Cleanroom Work Protocol

1. **Safety**
   1.1. Before entering the cleanroom, each user has to be instructed about the following things:
       1.1.1. Risks in the cleanroom,
       1.1.2. Properties of gases that are used in the cleanroom
       1.1.3. What to do in case of unusual event in the cleanroom.
   1.2. All users must complete a computerized chemical safety training (students should sign up for a course, workers will receive a link).
   1.3. Working alone in the cleanroom is not allowed. Any work in the cleanroom should be done in the presence of another person.

2. **Cleanroom attire**
   2.1. Full length pants
   2.2. Leather shoes
   2.3. Cleanroom suit
   2.4. Safety glasses
   2.5. Beard net
   2.6. Hair net
   2.7. Shoe net
   2.8. Gloves
   2.9. Eye contacts are not allowed.

3. **What you can't bring into the cleanroom**
   3.1. Food and drinks
   3.2. Paper not suitable for use in the cleanroom
   3.3. Pencils that are not suitable for use in the cleanroom
3.4. Any other object that is not suitable for use in the cleanroom

4. **Using Tools and Equipment**

4.1. Before entering the cleanroom, sign in the booking program.

4.2. Each tool should have a short manual next to it, in a visible place. Use only cleanroom paper for the manual.

4.3. Each tool should have a note with the tool owner details attached to it.

4.4. Before use of any equipment, one must complete training and become a certified user.

4.5. After use, sign in the log book.

4.6. For any problem with the tool, contact the tool owner.

   The tool owner should:

   4.6.1. Update tool status in the booking program.

   4.6.2. Notify maintenance manager and email to fablist.

4.7. Users should always make sure that their 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.

5. **Using Chemicals**

5.1. 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.
5.2. Wear long closed lab coat, 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.

5.3. When working with acids and bases, wear lab coat, nitrile gloves and face mask.

5.4. 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.

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

5.6. 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.

5.7. 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.

5.8. 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.

5.9. 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.

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

5.11. 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.

5.12. Incompatible chemicals should be stored separately.
5.13. Store only minimal amount of materials that you need to use that day in the hood/ work station.

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

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

5.16. 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.

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

5.18. 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.

6. **Work in a chemical hood**

6.1. **General:**

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

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

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

6.2. **Proper use of the hood:**

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

   6.2.2. All equipment and chemicals should be placed 10cm from the edge of the hood to prevent turbulences.
6.2.3. Do not block the rear exhaust openings that are used for gas/vapors removal from the hood.

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

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

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

6.2.7. Do not place light objects such as wipes, gloves etc., in the hood. They may be sucked and clog the exhaust openings.

6.2.8. 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.

7. **Waste treatment**

7.1. No concentrated chemical should be thrown to the sink.

7.2. Chemical waste should be collected in small 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.

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

7.4. Disposal of piranha solution: the solution should be diluted by 50%, and then disposed in a separate container.
<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Container Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidic liquid</td>
<td>*Suitable bottle/container</td>
</tr>
<tr>
<td>Basic liquid</td>
<td>*Suitable bottle/container</td>
</tr>
<tr>
<td>Organic Liquid</td>
<td>*Suitable bottle/container</td>
</tr>
<tr>
<td>Organic acid</td>
<td>*Suitable bottle/container</td>
</tr>
<tr>
<td>Contaminated Tips</td>
<td>Plastic Container</td>
</tr>
<tr>
<td>Sharps- contaminated</td>
<td>Plastic container/ two plastic bags in a cardboard box</td>
</tr>
<tr>
<td>Sharps- not contaminated</td>
<td>Two plastic bags in a cardboard box</td>
</tr>
<tr>
<td>Solid waste (papers, etc.)- contaminated</td>
<td>Paper bag inside a container in the Hood</td>
</tr>
<tr>
<td>Solid waste (papers, etc.)- not contaminated</td>
<td>Waste Bin</td>
</tr>
</tbody>
</table>

* 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!

7.5. Empty bottles:

7.5.1. 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).

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

7.6. Waste clearing:

7.6.1. Do not overfill waste bags and containers. Use new ones if necessary.

7.6.2. Person on duty is responsible for waste clearing:

7.6.2.1. Will take out the full bag of the solid waste out of the hood. The bag should be tightly sealed and put in a cardboard box in the chase. A new bag should be placed
in the container. Waste bags can be found on a shelf at the e-line station adjacent to the hoods.

7.6.2.2. Will take out all full waste containers from the hoods to the chase. The waste bottles/containers should not be overfilled. If a bottle/container is 3/4 full, close it tightly and take it out to the chase.

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

8. **First Aid**

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

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

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

9. **Safety event:**

9.1. Each room has an emergency door.

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

9.3. 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.

9.4. 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.

9.5. 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.

9.6. In case of a toxic / flammable gas alarm, everyone must evacuate the cleanroom immediately. Push the emergency button outside the cleanroom and call for help. Do not enter the cleanroom as long as a toxic gas may be present. Consults the emergency personnel.

9.7. 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.

9.8. 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.

9.9. 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. Portable Gas detectors can be used to make sure that there is no presence of toxic or flammable gases in the cleanroom.

9.10. 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.
9.11. 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.

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

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

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

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

10.1. No one is allowed to work in the cleanroom alone. Another knowledgeable person must be within range of seeing the person or hearing the person and be able to respond to any emergency situation.

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

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

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

10.5. In case of a chemical related accident the assisting person will put on appropriate personal protective equipment, including PVC apron, ABEK-P3 respirator, closed shoes and nitrile gloves. The person will aid the injured out of the cleanroom, to emergency shower as needed, and call for help.
10.6. In case of a toxic / flammable gas alarm, everyone must evacuate the cleanroom immediately. Push the emergency button outside the cleanroom and call for help. Do not enter the cleanroom as long as a toxic gas may be present. Consult the emergency personnel.

10.7. 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.

11. Emergency:

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

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

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

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

11.5. Emergency phone numbers:

Police 4101
Magen David Adom 4100
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
Elina Rubinov (safety and maintenance manager)  052-8490700
Alfred Sacharovich (maintenance engineer)  052-8338937

Facilities Malfunctions (Water, Electricity, Gas)
Maintenance  61666