Cleanroom Work Protocol

1. General

1.1. Before entering the cleanroom, each user has to:

1.1.1. be instructed about the following topics:

1.1.1.1. Risks in the cleanroom.

1.1.1.2. Properties of gases that are used in the cleanroom.

1.1.1.3. What to do in case of unusual event in the cleanroom.

1.1.1.4. What to do in case of Emergency in the cleanroom.

1.1.2. Complete a computerized chemical safety training (students should sign up for a course, workers will receive a link). A certificate must be provided by the student.

1.2. The user has to sign a declaration in which he commits he have fulfilled steps 1.1.1-2 and read the document "Cleanroom Work Protocol".

1.3. Working alone in the cleanroom is not allowed. Another knowledgeable person who have received a safety training must be within range of seeing the person or hearing the person and be able to respond to any emergency situation.

1.4. Working hours: 08:00-17:00. If you wish to work outside the working hours, please refer to section 11.

2. Safety

2.1. All fab users who witness a safety violation must report it to the fab management immediately. The report has to include date, time, place and names of the involved persons and a detailed description of the safety violation.

2.2. A user who does not follow section 2.1 endangers his wellbeing and health, and the wellbeing and health of other fab users.

2.3. A user that will not follow section 2.1 will not be allowed in the fab.

3. Cleanroom attire

3.1. Full length pants
3.2. Closed, impermeable shoes – preferably leather
(no sandals or shoes made of cloth material are allowed)
3.3. Cleanroom suit
3.4. Safety glasses
3.5. Beard net
3.6. Hair net
3.7. Shoe Covers
3.8. Gloves
3.9. Eye contact lenses are not allowed.

4. What you can't bring into the cleanroom

4.1. Food and drinks.

4.2. Paper not suitable for use in the cleanroom.

4.3. Cardboard boxes of any kind and size.

4.4. Pencils that are not suitable for use in the cleanroom

4.5. Any other object that is not suitable for use in the cleanroom

4.6. New materials that have not been preapproved by Fab administration

5. Entering the cleanroom:

5.1. Before entering the cleanroom, sign in the BookItLab program (section 7). Entrance and work inside the fab is not allowed without a reservation (this includes co-workers, users which only observe the process, etc.) or approval in advance.

5.2. Swipe your entrance sticker in the entrance: card must be swiped each time you enter, even if you are accompanying another user.

5.3. Dress up: wear shoe covers, gloves, hair net, beard net and cleanroom suit.

6. Using Tools and Equipment

6.1. Before use of any equipment, one must complete training and become a certified user. For training protocol refer to section 8.

6.2. Before entering the cleanroom, sign in the BookItLab program (section 7). Entrance and work inside the fab is not allowed without a reservation.

6.3. All new processes must be authorized and approved by the FAB's staff. For new process protocol, refer to section 9.

6.4. Users should always make sure that their area is clean before they begin to work. If it is not clean, you must notify the NFC staff.

6.5. Basic instructions for using the BookItLab program installed on tools' computers:

6.5.1. After the computer is turned on, a BookItLab window is opened. Enter your BGU username and password.

6.5.2. If you did not make a reservation, the system will not let you to use the tool (except for several specific tools). Do not attempt to open the tool's application without logging into BookItLab.

6.5.3. After logging in, click Activate Service to turn on the application.

6.5.4. At the end of your session:

6.5.4.1. Turn off the application

6.5.4.2. Click LOGOFF in the BookItLab system

6.6. The username and password for logging into the BOOKIT system are private. Only the person who has booked the tool may use it. It is not allowed to use a tool instead of another user.

6.7. Each tool has a short manual next to it, in a visible place.

6.8. After use, sign in the log book.

6.9. The nanofabrication center is not responsible for the success/ calibration of a process performed independently.

6.10. For any problem with the tool, contact the Tool owner or a staff member **immediately**. Do not attempt to solve the problem on your own.

6.11. Payment cancellation:

6.11.1. Possible only in case of a malfunction that was reported and diagnosed during a process.

6.11.2. Payment cancellation will not be done due to cases of unsuccessful process that was done using functioning systems.

6.11.3. The cancellation should be done within 48 hours from to the malfunction diagnose. It will not be possible after receiving the monthly billing.

6.12. If you intend to leave your sample overnight in a machine (e.g. for vacuum), and work in the morning:

6.12.1. Receive permission and coordinated with NFC staff.

6.12.2. .Make a reservation for all the time the machine will be unavailable, and stay logged in the Bookit program until the machine is available.

6.12.3. Pick up the sample as early as possible on the next morning.

6.12.4. Send an email to BGU coordinator with the dates and hours of the actual work done. The charge will be for these hours.

6.13. Users should always make sure that their work area is clean before they leave. Users should thoroughly clean and dry the area they have used, along with any labware, tools or equipment. No tool parts, lab equipment or chemicals should be stored on tools.

6.14. User who has not used a tool for more than a few months will not be allowed to work independently. The user is required to consult the NFC staff regarding any updates in the tool's status and new working guidelines, and be recertified in order to work independently

7. **Booking equipment**

7.1. Booking equipment is done using the BookItLab program.

7.2. You must reserve all tools you are using in the fabs, even if you work on several tools in parallel.

7.3. There is a minimal usage time for each tool.

7.4. Cancelation or change of reservations has be done before the reserved session, and no less than the period of time set in bookit for each equipment. Otherwise, special permission is required.

7.5. If you wish to join a co-worker in the cleanroom, you must book co-worker in the program.

7.6. In order to use the BookItLab program:

7.6.1. One must be registered in the BookItLab system. If you are not registered, you will receive a form to fill.

7.6.2. You will be allowed to work in the cleanroom only after receiving approval of your registration.

7.6.3. Make a reservation in the calendar of the tool.

7.6.4. Once you have made the reservation, you will be in a "pending" status, until the approval of your work. Make sure your status is approved before the beginning of your session.

8. **Training**

8.1. Practical training and certification will be done only by the fab staff.

8.2. Training steps:

8.2.1. Basic training- on a defined training program based on an example process/ analysis etc.

8.2.2. If required- advanced training on the students process.

8.2.3. In case a process/ analysis is required urgently (before the basic training), the student can join the fabricator as a co-worker, but the work will not include training. User will be escorted by a fabricator until the fabricator decides the user is able to work independently.

8.3. Certification is only for working hours. Night work is allowed only after the user have gained work experience and with BGU coordinator's permission. For night work instructions, refer to section 10.

8.4. When training with your co-workers, you are not allowed to use the tools. You can only observe your co-workers and learn from them. In addition, the user is not allowed to use other clean room facilities and tools during the time of the training.

8.5. Training with a co-worker require BookItLab reservation (as co-worker). In this case, there is an entrance fee of 20₪. You need to let the fab's staff know you intend to train with a co-worker.

9. **New process approval**

Before beginning of work with any new process which include:

a. Processes that the student was not trained to perform and was not certified by the center's staff/ approved by the center's staff in advance.
b. Substrate material that was not supplied by the center's staff (including new coatings, layers, or any other modification on top of the substrate).
c. New chemicals

The following steps are required of the research group:

9.1. Submit a work paper that includes the following details:

9.1.1. Complete protocol of the process (including equipment, amounts, reactions, etc.)

9.1.2. Names of the students that will perform the process

9.1.3. Risk assessment (energy released, materials released, etc.)

9.1.4. Risk handling

9.1.5. Necessary protective equipment

9.1.6. Waste disposal (container type, container handling after disposal, etc.)

9.2. The student must receive training and instructions regarding the process he intends to perform. The researcher should submit a certification the student has received the training.

9.3. Read the MSDS of each material.

10. **Using Chemicals**

10.1. All new processes must be authorized and approved by the FAB's staff.

10.2. Materials' inventory:

10.2.1. The nanofabrication center is obligated to have valid chemicals in stock for general nanofabrication use.

10.2.2. The center can provide materials based on an existing inventory.

10.2.3. The users will be charged for the use of expensive materials, such as photoresists, gold, platinum, etc.

10.2.4. If there is a specific material that the researcher require, it is the researchers' responsibility to purchase it. In this case, the center allows to keep the material in the FAB (if the instructions of using new material are followed).

10.3. Ordering and using chemicals:

10.3.1. For safety reasons, independent users do not have access to most materials in the fab, such as acids/bases, photoresists, etc.

10.3.2. If you wish to work with a specific chemical, you need to coordinate it with BGU coordinator:

10.3.2.1. For liquids (e.g. photoresists) - at least 3 working days in advance (before Thursday). The material will be ready on the next Tuesday.

10.3.2.2. For deposition materials you need inside the chamber- two working days in advance.

10.3.3. If you deposit gold or platinum, send an email to BGU coordinator with the metal layer thickness.

10.4. If you wish to use a chemical that we do not have in stock, you need to receive approval from Elina in advance to bring your own material. You should also provide an MSDS of the chemical.

10.5. Before using any chemical, the user should read the MSDS and have a complete understanding of the chemicals he intends to use in the hoods and tools. In each lab there is a folder of MSDS for materials that are used in that lab.

10.6. Before using any chemical, the user is responsible to check the name and the expiration date of the chemical.

10.7. Wear closed working shoes, safety glasses and suitable gloves. Check the MSDSs for suitable glove for the chemicals you're working with, or consult your supervisor.

10.8. When working with acids and bases, wear apron, extra pair of suitable gloves and face mask.

10.9. Work with hazardous materials should only be done in the fume hood. If you wish to work outside the hood with analytical equipment or diluted solution, you should get permission from the lab manager.

10.10. Bottles and containers should be closed at all times, accept when removing materials from them. Do not try to open a container forcefully.

10.11. Hazardous materials should be moved across the lab only using a suitable cart, plastic bucket that is suitable for carrying a single bottle, or a suitable cooler.

10.12. Bottles and containers with chemicals should be placed at least 10 cm from the edge of the working surface. Make sure that they are stable.

10.13. When working, put your name and phone number in your work area. Write down the names of the materials that are in your work area.

10.14. If you encountered an unknown material in the hood, on the floor or in any other place, notify one of the center's workers, or take out the material and store it in a designated cabinet.

10.15. During acid dilution, always add acid to water.

10.16. After use, seal the chemical's container and return it to its original location. Chemicals should not be stored in the fume hood, on equipment, carts, floor, etc.

10.17. Incompatible chemicals should be stored separately.

10.18. Store only minimal amount of materials that you need to use that day in the hood/ work station.

10.19. Make sure that each container with chemical is labeled with the material's name and hazard.

10.20. Liquid hazardous materials will be stored in exhausted chemical cabinets (i.e. under the hood). Solid materials should be stored in appropriate cabinets.

10.21. Materials of different hazard classes should be stored separately, in order to prevent a chemical reaction. Take special care in separating between flammable materials and oxidizing and corrosive materials as well as acids and bases.

10.22. Check your cleanroom gown. If it is contaminated, send it for cleaning.

10.23. Any small chemical spill should be cleaned immediately. Notify all people who work in the room with you. Use Trivorex to absorb and neutralize the liquid. Use respirator as needed.

11. **Work in a chemical hood**

11.1. General:

11.1.1. Make sure that the hood is in order, and that its test is valid (written on a sticker attached to the hood).

11.1.2. The hood should be tested at least once a year by the maintenance department.

11.1.3. If the hood is not in order, do not work with hazardous materials in it.

11.2. Proper use of the hood:

11.2.1. All work involved in releasing pollutants to the air should be done in the hood.

11.2.2. All equipment and chemicals should be placed 10cm from the edge of the hood to prevent turbulences.

11.2.3. Do not block the rear exhaust openings that are used for gas/vapors removal from the hood.

11.2.4. Do not block the front holes. They are part of the air flow system.

11.2.5. Place only the chemicals and equipment that are necessary for your current work.

11.2.6. Do not use the hood as storage for chemical waste. Only store small amounts of volatile materials.

11.2.7. Remove any ignition source when working with flammable liquids or gases.

11.2.8. Do not place light objects such as wipes, gloves etc., in the hood. They may be sucked and clog the exhaust openings. When you finish using a wipe, put it in the dedicated bin or take it out of the hood.

11.2.9. Unnecessary chemicals and equipment should not be stored in the hood. Only materials and equipment that are used continuously should be placed in the hood.

12. **Waste treatment**

12.1. No chemical should be thrown in the sink.

12.2. Chemical waste should be collected in dedicated containers. The containers should be marked clearly with the type of waste. They should be tightly sealed, except for when liquids are poured into them.

12.3. Different material types should be stored separately, in order to prevent violent chemical reaction between incompatible materials.

12.4. Disposal of piranha solution: the solution should be diluted by 50%, and then disposed in a separate container.

Waste Type	Container Type
Acidic liquid	*Suitable bottle/container
Basic liquid	*Suitable bottle/container
Organic Liquid	*Suitable bottle/container
Organic acid	*Suitable bottle/container
Contaminated Tips	Plastic Container
Sharps- contaminated	Plastic container/ two plastic bags in a cardboard box
Sharps- not contaminated	Two plastic bags in a cardboard box
Solid waste (papers, etc.)- contaminated	Paper bag inside a container in the Hood
Solid waste (papers, etc.)- not contaminated	Waste Bin

* The waste container should be of a material compatible with the waste you intend to collect.

No liquid waste should be placed in the contaminated solid waste bag!

12.5. Empty bottles:

12.5.1. Volatile materials should be evaporated in the hood. The bottle should be washed twice with water, and thrown into non-contaminated waste bin (without capping it).

12.5.2. Non-volatile materials: the bottle/container should be emptied completely, washed twice with water and thrown into non-contaminated waste bin (without capping it).

12.6. Waste clearing:

12.6.1. Do not overfill waste bags and containers. They should only be filled 3/4 of their volume.

12.6.2. When the container/ waste bin is 3/4 full, notify the NFC staff. Use new ones if necessary.

Only closed waste containers can be taken out of the hood!

13. **Gases in the cleanroom**

In several processes done in the cleanroom, gases are used. There are several types of gases, with various risks. Some of the gases are hazardous. They can be toxic, corrosive, pyrophoric, flammable, oxidizing etc. The gas system is equipped with sensors and alarms in case of a leak (for details refer to section 16).

14. **Finish working and exiting the cleanroom:**

14.1. Logoff from BookItLab

14.2. Clear any waste, materials, equipment pieces, labware, etc. that you used.

14.3. Clean all surfaces, labware, tools and equipment you have used.

14.4. Remove contaminated extra gloves in the dedicated waste bin.

14.5. Exiting the cleanroom (in the gowning room):

14.5.1. Remove cleanroom suit. When hanging the suit on the hanger, make sure you zip the zipper, so that the suit will not fall from the hanger.

14.5.2. Remove gloves, head, beard and shoe covers and throw into the gowning room waste bin.

14.5.3. Swipe your card in the exit card reader.

15. **Working off shift / after regular work hours**

15.1. No one is allowed to work in the cleanroom alone. Another knowledgeable person who have received a safety training must be within range of seeing the person or hearing the person and be able to respond to any emergency situation.

15.2. Work on the weekends is not allowed.

15.3. Certification for night work is given separately to each student.

15.4. The tool must be reserved until 15:00 at the day you wish to work at night. In addition, notify the staff if you intend to work at night.

15.5. No work with toxic / flammable gases is allowed off shifts. The main valves of the cylinders must be closed.

15.6. No work with acids and bases for wet etch and cleaning is allowed off shifts.

15.7. The person working off shift must be equipped with personal alarm band, which will alarm in the security post when pushed.

16. **First Aid**

16.1. In the entrance of each fab there is a first aid cabinet. There are also first aid kits for chemical spills on the body that contain: an eyewash spray for chemical splashes and spray for chemical spills on skin. In fab2 there is also first aid kit for HF.

16.2. In the entrance of the fabs there are safety showers and eye wash stations in case of chemical spills on the skin and eyes.

16.3. In case of any accident notify NFC's staff.

17. **Safety event:**

17.1. Each room has an emergency door.

17.2. Emergency power disconnection: each room has an emergency button to disconnect the power. Machines that use high voltage have their own emergency disconnection button.

17.3. In fab 1 and fab2 there are emergency buttons :

Fab1: in the entrance, above water cooler.

Fab2: on the right side of the emergency door.

17.4. Alarms in fab 1:

Orange light: problem with air exhaust. Leave the cleanroom, and notify the center's workers.

Red light: Reactive gas leak. Leave the room as quickly as possible (make sure no one is inside), press the emergency button and call for help of the center's workers and safety department.

17.5. In case of a chemical related accident, put on appropriate personal protective equipment, including PVC apron, ABEK-P3 respirator, closed shoes and nitrile gloves. Aid injured people out of the cleanroom, to emergency shower as needed, and call for help .

17.6. In case of a toxic / flammable gas alarm, everyone must evacuate the cleanroom immediately. Push the emergency button inside the cleanroom (next to the fire alarm) and call for help. Do not enter the cleanroom as long as a toxic gas may be present. Consults the emergency personnel .

17.7. If the assisting person cannot move the injured out of the cleanroom without risking himself / herself, he must evacuate the area and call emergency numbers and the security post immediately.

17.8. In case of an emergency, a representative of the nanofabrication center should be in contact/present, in order to instruct the universities personnel in the details of the event, and provide them with the necessary information.

17.9. Emergency/ Security teams will not enter the cleanroom in case of safety event, unless there is a trapped person inside that needs to be rescued. In any other case, gas valves must be closed. Wait until all gases are cleared, and the gas detectors

show no toxic or flammable gas presence. Only then enter the room to fix the malfunction that caused the leak.

17.10. In case of a need to rescue a person from the cleanroom, enter only with a self-contained breathing apparatus and a suit proofed against toxic gas. The safety equipment is stored in a safety equipment cabinet outside fab1. It includes two SCBA's and two suits.

17.11. Once a warning about a gas leak is received, and the security department is informed about a trapped person inside the cleanroom, the university teams- safety and security and the NFC's representatives will be called to the event site. Two people will wear SCBA's and suits, and enter to the fab to rescue the trapped person. The NFC's representatives will assist with information about the gas that have leaked and/or source of the leak.

17.12. An ambulance will be called to evacuate the injured person to the hospital.

17.13. In case of fire, call the firefighting department immediately.

17.14. Training will be held for the NFC's workers on proper use of SCBA.

18. **Emergency:**

18.1. In case of any emergency such as: accident involving injured people, fire or chemical leak/spill, notify immediately center's workers, Dr. Erez Golan, security and safety department.

18.2. Evacuate from the danger zone, while helping others.

18.3. Turn on safety means (fire extinguisher, emergency buttons/ emergency power disconnection button etc.)

18.4. When safety and security personal arrive, give them as much information as you can, and follow their instructions.

18.5. **Emergency phone numbers:**

Police	4100
Magen David Adom (ambulance)	4101
Fire Department	4102
National center for hazardous materials	12226911

Accident or Safety event

Security	61888/61555
Avner Mizrahi, safety inspector	052-8795998
Shahar Goldberg, head of safety department	054-6775599

NFC's Staff:

Dr. Erez Golan (head of NFC)	052-6839402
Alfred Sacharovich (maintenance engineer)	052-8338937

Facilities Malfunctions (Water, Electricity, Gas)

Maintenance	61666