Welcome to
Nanotechnology Research and Teaching Facility

Dr. Nader Hozhabri
NanoFAB Safety and Protocol Training
Goals

- Provide safe and secure work environment
- Maintain the facility in excellent condition
Introduction to Clean Room
Bay Area
Introduction to clean room-2
Introduction to the Clean Room-3

Entrance Room

- A Rack: with blue bins containing various sizes of Gloves, disposable shoe covers, hair nets, and face nets
- One cabinet: containing supplies of permanent gowns, booties, hoods, face nets, and hair nets
- Wire benches
- Laundry can
- Trash can
Entrance Room Cont.
Introduction to clean room-4 (Entrance Room. Cont..)
Tacky Mat
Entrance Room
Introduction to clean room-5 (Entrance Room. Cont..)
Introduction to the Clean Room-6

**Gowning Room**

- Racks with metal hangers for clean room gowns
- Hangers are labeled with names or ‘visitor’
- Wire benches
- First-aid kit
- Pass-through window For bringing in small, cleaned items
Introduction to the Clean Room-7- Gowning
Room Cont.
Introduction to the Clean Room-8

- Air shower
- Teaching FAB Facilities
- Bay 4 Process Equipment
- Bay 3 Process Equipment
- Alcove Process Equipment and Supply Cabinets
- Bay 2 Characterization Equipment
- Bay 1 Lithography and wet processing
- Chases Support Equipment
- Emergency equipment locations
- Note: Chases are also called ‘grey areas’ and bays are also called ‘white areas’
Introduction to the Clean Room-9 (Pass Through Window)
Clean Room Protocol

Entry & Exit

Proper street clothes and clean shoes required.

- Brush your shoes on a mat, walk over the ramp to the entrance. Step on the tacky mat at least 5 times. Swipe your card.
- Sit on wire bench, wear your shoe covers.
- Wear hair net, face net, and gloves before you pass the yellow line. Note: Do not touch the outside of gloves with bare hands, handle gloves from sleeves.
- Step on the tacky mat a few times before entering the gowning room.
- Wear hood, coverall, and booties. Make sure you button up the legs and close the zipper all the way. Hood should be tucked into the gown and the gown should be tucked in the booties.
- Wear your UTA MAV. ID.
- Wear safety glasses.
Proper Street Attire

- Clean clothes
- Closed shoes with appreciable sole thickness and heels no more than two inches. No sandals.
- No heavy makeup or cosmetics.
- No dangling jewelry. No sharp rings or bracelets that might cause a tear or puncture.
Gowning Policy

- Use the wire bench and Put on the shoe covers.
- Put on the hair net and face net
- Put on the gloves
- Put on a hood and button the hood. The hair net will be under the hood. (Remember that the hood should not be worn without hair net)
- Take a pair of Booties of your size and carry them to the next step (The first time or whenever you need to change the booties)
- Go to the push open door and enter the second room where gown are located. In this room, the order of the gowning is as follow.

- Put on your gown and tuck the hood inside the gown
- Put on your booties and tuck your gown inside the booties. Fasten the booties.
- Wear your safety glasses and go through the air shower and enter the clean room.
When you exit the clean room, do the following
Leave your gown, hood and booties in the gowning room. You can hang the booties and the hood to the gown or the metal hanger.
While you still have shoe covers on, enter the entrance room, and discard your hair net, face net, and the disposable shoe covers and then exit.
Gowning Policy-4
Gowning Policy-5
8. Enter the air shower. As the air starts blowing, put your arms up and turn slowly. Tap gently on your gown.

9. As the air stops, enter the clean room.

10. To leave the clean room, go through the door next to air shower.

11. In the gowning room, take off your Hood, Gown and the Booties and put it on your hanger.

12. Walk into the entrance room. When passed the yellow ribbon, remove the hair net, face net, and show covers and dispose. You may exit and dispose the hair net, face net, and the shoe covers after exiting the entrance room.

13. Swipe your card and leave the clean room.

Note: You don’t have to step on the tacky mats while exiting the clean room. Generally, when you are going from a cleaner area to the dirtier area, you don’t have to step on the tacky mat.
Emergency Procedures

Emergency Evacuation

1. Stop whatever you are doing
2. Assess the emergency
3. Evacuate in quick but orderly manner
4. Notify management/emergency personnel
Emergency Procedures contd.

Clean Room Evacuation

Evacuate by any of the following three ways depending on severity of emergency

- Evacuate as you normally exit
- Evacuate through main exit or clean storage in clean room attire
- Exit through nearest available emergency exit in clean room attire
Emergency contacts

- UTA Police: 817-272-3003
- EH&S: 817-272-2185
- Facilities Management: 817-272-2000

Give the following information

- Your name
- Location (NanoFAB, room number)
- Nature of emergency (fire, chemical leak, injury, etc.)

For injury always Call 911
NanoFAB emergency & safety equipment

Emergency equipment
- Phone, safety showers/eye wash stations, fire extinguishers, first-aid kits, automatic fire sprinkler system, emergency announcement system, fire & toxic gas alarms

Safety equipment
- Safety goggles, face shields, chemical resistant gloves, heat resistant gloves, chemical resistant aprons and sleeves, chemical masks/respirators, face masks, chemical spill kits, material safety datasheets (MSDS)
NanoFAB emergency & safety
Shower & Eye Wash
NanoFAB emergency & safety Face Shield, Acid Glove and Acid Sleeve
NanoFAB emergency & safety
Apron and picture of Bay-1
NanoFAB emergency & safety Acid and Solvent Storages
Chemical Cabinets, Part of TFAB and Bay-2
TFAB, and Bay-3
Yellow Room (TFAB) and Part of Bay-4
Road Map to NanoFAB Facilities

All of these steps are required. Can be done in any order.

Application Form
- Not Approved
  - Not Passed
  - Passed
- Approved

NanoFAB Safety & Protocol Class and Exam
- Not Passed
  - Not Passed
  - Passed

General HAZCOM Online Training
- Not Passed
  - Not Passed
  - Passed

Characterization Labs Access & Training

Clean Room Access & Hands-on Chemical Training

Training Schedule
Equipment Contacts
NanoFAB Application

- Internal Application is for users affiliated with UTA.
- External Application is for outside academic or industrial users.
- Internal applications are generally approved within 3 business days.
General HAZCOM

- It is available online

- **Requirements:**
  - Registration
  - Please register by calling 817-272-2185.
  - Print and submit (or email to tbui@uta.edu) the certificate after you finish the training.
NanoFAB Safety & Protocol Training

- NanoFAB Annex Building, Room 108 (Conference Room),
- 2:00 - 4:30 PM
- Offered on 2nd Tuesday or Wednesday (alternating) of Every Month*. 
- Quiz results e-mailed within 3 business days 
- Requirements: Registration. Bring the training document with you to the training.
- Send an email at least 3 working days in advance with your name, current email address, department, and faculty advisor’s name to nanofab@uta.edu. If you are taking this training for the EE5343 course, include that information instead of the faculty advisor’s name. The training document is available on the website. Please bring that document with you to the training.
- This training expires after two months. If you do not start using the cleanroom within that time, it must be taken again.
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Hands-on Chemical Training & Clean Room Access

- 9:15AM to 12PM
- Meet in NanoFAB’s 1st Floor Lobby no later than 9:15AM
- Offered on 3rd and 4th Tuesdays or Wednesdays (alternating) of Every Month*. Please see the table below for the dates.
- **Requirements:**
  - Registration, Approved Application, NanoFAB Safety & Protocol Training, Successful Completion of the NanoFab Safety Exam, and the General HAZCOM Training.
- Send an email at least one working day in advance with your name, current email address, department, faculty advisor’s name, and the desired session to tbui@uta.edu.
- Items to bring with you: Your Mav ID.
Equipment Training and 24/7 Access

- Contact NanoFAB staff for the training on other equipment (list available on the website)
- 24/7 access after **120** hours of work experience by sending an email with
  - Date you got daytime access
  - Equipment trained on
  - Reason for 24/7 access
Using NanoFAB contd.

Important

- No equipment can be used without training
- You must use the equipment during the daytime within a week after you become authorized for its use. Failing to do so will result in cancellation of your authorization.
- Only approved processes can be done
- No equipment or facility modification
- Automatic cancellation of access for not using clean room continuously for six months
- Immediate revocation of access for using others MAV. ID to enter clean room
Equipment Reservation

- Online equipment reservation
- Link: Nanofabreservation.uta.edu
- User name and password provided after Nanofab application is approved
- Reservation list only shows the equipment you are authorized on
- Contact the trainer if the equipment is not in the list
Clean Room Operation
Clean Room Air Flow

Outside air intake

Makeup Air Handler

Pre filters

Pre heat coil & temp sensor

Steam disperser coil

Cooling coil

HEPA

BAY

Chase

HEPA

HEPA

HEPA

HEPA

raised floor

raised floor

raised floor
Clean Rooms

- Rated by class: $[\# \text{ of particles} (\geq 0.5 \, \mu m)]/ft^3$

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- Filter particles using HEPA filters
Our Cleanroom Features

- Class 100 (180 room air changes/hour)
- Relative humidity control $45\% \pm 2\%$ RH
  - Two trim units and one primary unit
- Temperature control $68 \, ^\circ F \pm 2 \, ^\circ F$
- Process vacuum system throughout bays
  - $25''$ to $28''$ of Hg
- Compressed dry air
  - $44 \, ^\circ F$ DP, 110 psi, 24 scfm
Features continued

- House clean up vacuum
- Nitrogen gas piped throughout, 100 psi
- Emergency power with a transfer switch over in \(~7.5\) sec
- Computer control monitoring of each bay and mechanical room air handlers
  - pressure
  - temperature
  - relative humidity
Airborne Particles

- Human eye can see objects bigger than about 10 to 20 $\mu$m across
- hair: about 100 $\mu$m across
  grain of salt: between 20 & 40 $\mu$m
  pollen: 10 $\mu$m
  e.coli bacteria: 0.6 to 15 $\mu$m
- Sources: shoe dust, outside air, etc.
- Organic materials shed the most
  - skin
  - wood
  - leather
  - paper
Bringing items through equipment entrance/clean storage

You need training to clean and bring items through this room. If you are authorized and bringing some approved items after cleaning from equipment entrance/clean storage room, follow this procedure.

1. Make sure items are authorized and properly cleaned.
2. Open the door and place the items on a table closest to the door.
3. Come out of the equipment entrance room and make sure the door shuts behind you.
4. Go to the main clean room entrance and follow the entry procedure given above.
5. Once in the clean room, go to the clean storage room through the chase and bring your items to the desired location.
Taking items out through equipment entrance/clean storage

You need to be trained and authorized to do this. Also, items should be authorized. Follow this procedure.

1. Make sure the items belong to you. You must get permission from management for anything that belongs to NanoFAB and you want to borrow. Enter the description of the items you are borrowing on the ‘items in/out sheet’ posted over the bench in clean storage.

2. Take the items to the clean storage area and place them on the table closest to the outside double doors.

3. Come back to the Teaching FAB and exit the clean room through the main exit following the procedures described above.

4. Once you are outside clean room, go to the equipment entrance, open the door, and pick your items.

5. Make sure the door shuts behind you after you leave this room.
Entry/Exit through Equipment Entrance/Clean Storage

Entry through this room is only reserved for service people who need to go in the chases only. Follow the following entry procedure.

1. Open the door and step on the tacky mat at least five times.
2. Make sure the door shuts behind you.
3. Sit on the bench and wear the shoe covers
4. Wear the hairnet
5. Wear the right size smock.
6. You will exit through the same location (clean storage/equipment entrance) by removing chase attire in reverse order.

In this attire you can only go to the chase areas (grey) and cannot enter the bays or white areas.
Proper Behavior in Clean Room

- Absolutely no food is allowed anywhere in the clean room. Food means any kind of food including candies, chewing gum, cough drops, drinking water, etc.

- No smoking is allowed on campus.

- Keep the table tops, equipment tops, and hoods organized.

- Leave the chairs organized in their proper place. Do not move chairs from one room to the other. If you move a chair within a room, move it back to its original place after using. No chair should be left in a place where it is obstructing peoples’ movement in and out of the room or around the equipment.
Proper Behavior in Clean Room contd.

- Do not sit on the floors. This brings dirt from the floor in to the air.
- Do not nap or sleep on chairs. This is a serious safety hazard to you and others.
- Do not run or walk fast in the clean room.
- Do not lean on equipment, hoods, tables, etc.
- If you need to open zipper of your coverall, come to the gowning room.
- Use clean room wipes sparingly since these are lint-free and hence quite expensive. Generally, no more than 4 wipes are needed for wafer cleaning.
- Never use the wipes for writing on them. Wipes are the property of NanoFab and using them for anything else except cleaning is against the rules and subject to disciplinary action and access revocation.
- Never touch your face with clean room gloves on.
Items not allowed in the Clean Room

Anything that sheds particles or emit odor/evaporates (other than chemicals, for those all chemical rules apply) is not allowed in the clean room. Some examples are:

- Wood or wood products
- Cardboard or its products
- Paper (only clean room notebooks allowed)
- Napkins (only clean room wipes allowed)
- Lead pencil and eraser (ball-point pens allowed)
Proper Equipment Use

- Use only the equipment that you are trained on and authorized to use.

- Do not try to fix any equipment. Never open equipment panels, lethal voltages may be present.

- Use proper safety equipment, like insulating gloves, while using furnaces or pouring cryogenic liquids.

- Use the equipment for the process you are trained for. Any changes in the process or any new process must be approved by the management before use.
Proper Equipment Use contd.

- Do not make any changes in the equipment no matter how minor those are without prior approval of the staff.

- You must fill in the equipment logbooks with all the required information for each use. Do not move the logbook pens to other places, they are labeled.

- Follow all the equipment specific instructions that you received during training on particular equipment.

- If your name is not on authorized user list, you are not authorized to use that equipment.

- Equipment operating procedures are for guidance only and are not substitute for training.

- If in doubt, do not use your best judgment but ask the management.
Proper Chemical Use

- Do not order any chemical without prior approval of the management. Submit chemical name, its MSDS (material safety data sheet), quantity, and container size that you want to order by email to the management prior to placing order. Paper copy of MSDS is only acceptable if electronic copy is not available.

- Once you receive the chemical provide a paper copy of the MSDS to the administrative assistant for filing into MSDS folders.

- Chemicals can be very dangerous and even lethal. It is your responsibility to follow all the safety precautions described in MSDS of each chemical that you use.

- All the chemicals must be used in the chemical hoods. Only exceptions are the solvents in squeeze bottles (like acetone, methanol, and isopropanol) that can be removed from the solvent hoods if necessary for cleaning but must be returned to the solvent hoods as soon as you are done.
Proper Chemical Use contd.

- Acids must be used only in acid hoods. These are made of special acid resistant plastic. Acid hoods have the city and DI (deionized) water available and have the drains connected.
- Solvents must be used only in solvent hoods. These are made of stainless steel since most solvents are highly flammable. Note that there is no water available, hence drains in the solvent hoods are not connected.
- You must use chemical resistant aprons, gloves, sleeves, and face shields when working with any chemicals. Any additional safety equipment must be used if required in MSDS of the particular chemical.
- Always rinse the glassware, hood, and your gloves thoroughly with water when done with a chemical process. Do not touch anything with contaminated gloves.
- Focus on your work when using acids. Do not attend phones.
Proper Chemical Use contd.

- **If you have to leave a chemical process running** while you are gone, you must:
  - Label each chemical clearly with its name
  - Write your departure time and approximate time to come back
  - Your name and faculty advisor’s name and your phone number

- Absolutely no chemicals are discarded in drains, use the properly labeled waste bottles.

- **Chemical storage:** Chemicals must be stored in correct storage; acids must be stored in acid cabinets and solvents must be stored in solvent cabinets.

- **Mixed chemicals:** These must be properly labeled with each component and its ratio, your and your faculty advisor’s name and phone number, and date mixed. These must be stored in proper storage.
Proper Chemical Use contd.

Piranha Solution
(H2SO4 + H2O2 3:1 Concentration)

Please wait for 90 minutes to discard after mixture is made.
Proper Chemical Use contd.

- **Chemical transport:** Always transport chemicals in tightly closed bottles. To transport chemicals between rooms, always use chemical transport cart. Never remove chemicals in beakers from the hood.

- **Waste Chemicals:** These must be collected in properly labeled waste containers.

- **Chemical Spill:** In case of a chemical spill use the appropriate chemical spill kit and inform the management. In case of a big spill, vacate the room and inform the management immediately.

**Specific chemical precautions**

- When mixing etches, always add acid (AAA). *Never add water (NAW) to acid.*

- Never mix acids and solvents, they can catch fire.
Compressed Gas Cylinders and Cryogenic Liquids

- Only authorized users are allowed to change, replace, or otherwise handle the compressed gas cylinders.
- Cylinders must be properly anchored in a physically secure manner.
- Toxic gas cylinders may only be used inside toxic gas cabinets specifically installed for them. These systems may only be handled by authorized personnel.
- Pour cryogenic liquids only in well-ventilated rooms to avoid displacement of breathing air. Use insulating gloves and eye protection and follow all the other guidelines when handling cryogenic liquids.
Proper Sample Handling

- Do not grab samples with hands, always use proper tweezers. This keeps the samples clean and also saves you from sharps if the samples break in your hands.
- Stainless steel tweezers are good for handling samples and to use with solvents. Use Teflon tweezers with any other chemical.
- Get proper holders for your samples and always use those for storage and transport.
- Do not place wet samples on equipment chucks
Buddy System

- You are not allowed to be in the clean room alone after the regular work hours i.e., 7 AM to 6 PM, Monday through Friday or when UTA offices are closed.

- If there is no other user in the clean room during these hours, you must get another user to be with you in the clean room while you are working there. This rule is not applied if you do electrical testing or E-Beam or Sputtering deposition processes.
Visitors to the Clean Room

- NanoFAB management approval is needed
- You must sign-in for your visitor on the ‘visitor sign-in sheet’ located in the entrance room
- Visitor is only allowed observation
- You are responsible for the actions of your visitor
Good Housekeeping

- Do not throw trash on the floor
- Do not leave broken samples on the equipment chucks or tables
- Always leave your belongings in your storage box
- Anything left outside your box will be removed
VIOLATIONS OF NanoFAB SAFETY POLICY AND OPERATING PROCEDURES

- You must practice the safety policy and operating procedures described in this document.
- Any violations will be considered on case by case basis by the management and penalties will be imposed.
- Persistent violations will result in permanent revocation of your access to all NanoFAB facilities.
UNDERTAKING

I have received a copy of the ‘NanoFAB Safety and Operating Procedures’ document.
I will practice the safety policy and operating procedures described in this document.
I will bear liability for equipment damage and personnel injury caused due to my negligence.

_________________________________
Name (Please print) ________________ ________________

_________________________________
Signature Date ________________ ________________

_________________________________
University/Company Phone ___________________________

_________________________________
E mail