RULES FOR USING THE INESC MN CLEANROOM

(Updates: 19 January 2010)

General Rules

(1) Locate a First Aid Kit near the outside wetbench (on the shelf next to the door to enter the grey area) and another inside the cleanroom containing only the CGG gel (calcium gluconate gel for HF or BHF injury). If you injure yourself, be sure to seek assistance immediately.

(2) All personnel who will need to work in the cleanroom must undertake a training course with experienced staff and read all the rules in this document. Only authorized personnel will be allowed inside the cleanroom.

(3) **Do not eat or drink** in the working area (chewing gum is not permitted as this can cause you an intoxication)

(4) It is strongly recommended **not to use contact lenses** in the lab

(5) **Open-toed shoes, sandals and shorts** are not allowed.

(6) **Bare legs** must be **covered** by wearing proper protective pants when working with chemicals.

(7) Keep your **hair tied** when working in the wetbench.

(8) Read **MSDS** (**Material Safety data sheet**) before handling hazardous substances (you can find it in the folder \\microsrv02\transfer\A-safety)

(9) Do not wear dangling jewelry or items that may get tangled with a tool

(10) The use of mobile phones inside the cleanroom is not permitted when working close to wetbenches or chemicals. Phones should not be kept inside your cleanroom gowning if you plan to use it inside the cleanroom, as opening your suit will contaminate the clean environment.

(11) Never block safety equipment such as eyewash, showers, or emergency exits. Keep aisles clear and free of tripping hazards.

(12) Avoid entering the cleanroom if you are sick.

(13) All equipment have a log book. Always review the log book before using the equipment, record your name, date, materials used, process run details, and any errors or maintenance done to the equipment. Annotate when you are done using the equipment in order to let others know that the tool is available for the next user.

(14) Each equipment has specific sample holders, which are not inter-exchangeable (eg: sample holders from N7000 cannot be used in N3000). These should be kept cleaned and stored near the machine. Maintaining these in order and cleaned will prevent cross-contamination and potential tool downtime.

(15) Take into the cleanroom only what is necessary to minimize contamination of the cleanroom. Any material or activity that makes dust or particles are prohibited in the cleanroom (such as: cleaving wafers, tearing paper/wipes, blocking airflows, exposing hair, impeding laminar flow, rapid movements). Materials that are not permitted inside the cleanroom include: Regular Paper, Cardboard, Wood, Make-up, Pencils, green papertowels, and packaging materials. Items must be removed from its cardboard packaging before going in. Paper must be either cleanroom paper or if using regular paper, it must be inside a plastic sleeve.

(16) Only dedicated tools are allowed in the cleanroom.

(17) Do not handle wafers or chemical bottles without gloves.

(18) Maintain good airflow management – do not block the airflow from the HEPA (High Efficiency Particulate Air) filters in the wet benches nor the exhaust at the back of the wetbenches.

(19) If you make a mess, clean it up. If you finish some consumable (resist, acetone, IPA, clean room wipes, glass substrates, multimeter batteries), you are responsible to refill it or inform immediatelly the person responsible. Return everything in the condition that you found it or better. This is critical to avoid damaging or negatively impacting your work and those of other people working around you.

(20) Do not remove materials from clean room without returning: pens, multimeter, diamond scribers, lamps, tools, Aluminum foil, … Keep tools (screwdriver, wrenches, etc) in their respective laboratories and toolboxes

(21) Escorted Guests or Visitors: Guests should always be escorted in the cleanroom (they should never be left alone). Visitors that will work by themselves will need to go through the safety and cleanroom protocol training provided by the trained personnel.

Emergency Procedures:

(1) **Alarm**: if you hear an alarm go off and you are in the cleanroom:

a. leave the cleanroom immediately. There are 2 exits of the cleanroom:

i. the normal door used to enter the cleanroom through the gowning area - use this door unless it is blocked.

ii. the door near the IBD that leads to the grey area. If you use this door, you can exit through the door in the deposition room. This door is for emergency use only and should never otherwise be used except for moving large equipment.

b. Leave the basement by the stairs – if the stairs are blocked and you cannot exit that way, go up the ramp and remove the key that is located on the wall to the right of the garage door. An alarm will go off if this door is opened so only use it in case of an emergency.

c. Inform the security at the door - report that there is an alarm to the security guard

d. Report the alarm to someone from INESC MN:

i. Virginia Chu , ext. 2231

ii. Paulo Freitas, ext. 2348

iii. José Bernardo, Fernando Silva or Virginia Soares, ext 2504

iv. Natércia Correia, ext 2237

Once the incident has been reported, a check will be made to see if the alarm is false or true. If it is not a false alarm, follow instructions and, if necessary, evacuate the building.

(2) **Accident that requires medical attention**: if an accident occurs in the cleanroom or anywhere on the premises of INESC MN that requires medical attention, you need to:

a. ask someone for help- if someone is in the cleanroom with you, tell them immediately what happened and ask them to call for help. If the injury is serious and requires medical attention, immediately call for medical help.

b. report the incident to INESC MN responsibles: all incidents that involve the need to seek medical attention should be reported to INESC MN responsibles.

(3) Off-hours Emergencies - if an emergency occurs outside of normal working hours (weekends, after 7pm) and there are no other people in the lab to help you,

a. Contact the security guard immediately, tell him/her what happened and ask them to call for help.

INESC Security guard:	dial "9"
General emergency:	dial "0" then "112"

b. Report the incident to INESC MN responsibles: all incidents that involve the need to seek medical attention should be reported to INESC MN responsibles. INESC security guards have the home phone numbers of INESC MN responsibles if they need to be contacted during off hours.

Gowning

It is absolutely NOT PERMITTED to enter the cleanroom without first properly gowning up. Below are listed some rules regarding cleanroom gowning:

(1) Follow this order when gowning:

a. Blue shoe covers
b. Coverall
c. Hairnet and Hood
d. Boots (at the bench)
e. Safety Glasses
f. Gloves

(2) Always make sure that all head/facial hair is covered once inside the cleanroom – do not expose any facial/head hair. If you have a beard or mustache, you are required to wear a face mask. For other people, a face mask is preferable, but not required.

(3) The hood should be tucked inside the coveralls (see photo).

(4) Tuck the pant legs of your coverall inside your boots.

(5) Always wear gloves when entering the cleanroom. Gloves can be reused if they are not broken or covered with something (photoresist, tape, etc.).

(6) Keep cleanroom garment closed at all times while inside in the cleanroom – do not expose any street clothing.

(7) Always use a new face mask and throw the old one for wash. Everything else (coverall, head cover, boots) can be reused. You should judge when they need to be washed. A general rule is to exchange the garment for new ones after you have worn it for 40-50 hours. If you are in the cleanroom intensively, you may need to change the garments every week. If you only go in for a few hours per week, you can keep them longer.

(8) When leaving the cleanroom, hang your coverall using a designated hanger with your name. If you are a visitor, use the numbered hangers and write your name on the available user sheet taped near the gownroom door and hanging rack.

(9) Do not open the two gownroom-to-cleanroom doors simultaneously.

(10) It is not permitted to wear your cleanroom garment in the grey area. If you need to leave the cleanroom, you must remove your cleanroom garment.

Chemical Wetbenches

(1) Clean up your glassware after each use (DI water rinse for acids, IPA rinse followed by DI rinse for organics or microstrip). HF use must be done at a specific wetbench. HF-specific safety training is required.

(2) There is a logbook sheet taped on the wall next to the wet bench for the users who will need to use the left side of the wet bench alone for long experiments (for instance glass etching with HF). Please check the log sheet before using the wet bench for cleaning or thin metal etching to be sure it is free. The right side will be for common use.

(3) Never place organic solvents (acetone, IPA, etc) close to or directly on hot plates because of fire-risk. Organic solvents may only be heated au-bain-marie.

(4) Keep organic liquids strictly separated from acids, peroxides, alkalines, etc,. because of explosion risk.

(5) If the microstrip can be reused (it can be except after lift-off). Ask Virginia Soares for a container to keep your own microstrip for reuse. These containers must be kept under the wetbench with the following information written on the bottle: your name, date, and chemical identification (eg. Microstrip).

(6) The aluminium etchant can be reused for 2 or 3 days. Ask Virginia Soares for a bottle and funnel to transfer unwanted etchant. Label it with your name, date, and chemical name.

(7) Do not obstruct the holes at the back of the wetbench, as this is the exhaust of the bench. Avoid Inhalation and exposure to vapour when working in the laminar flow of the cleanbenches

(8) When working with acids, never work alone. Wear goggles, apron and rubber gloves. Identify the chemicals you are using if you have to be away from the wetbench even for a small amount of time. Do not touch anything else with the gloves, you could be transferring acid to doorknobs, etc… If the gloves have been contaminated with acid, remove them, wash them with plenty of water and discard them.

(9) Piranha solution: always add the H_2O_2 to the H_2SO_4 and not the opposite.

(10) HF: Do not use glassware, only plasticware.

(11) Chemical Spill: If you have a major chemical spill be sure to call for assistance immediately.

- If you spill chemicals on yourself :
    - Acids and alkalines : rinse directly with diphoterine (in First Aid Kit) and look for assistance. If you come in contact with HF, rinse 1 to 5 minutes with water and then apply the calcium gluconate gel located in the First Aid Kits. It is advisable to seek medical attention if you suspect a direct contact with HF.
    - Organic liquids : absorb liquid with a tissue and wash the spot well with soap and water. Let residues from the tissue evaporate on wetbench near ventilation.
    - There is an eye wash and shower inside the cleanroom and near the outside wetbench.

(12) Waste disposal:

- Do not throw anything in the drain (except for alconox which is basically soap). There are labelled waste bottles on the floor near the bench. If the bottle is full please ask Virginia Soares for a new bottle.
- The waste bottles should never be filled to the top, as it can be dangerous when they are transferred to a bigger container. Only fill bottles 2/3 full.
- Piranha solution: after use, leave it in an open vial for 24h to let it cool and degas. Label it appropriately with your name, date, and chemical name. Fill the quick dump with water and slowly add the solution so it is very diluted before emptying the bath.
- The **HF waste** must be thrown in the **HF(CAW) drain** that is available at the wet bench.

(13) Wetbench located outside (near entrance to cleanroom):

a. All the rules above also apply here

b. If using the heated bath, be sure to check regularly that the system has plenty of water.

c. Keep this area clean since it is the first thing that visitors see of our cleanroom and it makes a bad first impression if it is a mess.

d. The microstrip waste bottle should always be changed before the liquid reaches the top. There are usually empty bottles next to the wetbench. If not, ask Virginia Soares. If reusing the microstrip, remember to ask for your own personal bottle to store it. Label it appropriately.

e. If you drop substrates or other things inside the bath, take it out to avoid clogging the drain.

f. If the drain is clogged, you need to unclog it to drain the water. It is not safe to leave the drain full of water and whatever chemical has been dumped inside.

Disciplinary Action

The rules outlined in this document are to help safeguard your safety, the safety of your colleagues and to avoid damage to equipment or infrastructure. Some rules are simply guidelines to respectful behavior when working in close proximity to other people. All the rules should be followed.

People who break any rule will first be given a warning. This may come from one of the cleanroom engineers or a colleague who is working near you. If you have to be warned more than twice, the conduct will be reported to your supervisor and/or one of the directors and will lead to (depending on severity of the infraction and the number of times warnings have been given) suspension from using the cleanroom for a certain time period or expulsion from INESC MN. Expulsion from INESC MN means that you will lose entrance priviledges to the building and no further lab work can be conducted on INESC MN premises.

Rules for Specific Equipment and Processes

General

The following are rules and guidelines for using cleanroom equipment and processes. This is only for those people who have already been trained and authorized to use the equipment. No one should use equipment without having authorization from his/her supervisor and being trained and signed-off by the responsible for the equipment.

Anyone who is trained and authorized to operate an equipment alone but is not authorized to operate the machine in manual mode should not use the machine off hours (ie., after 19h or on weekends). You should only operate equipment when the responsibles are around to help if there should be any problems. If an equipment fails or does not operate properly, you need to inform the responsible of the equipment right away. Do not try to fix it yourself.

Micro and Nanofabrication Equipment and Processes

Photoresist Track

(1) Use only clean wafers as support substrates. Clean the backside of the wafer with acetone if needed. Clean them at the wetbench so the acetone fumes are exhausted.

(2) If the Silicon wafer is broken, it should be put in the trash can, never left on the table.

(3) For developing, just open the nitrogen top line.

(4) Turn ON the nitrogen black valve only if you need to coat.

(5) To purge the photoresist line, just press the purge manual control 2 or 3 times. It is enough to fill the resist tube.

(6) When the coat step is finished, you can see (on the heat station) if the resist is uniform. If this is the case, you can now turn OFF the black valve of nitrogen (bottom one).

(7) Turn OFF nitrogen after you coat or develop.

(8) If you need to strip the resist (prog# 8/6) you do not need to open the nitrogen black valve, use only the top one.

(9) Remove tape from your sample and put it directly in the trash. Do not glue your tape in the SVG frame, in the support wafers or your gloves.

(10) If you make a mess, clean it up. Return everything to its original condition, or leave conditions better than you found them.

(11) If you use PMMA or SU-8, clean the SVG frame with acetone.

(12) If you need to dilute the e-beam resist, do it at the wet bench, with safety glasses and gloves, and label the beaker with your name, name of chemical, concentration, and date. Leave the beaker inside the wetbench until you are ready to use it. The fumes are extremely irritating.

Direct Write Lithography System - DWL

(1) Please schedule your runs in advance when possible. Do not sign-up for more time than you think you may need it.

(2) Use only clean wafers as support substrates. Clean the backside of the wafer with acetone if needed. The silicon wafers are expensive (even if dummy) so care should be taken to avoid breaking the wafers.

(3) After exposure, remove the tape and put it in the trash (do not glue it on the table nor on the wafer).

(4) For the lithography, remove tape from the sample. Only one or two pieces of tape are allowed. Use tape only in the top left corner and bottom right corner.

(5) Control Panel:

a. Do InitStage before you load your sample.

b. Before focusing your sample, be pretty sure that it is below the nozzle.

c. The nozzle can be permanently damaged if

i. the stage moves while performing the **Focus** function, or

ii. focusing is done on the edge of a substrate, or

iii. focusing was done beside the substrate and the stage is then moved so thatthe substrate crashes against the nozzle.

With a damaged nozzle, exposure results will deteriorate dramatically, or exposures might even not be possible any more.

(6) If the wafer from the previous exposure is still on the chuck when you arrive to do your exposure, please remove the wafer and place it inside the cassette next to the DWL computer, labelled EXPOSED. If you place it somewhere random and it has not been developed, it can be mistaken for a plain silicon wafer and be ruined.

Vapour Prime Oven

(1) Do not put mounted samples inside. We do not know how the tape reacts to the HMDS.

(2) Do not open the vapour prime until the display indicates it is in step 41 or 42. Otherwise the purging of the chamber might not be complete.

(3) The vapor prime is not a storage facility. Do not leave sample there for several weeks.

Reactive Ion Etching System - LAM

(1) Check the backside of the support wafers you use: it should be clean, check for tape or PDMS residues. If the backside is not clean, wipe it with acetone or IPA. Tape or PDM residues in the backside may lead to wafer breakage in the chamber as the arm will not pick them up correctly. They should not have metal deposited on the backside either. Do not handle them without gloves.

(2) For etching, the support wafers should always be covered with photoresist (it would be perfect if you can use the wafer you used for lithography). Do not mark it with ink because this will contaminate the machine.

(3) For PDMS processing remember that the sample thickness should be 1mm at the most, otherwise it will be, in the best of cases, stuck when it goes inside the Entrance Load Lock. It can also contaminate the chamber.

(4) If you need to change the etch time in the recipe, save it either as a temp file or change it back to the original time when you are done.

Metallization System – Nordiko 7000

(1) Write down in the log book the base pressure of the modules before starting a process and the machine status in a daily basis.

(2) Write down the read parameters during the processes (not only the set point values) .

(3) Do not change pre-defined functions. If power or other deposition conditions are needed, a new function needs to be set.

(4) Check the backside of the support wafers: tape residues in the backside may lead to wafer breakage in the chamber as the arm will not pick them up correctly. Greasy residues (PDMS or resist) are contaminants for the high vacuum systems.

(5) Always keep the metalic holders clean and stored near the machine.

(6) Always pump the loadlock IMMEDIATELY after placing/removing a wafer (this saves Nitrogen).

(7) After lithography, samples cannot be mounted directly onto the Nordiko holders for metallization: sample back side MUST be cleaned with acetone to avoid contamination of the metalic holders.

Ion Beam Systems – Nordiko 3000 and N3600

(1) Always use the dedicated metallic holders, and respect the sample dimensions allowed for each machine. Check the backside of the support wafers: tape residues in the backside may lead to wafer breakage in the chamber as the arm will not pick them up correctly. Greasy residues (PDMS or resist) are contaminants for the high vacuum systems.

(2) After venting loadlock always close the vent valve manually. Loadlock doors must be closed carefully, to avoid damaging the sealing o-ring.

(3) In the N3000 system, the cassette must be placed correctly (= horizontally) to avoid loading problems.

(4) Write down in the log book the base pressure of the module before starting a process. Write down the read parameters during the processes (not only the set point values).

(5) Do not change pre-defined functions. If different process conditions are needed (beam current, power, gas flow, angle), a new function needs to be set.

(6) These systems are priority for ion beam deposition. Milling has to be done after the deposition processes finish, to avoid unnecessary cleaning of the targets (targets are very expensive). Several users should combine their milling processes (= several samples together) to minimize the machine usage time and gas waste.

(7) After lithography, samples cannot be mounted directly onto the Nordiko holders for etching: sample back side MUST be cleaned with acetone to avoid contamination of the metallic holders.

Chemical Mechanical Polishing System

(1) Before starting the CMP please always check the following:

- the container in the back of the CMP: if it's almost full you should throw away its contents or it will spill onto the table without your noticing (that's why the table is full of dirt).
- the collection system that delivers the liquid excess to the container: if it is too full of solid residues it will end up being obstructed. In that case you should try to remove them as best as you can.

- the table contour: check that there is no accumulation of solid waste.

(2) After using the CMP, you should remember to do/check the following:

- clean the pad carefully: the slurry that is being used is difficult to clean so we have to be extra careful.
- clean the cup used to spill the slurry.
- clean the sample holder and the holder responsible to keep the rotation.
- remove the excess of water from the pad border with a piece of paper to prevent accumulation.

Biological Processes

Cell Handling

People working with microbial cells must follow strict security rules to minimize contamination risks.

(1) Consumable waste (eppendorfs, pipette tips, gloves, paper wipes…) and glassware must be discharged in proper containers for sterilization purposes;

(2) Liquid waste must be poured in a proper container with bleach;

(3) Whole working area must be carefully cleaned up with ethanol at 70 % before and after using microbial cells;

(4) Avoid spreading contamination outside the strict working area (e.g. answering the phone with gloves on.)

(5) People working with microbial cells must restrict their use of equipments (eg., pipettes) and glassware to a set of designated material for this purpose.

Biological Wet Bench and Processing

(1) Always leave the working space and materials (glass ware, wet bench, clean room table, equipments …) in proper clean conditions for the next user;

(2) Never use a chemical without knowing its characteristics and its safety rules (check the MSDS);

(3) When using hygroscopic chemicals that are stored in the refrigerator, always wait until it reaches room temperature before opening it;

(4) When using silane compounds (APTES, etc.), be very careful with splashing; silane is very difficult to clean up; use it only with identified glass ware;

(5) All chemical solutions must be identified with the name of the chemical, user name and opening/preparation date;

(6) If you want to keep a chemical to reuse, it should be identified with the name of the chemical, user name and date;

Pipettes

(1) Never turn pipettes upside down when the tip is filled with liquid;

(2) Never set volumes lower or higher than the recommended range (check the volume range in the pipette);

(3) Be gentle while pressing (stop at the first position) and releasing the push button to avoid fluid entering in the filter;

(4) Never pipette corrosive chemicals (eg. strong acids, strong basis);

(5) When the filter and pipette interior gets dirty, immediately ask for help to clean it.

BioLab

(1) **General**:

a. It is strongly recommended the use of a lab-coat

b. Do not move the furniture disposition in the room before previous agreement from all the users

c. Minimize the usage of toxic volatiles (organic solvents, ozone generators …)

d. It is strictly forbidden the usage of corrosive chemicals in BioLab.

e. Be cautious to not interfere with ongoing experiences (e.g. do not switch the light before checking with the colleagues under work).

(2) **Fluorescence microscope**

a. **General rules:**

- Do not move the microscope and the power supply for the fluorescence lamp.
- Clean the microscope only with appropriate wipes and cleaning solution.

b. **Before use:**

- Before switching on the light, check if the light intensity regulator is in the lowest position (0)

c. **After use:**

- Put the light intensity regulator in the lowest position (0).
- The stage must be moved down to the lowest position away from the objective lenses.
- The objectives revolver must be positioned with the available site facing the stage.

d. **Fluorescence lamp**

- Before switching on the fluorescence lamp, always check the registration of the last user in the log book (if it was switched off at less than 30 minutes wait until the 30 minutes have passed).
- After switching on the fluorescence lamp, wait 30 minutes before using it (light stabilization).

Microfluidics Processes

Corona

(1) Before switching on the corona, always check if all the neighbouring electronic devices are turned off. The corona discharge can cause interference to other electronics and may damage its display;

(2) Before using, remove any flammable compounds that may be in the surrounding area;

(3) Use it in a ventilated area and do not breath the ozone that is released after the discharge;

(4) Do not use it for longer periods than 20 minutes;

(5) After using it, remove and store the electrodes properly;

UVO cleaner

(1) Always set program 1 for minimum 5 minutes, because program 1 is for gas exhaust. If you do not do this, ozone will come to the clean room;

(2) After using the equipment always turn it off;

PDMS processing:

PDMS is highly greasy and viscous, so you should take special precautions when handling it. Also, you should use specific glassware not to be shared with non-PDMS projects:

(1) To open the flask use wipes otherwise, your gloves will be greasy; also clean the flask after using PDMS;

(2) To prepare PDMS use only identified material (eg., glassware) for this purpose;

(3) When weighing PDMS, be very careful not to smudge the balance, and place a piece of wipe to protect the dish of the balance;

(4) When pipetting the curing agent always use the 5 mL pipette;

(5) After being cured, the PDMS should only be handled in the table designated for this purpose;

(6) To clean the glass where the PDMS and curing agent were prepared, do it in the wet bench outside the clean room, and never throw PDMS in the sink;