants must be worn at all times.
  - ⦿ Only closed-toed shoes are allowed. No heels, sandals or flip flops allowed.
  - ⦿ Bunny suit, head garment, safety glasses, boots, shoe covers, mustache/beard nets and nitrile gloves **must** be worn at all times inside the cleanroom.
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# Hours of Operation

- Open 24/7 during the week and upon request during weekends.
  - Staff hours are 9AM-5PM, Monday through Friday (with the exception of U of L holidays).
  - Never work alone or without a buddy!!
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# Laundry

- Place contaminated or soiled gowns in the laundry bin in gowning room.
  - Wash head garments after 2 weeks of usage.
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**MICRO/NANO TECHNOLOGY CENTER  
SAFETY TRAINING**

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# Entering the Cleanroom

- Put on blue shoe covers (in a box outside the cleanroom door).
- Step on the sticky pad to remove any dust from your feet.
- Scan your ID card to unlock the door.
- Place backpacks, jackets or unnecessary items in the lockers in the gowning room.
- Do not leave items on the floor of the gowning room.



# Basic Gowning Procedure

- Put on head garment and a beard cover (if necessary).
- Find an appropriate sized bunny suit off the rack and adorn.
- Tuck in the tails of the head garment inside the bunny suit.
- Find an appropriate sized pair of boots (color coded according to foot size)
- Adorn safety glasses and gloves located near the door. Make sure your gloves are covering the cuffs of your bunny suit.



# Personal Protective Equipment (PPE)

- ⦿ Always wear PPE when working with chemicals.
  - ⦿ PPE is chemical resistant, NOT chemical proof.
  - ⦿ Always inspect PPE before and after use. Check for holes, stains and other indicators of contamination.
  - ⦿ Dry gloves before removing.
  - ⦿ Do not leave gloves inside out for the next person.
  - ⦿ Do not wear PPE outside of the wet bay.
  - ⦿ Users need Wet Bench training before they are allowed to process in the Wet Etch Bay.
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1. Inspect Apron



2. Tie apron in the back only.



3. Use 10% IPA + Water on towel to clean Face Shield.



4. Put on the Face Shield.



5. Adjust Face Shield.



6. Inspect Gloves for cracks



7. Put on Chemical Resistant Gloves over apron sleeves



# How to Wear Personal Protective Equipment

1. Check gloves, apron and face shield for contamination and rinse them thoroughly if necessary. If they are not easily cleaned then them throw away.

2. Wash gloves



3. Dry gloves using a towel.



4. Remove and hang face shield.



5. Remove and hang apron.



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# Removal of PPE

- ⦿ An SDS will give you valuable information about the chemical, its safety protocol and how to handle accidental exposure.
- ⦿ You must thoroughly review the chemical's SDS before using the chemical.
- ⦿ Copies of SDS's for all chemicals can be found in:
  - Gowning Room (SDS)
  - Online

# **Safety Data Sheets (SDS)**

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- ⦿ If you need a container for chemical processing you must first know what type of container to use (i.e. Pyrex or Nalgene).
- ⦿ Always wear appropriate PPE.
- ⦿ Always stand when working at any bench.
- ⦿ Only work with chemicals in their designated areas.
- ⦿ Chairs are not to be in front of the benches at any time.

# **Rules for Working with Chemicals**

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- ⊙ Most chemicals are clear and appear as water. Assume all liquids are potentially dangerous if you do not know what they are.
- ⊙ Only use dedicated tanks/baths as they are labeled.
- ⊙ Uncap only one bottle at a time.
- ⊙ Pour chemicals slowly.
- ⊙ Keep gloves dry and clean.
- ⊙ Common solvents: acetone, methanol, Isopropyl Alcohol (IPA)

# **Rules for Working with Chemicals**

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- When mixing chemicals:
  - Pour acids into water. *NEVER pour water into acids.*
  - Do not mix acids and solvents.
  - Do not mix halogenated solvents with non-halogenated solvents.
- Do not leave chemicals unattended without being clearly labeled with the chemical name, date and your name.
- Do not pour chemicals back into original container due to contamination issues.

# **Rules for Working with Chemicals**

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- Chemicals should only be used at their designated benches (i.e. acids at the Acid Bench)
- Always put the cap on securely on to containers and wipe away any drips on the side of the bottle before transport
- Make sure you know understand how to dispose of the chemical before processing.
- Leave it cleaner than you found it.
- Place empty bottles on the bottom shelf of the cabinet that it came from.

# **Rules for Working with Chemicals**

- Wipes, cotton swabs and solid waste must be disposed into the appropriate and designated trash containers.
- Hazardous waste trash bins are located in the wet etch and photolithography bays.
- Wafers are to be disposed placed in the sharps bins located through the cleanroom.



Acid waste only

Acid Bench

# Waste

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# **RESPONDING TO SAFETY INCIDENTS**

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# Buddy System

- You are never allowed to work alone in the cleanroom.
  - A cleanroom buddy is required before 9 am, after 5 pm Monday through Friday and on all weekends.
  - A cleanroom buddy is someone who also has access and is trained how to use the cleanroom.
  - If you see someone in distress you will automatically become their safety buddy.
  - Call 911.
  - Be sure you are wearing PPE before helping the victim.
  - Take the appropriate SDS to the ER.
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# Safety Station = Fire Extinguisher + Safety Shower + Eye Wash Station

- There are safety stations located on the windowed wall at the end of every bay.
- Pull down the handle to engage the safety shower.
- Pull out the drawer to engage the eye wash station.



Eye Wash Station

Safety Shower Handle

# Responding to Emergencies

## LEAVE IMMEDIATELY!!

- ⦿ You Hear: Horns going off
- ⦿ You See: Flashing White or Blue Lights

Fire Alarm  
(white strobe)



- ⦿ You DO: Evacuate the Building Immediately!!

- ⦿ Warn others as you exit and assist them if needed.
- ⦿ Do not attempt to de-gown.
- ⦿ Do not try to finish an experiment or understand why the alarm is sounding.

Hazmat Alarm  
(Blue Strobe)



# Responding to Emergencies

- An emergency poster is placed in the gowning room for quick reference, but the basic idea is to just get out of the building as quickly as possible.
  - Any chemical spill regardless of size must be reported to MNTC staff immediately after securing the area.
    - Contact by phone for minor incidents
    - Hazmat Alarm / Safety Shower for major incidents
  - Three important phone numbers:
    - 911 – Emergency Services
    - 502-589-8222 – Poison Control
    - 502-589-8222 – UofL Campus Police
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# Minor Chemical Spill

- ⦿ Acceptable for trained lab personnel to manage; ensure you know location of the chemical spill kit.
  - ⦿ Call the MNTC staff and/or Poison Control.
  - ⦿ Place the affected skin under running water for 15 minutes.
  - ⦿ Remove any contaminated clothes or jewelry.
  - ⦿ If ER trip is needed, call 911, contact the MNTC staff and bring the SDS of the exposed chemical with you.
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# Major Chemical Spill

- ⦿ Get under a running safety shower and pull the handle. There will be a lot of water and alarms will go off. This will also notify the MNTC staff.
  - ⦿ Have your buddy call 911 and request an ambulance.
  - ⦿ Remove all contaminated garments and jewelry.
  - ⦿ Have your buddy bring the SDS of the exposed with you to the ER.
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# Chemical Splash in the Eyes

- If you are wearing contacts – take them out!
  - Flush eyes in eyewash fountain for 15 minutes. There will be a lot of water and alarms will go off. This will also notify the MNTC staff.
  - Have your buddy call 911.
  - Go to the ER and bring the SDS of the chemical that was exposed.
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# Hydrofluoric Acid (HF)

- ① HF is a very dangerous chemical. If contact occurs:
  1. Immediately rinse affected skin with water.
  2. Remove all jewelry or clothing exposed to HF.
  3. Have a cleanroom buddy CALL 911.
  4. After washing for 5 minutes, do not dry the skin.
  5. Cover entire affected area with calcium gluconate gel (Calgonate).
  6. Continuously apply fresh gel while on the way to the ER and while waiting.



# Hydrofluoric Acid (HF) in Eyes

1. Flush eyes at eyewash station for 5 minutes
2. After 5 minutes, switch to calcium gluconate (Calgonate) eyewash.
3. Have your cleanroom buddy call 911 and request an ambulance.
4. Continue flushing until reaching the ER.
5. Bring the HF SDS to the ER.



# Chemical Spills

- If the chemical that spilled is not toxic or dangerous and did not come into contact with your body then contact the MNTC staff for cleanup protocol.
  - Should any hazardous chemical be improperly disposed in a sink or floor drain, be sure to report the incident to ULPD (852-6111)
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# Mercury Spills

- If a Mercury Lamp explodes in the Suss Aligner:
    - Evacuate the cleanroom and activate the blue HAZMAT alarm.
    - Warn others as you exit.
    - Do not attempt to de-gown.
    - Do not try to finish an experiment.
    - Call 911 and alert them if anyone is injured.
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# Flammable Solids on Skin

- Brush off as much solid material as possible.
  - Treat the exposure like a small spill on the skin.
  - Check the SDS before using any chemical – some flammable solids react with water!
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# First Aid for Other (Minor) Incidents

- First Aid Kits are located in the gowning room and around the lab
  - Thermal Burn / Bleeding
    - Contact MNTC staff and/or Campus Health
  - Clothing Fire
    - Douse victim with safety shower or smother with fire blanket.
  - If unsure - CALL 911!
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# **EQUIPMENT USAGE**

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# Facility Online Management (FOM)

- Set up your FOM account.
- Request for training on specific tools.
- Reserve the tools you need for processing.
- Communicate with the MNTC staff, other users and supervisors.
- Generate financial and usage reports and keep access of your tab.

Create your FOM account at:

<http://louisville.edu/micronano/users/fom>

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# FOM Registration

University of Louisville - FOM - User Registration

  
Time on server  
Friday Sep. 20  
15:23:12

FOM New User Registration

Please choose:  Internal User  External User

Username:

Password:

Password Again:

Category:

Discipline:

Department:  [My department is not listed here](#)

Supervisor:  [My supervisor is not listed here](#)

First Name:

Last Name:

Email:

Phone Number:

# FOM Reservations



Time on server  
Friday Mar 21  
12:12:37

- » Zhenya - Home
- » Instrument sched
- » Collaborate & Service
- » Purchase Supplies
- » Documents
- » User Report
- » My Profile
- » My Accounts
- » Contact Manager
- » Logout
- » User Forum

Message from Facility Manager:  
 (2014-02-06 17:01:07) You did not show up your reserved session on Sputterer started at 2014-02-06 16:50:00.  
 (2014-02-06 16:01:07) You did not show up your reserved session on Sputterer started at 2014-02-06 15:50:00.  
 (2013-09-26 01:01:30) You did not show up your reserved session on Sputterer started at 2013-09-26 00:50:00.  
 (2013-09-24 10:41:29) You did not show up your reserved session on Sputterer started at 2013-09-24 10:30:00.

Delete all messages

**Authorized Instruments (Click to view schedule)**

- ALD (UofL\_MNTC): To Be Trained, AVAILABLE
- PVD 75 (UofL\_MNTC): Any time Access, AVAILABLE
- Technics Sputterer (UofL\_MNTC): Any time Access, AVAILABLE

**Available Instruments (Click to request training or usage approval)**

Select or type to search

**UofL\_MNTC**

Resources in this facility

- [ABM Aligner](#) (ABM Mask Aligner)
- [Critical Point Dwyer](#)
- [Denton Evaporator](#) (Denton Evaporator)
- [DRIE](#) (DRIE)

06:30 - 07:00	06:30 - 07:00	06:30 - 07:00	06:30 - 07:00	06:30 - 07:00	06:30 - 07:00
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07:30 - 08:00	07:30 - 08:00	07:30 - 08:00	07:30 - 08:00	07:30 - 08:00	07:30 - 08:00
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Zhenya M, 11:13-11:30				11:00 - 11:30	11:00 - 11:30
Ana Smith, 11:30-12:00				11:30 - 12:00	11:30 - 12:00
12:00 - 12:30				12:00 - 12:30	12:00 - 12:30
Zhenya M, 12:30-13:00				12:30 - 13:00	12:30 - 13:00
13:00 - 13:30				13:00 - 13:30	13:00 - 13:30
Click to log on				13:30 - 14:00	13:30 - 14:00
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20:00 - 20:30				20:00 - 20:30	20:00 - 20:30

**Instrument Reservation**

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**Express Logon**  
 Previous user comment:  
 ok

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Select the account number you want to use for this session:  
 Oups

Start time:    
 End time:

Estimated cost: 24.166666666666668

Comment:

# More Information

- ⦿ Check out our website for more information:  
<http://louisville.edu/micronano/users/lab-safety>
  - ⦿ You can access SDS's, standard operating procedures (SOP's), the safety quiz and safety presentation, request equipment training and schedule use of equipment.
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# So... When do I get my access?

- Complete your safety quiz and return it to the MNTC Staff.
  - Make sure to provide your advisor's speedtype on your quiz!
  - Go through a process review with an MNTC staff member to learn more about which equipment you will need for your process
  - You will then be given cleanroom access and can sign up for training on specific tools.
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# Appendix I – Chemical Classifications

- **Acids:** Acids have a pH of less than 7. Chemicals can be identified as acids if they have a name ending in ‘acid’ or if their chemical formula is of the form  $HX(aq)$  or  $HaXbOc$ .
  - **Bases/Caustics:** Bases have a pH of greater than 7. Chemicals can be identified as bases if they contain hydroxide ( $OH^-$ ), or hydrogen carbonate ( $HCO_3^-$ ) anions. Ammonia ( $NH_3$ ) is also a base.
  - **Corrosives:** Corrosives have the tendency to cause deterioration of metal surfaces. Strong acids and bases are corrosives. Corrosives are chemicals which erode the skin and the respiratory epithelium and can be very damaging to the eyes. When inhaled, the vapors of corrosives can cause severe bronchial irritation.
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# Appendix I – Chemical Classifications

- **Flammables:** Compounds whose vapors are easily ignitable at room temperature. Flammables can be identified by looking at the SDS sheet for the chemical.
  - **Halogenated Solvents:** Halogenated solvents contain an element from the halogenated (second to last) column on the periodic table. These elements are: Fluorine, Chlorine, Bromine, Iodine, and Astatine.
  - **Non-Halogenated Solvents:** Any solvent that does not contain an element from the halogen class (second from last column of the periodic table).
  - **Inorganic Acids:** acids have chemical formulas that do not contain carbon.
  - **Organic Acids:** acids have chemical formulas which contains carbon.
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# Appendix I – Chemical Classifications

- **Oxidizing Agents:** Materials which gains electrons when they react with other substances. This reaction may result in explosion or fire.
  - **Peroxide Forming Compounds:** Peroxides form by the reaction of the chemical with oxygen allowed in the headspace of chemical containers once the container is opened for the first time. Peroxide formation in laboratory solutions and reagents by auto-oxidation has caused many laboratory accidents, including unexpected explosions of residues remaining after solvent distillation.
  - **Reducing Agents:** which become an electron donor when they react.
  - **Solvents:** The component of the solution that is present in the greatest amount and is capable of dissolving another substance.
  - **Toxic:** Containing or being poisonous material especially when capable of causing death or serious debilitation. Exposure to chemicals in the laboratory can occur by several different routes: (1) inhalation, (2) contact with skin or eyes, (3) ingestion, and (4) injection. Toxicity information is available on the material safety data sheet of each chemical.
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# Appendix II – HCS Label

- Health Hazard: Carcinogen, Mutagenicity, Reproductive Toxicity, Respiratory Sensitizer, Target Organ Toxicity, Aspiration Toxicity
- Flame: Flammables, Pyrophorics, Self-Heating, Emits Flammable Gas, Self-Reactives, Organic Peroxides
- Exclamation Mark: Irritant (skin and eye), Skin Sensitizer, Acute Toxicity (harmful), Narcotic Effects, Respiratory Tract Irritant, Hazardous to Ozone Layer (Non-Mandatory)



# Appendix II – HCS Label

- Gas Cylinder: Gasses under Pressure
- Corrosion: Skin Corrosion/Burns, Eye Damage, Corrosive to Metals
- Exploding Bomb: Explosives, Self-Reactives, Organic Peroxides



# Appendix II – HCS Label

- Flame over Circle: Oxidizers
- Environment: Aquatic Toxicity
- Skull-and-Crossbones: Acute Toxicity (fatal or toxic)



# Appendix III – Common Acids in the Cleanroom

Chemical	Formula	Concentration
Acetic Acid	CH <sub>3</sub> COOH	95%
Hydrofluoric Acid	HF	49%
Hydrochloric Acid	HCl	36%
Nitric Acid	HNO <sub>3</sub>	68%
Phosphoric Acid	H <sub>2</sub> PO <sub>4</sub>	85%
Sulfuric Acid	H <sub>2</sub> SO <sub>4</sub>	96%
Hydrogen Peroxide	H <sub>2</sub> O <sub>2</sub>	30%
Buffered Oxide Etch	NH <sub>4</sub> / HF	50% / 10%

# Appendix IV – Common Bases in the Cleanroom

Chemical	Formula	Concentration
Ammonium Hydroxide	NH <sub>4</sub> OH	25%
Ammonium Fluoride	NH <sub>4</sub> F	40%
Potassium Hydroxide	KOH	45%
Sodium Hydroxide	NaOH	50%
TMAH	(CH <sub>3</sub> ) <sub>4</sub> NOH	25%

# Appendix V – Common Solvents in Cleanroom

Chemical	Formula	Concentration
2-Propanol	CH <sub>3</sub> CHOHCH <sub>3</sub>	100%
Acetone	CH <sub>3</sub> COCH <sub>3</sub>	100%
Chlorobenzene	C <sub>6</sub> H <sub>5</sub> Cl	100%
Methanol	CH <sub>3</sub> OH	100%
Toluene	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	100%
Trichloroethylene	C <sub>2</sub> HCl <sub>3</sub>	100%
Xylene	C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub>	90%

# Appendix VI – Common Corrosives

- Ammonium Fluoride
  - Ammonium Hydroxide
  - Ammonium Hydroxide
  - Buffered Oxide Etch (BOE)
  - Hydrochloric Acid
  - Aluminum Etch 80-15-3-2
  - Hydrofluoric Acid
  - Phosphoric Acid
  - Potassium Hydroxide
  - Resist Developer
  - Sulfuric Acid
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# Appendix VII – Incompatible Chemicals

- Acetic Acid
  - Ferric Chloride
  - Hydrogen Peroxide
  - Mercury
  - Nitric Acid
  - All Acids (ex. Hydrochloric, hydrofluoric)
  - Oxidizers (ex. Permanganates, inorganic peroxides, persulfates, perchlorates)
  - Water Reactives (sodium, potassium, metal hydrides, hydrolysable halides)
  - NANO-STRIP
  - Sulfuric Acid
  - Nitric Acid, Ethylene Glycol, Peroxides, Permanganates
  - Aluminum
  - Copper, Chromium, Iron, Alcohols, Acetone, Organics
  - Ammonia
  - Photoresist Developer, Acetic Acid, Flammable Liquids, Flammable Gases
  - All Bases (ex. Sodium cyanide, potassium hydroxide, sodium hydroxide)
  - Flammables, organic materials, reducing agents (ex. Zinc, alkaline metals, formic acid)
  - Water
  - Solvents
  - Solvents
-

# Appendix VII – Incompatible Chemicals

Chemical	Chemical
Acetic Acid	Nitric Acid, Ethylene Glycol,
Ferric Chloride	Peroxides, Permanganates Aluminum
Hydrogen Peroxide	Copper, Chromium, Iron, Alcohols, Acetone, Organics
Mercury	Ammonia
Nitric Acid	Photoresist Developer, Acetic Acid, Flammable Liquids, Flammable Gases
All Acids (ex. Hydrochloric, hydrofluoric)	All Bases (ex. Sodium cyanide, potassium hydroxide, sodium hydroxide)
Oxidizers (ex. Permanganates, inorganic peroxides, persulfates, perchlorates)	Flammables, organic materials, reducing agents (ex. Zinc, alkaline metals, formic acid)
Water Reactives (sodium, potassium, metal hydrides, hydrolysable halides)	Water
NANO-STRIP	Solvents
Sulfuric Acid	Solvents