

CLEAN ROOM OF INTEGRATED MICRO AND NANOFABRICATION

Document Code:	Protocol_0.1
Document Version:	v8.1_english
Revision Date:	16 th June 2014

**PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED
MICRO&NANOFABRICATION CLEANROOM (CSIC LARGE SCALE
FACILITY –ICTS-).**

- *The reading and assimilation of this document is a requirement for achieving the “Qualification 0.1” to access the Clean Room*
- *The rules and regulations contained in this document will be followed as far they don’t interfere with affected CSIC official regulations and rules.*

DRAFTING AND ADOPTION OF THE PRESENT DOCUMENT



This document was written by Eduard Figueras and the GICORG Commission of the IMB-CNM Institute Board and reviewed by the Cleanroom staff.

This document and subsequent revisions will be kept by the Director of Operations of the ICTS (see ICTS directory in the Annex III of the document).

This document is approved by the Institute Board at its meeting on Bellaterra, on 15th of May, 2009



This document is effective from the following day of approval.

Emilio Lora-Tamayo
Director of IMB-CNM

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 3 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

INDEX

INDEX	3
1 INITIAL CONSIDERATIONS	4
1.1 Main purposes of this document.....	4
1.2 Application of this document	5
1.3 Clean Room map and Common Terminology.....	6
2 CLEAN ROOM ACCESS	7
2.1 Clean Room Timetable and Calendar.....	7
2.2 Access to pre-SAS	7
2.3 Using the main SAS-1 to enter the Clean Room (Video Clip “Entry in CR”- <i>Link</i>)	10
2.4 Using SAS-1 to go out of the Clean Room.	12
2.5 Use of SAS-2 to enter to CR (See video Clip “Entry to CR”- <i>Link</i>).....	13
2.6 Using SAS-2 to go out.....	14
2.7 Things to consider before leaving the pre-SAS.....	15
2.8 Access to the perimeter corridor.....	15
2.9 Specific regulations on entering products and tools inside the cleanroom.....	15
3 BEHAVIORAL RULES	17
3.1 Behavior in the CR	17
3.2 Cleanliness and Contamination	18
3.3 Specific Rules for inspection of samples.....	19
4 ABOUT SECURITY	20
4.2 BASIC SAFETY RULES.....	22
4.3 GAS LEAK ALARM (Shrill and Discontinuous Horn)	23
4.4 FIRE ALARM (Continuous tone siren)	24
ANNEX I: EMERGENCY SUMMARY	25
ANNEX II : SB BANNERS	27
ACCESS TO THE PERIMETER CORRIDOR.....	27
SAS BANNER.....	28
ANNEX III: ICTS Directory	29
ANNEX IV: “Qualification 0.1 Application Form”.	31

 <small>Centro Nacional de Microelectrónica CSIC</small>  <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 4 of 34
		DATE 16/06/2014	VERSION 8.1_english

1 INITIAL CONSIDERATIONS

The ICTS-Clean Room is a CNM scientific facility with controlled environment used for the fabrication of micro and nanoelectronic devices. This requires a vast reduction of elements that may create environmental pollution, such as dust, aerosol particles, chemical fumes or particles coming from the body or dress of people working inside (such as cells skin makeup, hair, sweat ions or body fat, fiber fabrics, etc.). These risks require a proper behavior and way of dressing that must be strictly respected by all personnel who need to work in the facility.

Paper, pencils and pens, packaging materials and many other products can be also sources of unwanted contamination within the CR and consequently they are not allowed. Therefore, to enter the clean room it is necessary to observe the necessary precautions and personal hygiene to avoid introducing particles and contamination inside.

There is not a single type of Clean Room for Micro-nanofabrication, so it is mandatory to become familiar with the rules and policies of the installation of the CNM, even though you have already gained experience in other similar facilities.

1.1 Main purposes of this document



This document exposes the rules and instructions to follow to get in and out of the Clean Room, and the basic behaviour and safety rules that must follow everyone who access the ICTS IMB –CNM Clean Room.

The access to Clean Room is restricted only to people demonstrating the basics of procedure, following the conduct norms and safety protocols that are described herein.

Having the "Qualification 0.1" implies the knowing of the rules and instructions contained in this document as well as accept and carry them out. Provided that, it also means to be included in the "Register of Persons Authorized to Access cleanroom" (REPAS) list. Submission of Annex IV of this document to the Director of Operations of the ICTS is mandatory. The signature is absolutely required to guaranty that you will act as attest accordingly.


This is an informative document with an educational nature line. The procedure for obtaining the "Qualification 0.1", which provides access to the Clean Room of the ICTS, is detailed in Note GICORG 0.

It is advisable to supplement the information provided in this document with any of the available videos on the web and/or IMB-CNM intranet, or by attending a specific course on clean room conduct procedures.

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 5 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

1.2 Application of this document

- 1.2.1 This document is applicable to all staff that has the "Qualification 0.1" and therefore are accredited for accessing the Clean Room and registered in the REPAS list.
- 1.2.2 Knowledge of this document does not allow using any Clean Room equipment except optical microscopes and basic inspection or measurement systems.
- 1.2.3 Any amendment to the rules contained in this document, cancellation or addition of new ones will lead to a new version. In any case this new version will be announced in the SAS and eventually will be communicated by e-mail to people on the REPAS list.

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 6 of 34
		DATE 16/06/2014	VERSION 8.1_english

1.3 Clean Room map and Common Terminology.

Clean Room Map





1. Pre-SAS
2. Main SAS-1
3. SAS-2
4. Microsystems Lab.
5. Perimeter Corridor
6. Ion Implanter Area
7. Inspection Area / Annex Area
8. Atmospheric Furnaces

9. Photolithography-CMOS
10. Low Pressure Furnaces
11. Steppers Area
12. Planning/Wafers
13. Wet Etching
14. Mixt Zone
15. Nanotechnology Area

16. MNC Photolithography
17. RIE-Sputtering Area
18. RIE-Sputtering Service Corridor
19. Gases Warehouse
20. Chemical Warehouse

Fig. 01. CR General Plane

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 7 of 34
		DATE 16/06/2014	VERSION 8.1_english

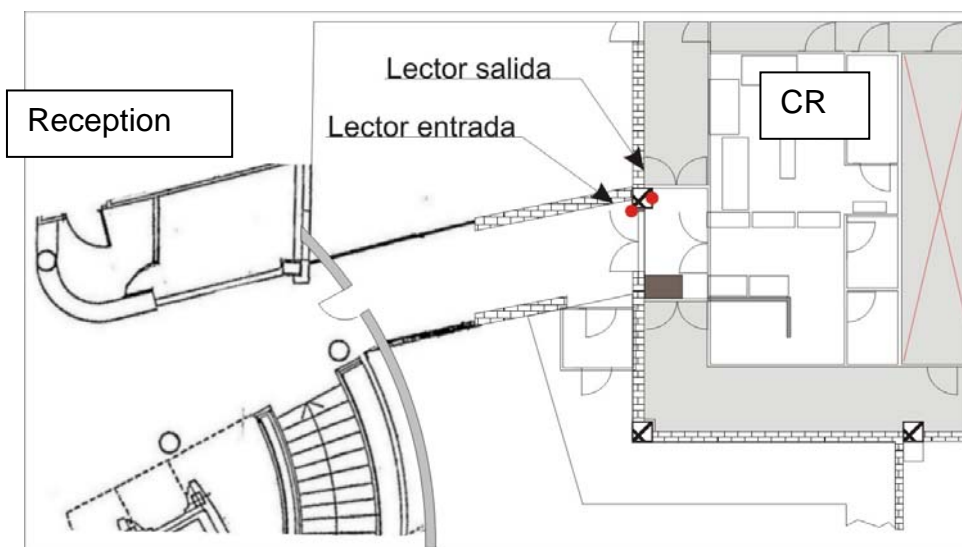
2 CLEAN ROOM ACCESS

2.1 Clean Room Timetable and Calendar

- 2.1.1 The timetable and calendar of the Clean Room is available on the web and /or on intranet of IMB-CNM.
- 2.1.2 The "Qualification 0.1" is required for the activation of the control card that provides the access to the Clean Room.
- 2.1.3 Out of the stated opening periods it will be necessary a specific authorization from the Director of Operations of the ICTS, to gain access to Clean Room and its annexes, except in emergency interventions.
- 2.1.4 It is not allowed the access into CR to anyone who does not have the "Qualification 0.1" updated. Visitors can also access the Clean Room with the proper authorization of the Director of Operations of the ICTS and always being accompanied by a member of the IMB-CNM staff (who must be already registered in the REPAS list).
- 2.1.5 The Director of Operations of the ICTS may temporarily deny access if he considers that there is an over occupancy, depending on the conditions and workload which may vary at that very moment.

2.2 Access to pre-SAS

- 2.2.1 The entrance to the Clean Room is exclusively done through the door that connects the Clean Room with the IMB-CNM main building, as depicted in figure 02.




	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 8 of 34
		DATE 16/06/2014	VERSION 8.1_english

Fig. 02. Access to SB from IMB-CNM reception.

2.2.2 Each person should use his own card, or use temporary access cards to enter and exit the Clean Room. The card reader for entering is located in the entrance corridor on the left frame of the Clean Room door and the card reader for exiting is on the right frame, inside the Pre-SAS. When exiting the Clean Room, apart from using cards, which is always mandatory except in emergencies, you can use mechanical latch for security.

It is very important that you use the card reader when entering and going out of the Clean Room , as our reception staff can easily locate both the members of our staff and the different people who are in the Clean Room in case of emergency situations.

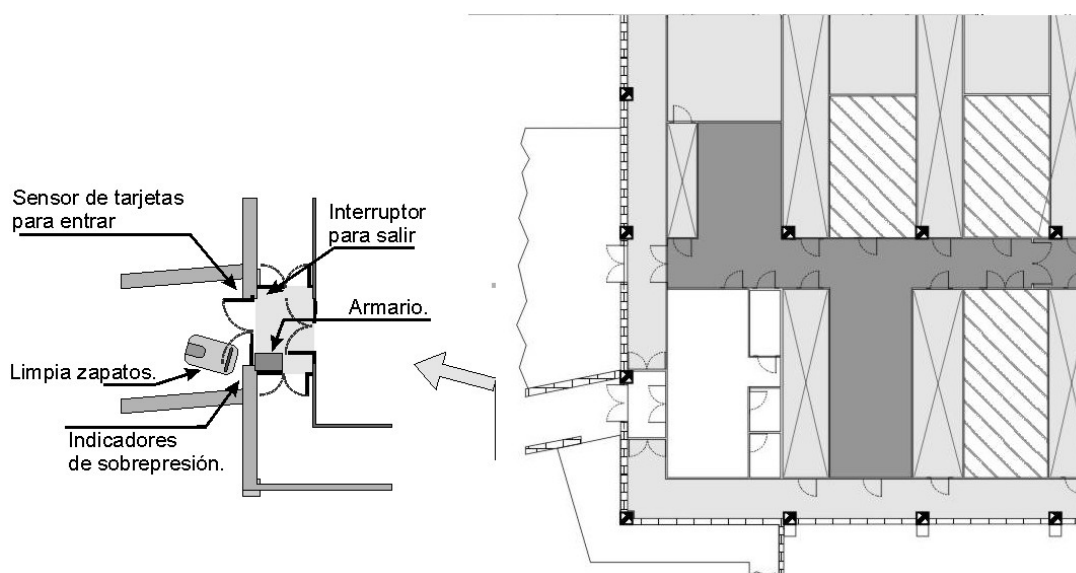



Fig. 03. The pre-SAS distribution and the associated elements

2.2.3 Before entering the Clean Room, please check that overpressure indicators which are located on the right side of the frame of the door of the pre-SAS, mark a value greater than 0,1. If this is not the situation, please ask to the facilities maintenance staff of the Clean Room (see Annex III) if access is allowed.

2.2.4 Please wipe your shoes on the specific shoe-cleaning device located at the entrance. It is very important that you have your soles cleaned. There is no need to polish the whole shoe. Push the bar to switch the machine on.

2.2.5 Swipe the card through the front of the card reader located to the left of the door for entry, then after hearing a short click, pull out the door.

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 9 of 34
		DATE 16/06/2014	VERSION 8.1_english

2.2.6 Once inside the pre-SAS area please close the access door before opening the next. The pre-SAS is on purpose designed without its own input of conditioned and filtered CR air to prevent any overpressure escape as a result of door opening.

2.2.7 On top of the pre-SAS entrance door there is a green indicator light that corresponds to the operating gas detection system (see figure 04). Please make sure that it is on. If not, please consult about the system status to somebody of the Clean Room staff and follow the instructions if necessary.




Fig. 04. Gas detection indicator in the pre-SAS.

2.2.8 Leave your warm clothes and sweaters in the pre-SAS locker and keep the soles of your shoes cleaned stepping in the carpet before entering.

2.2.9 If you want access to the perimeter corridor in either direction, go through the corresponding lateral door and take and put a pair of plastic shoe covers that you will find in the baskets at the beginning of every corridor.

2.2.10 Please check if there is any warning on the white board of SAS; go inside to read it better if necessary. Please follow the indications written on the board, if any.

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 10 of 34
		DATE 16/06/2014	VERSION 8.1_english

2.3 Using the main SAS-1 to enter the Clean Room (Video Clip¹ “Entry in CR”- *Link*)

2.3.1 Take a pair of plastic shoe-covers from the methalic container on the left, besides the benches. Sit down on one of the benches that divide the SAS in two areas and put the shoe covers. Once you have put them, be careful to step only on the blue carpet that is on the clean side of the bench/SAS.

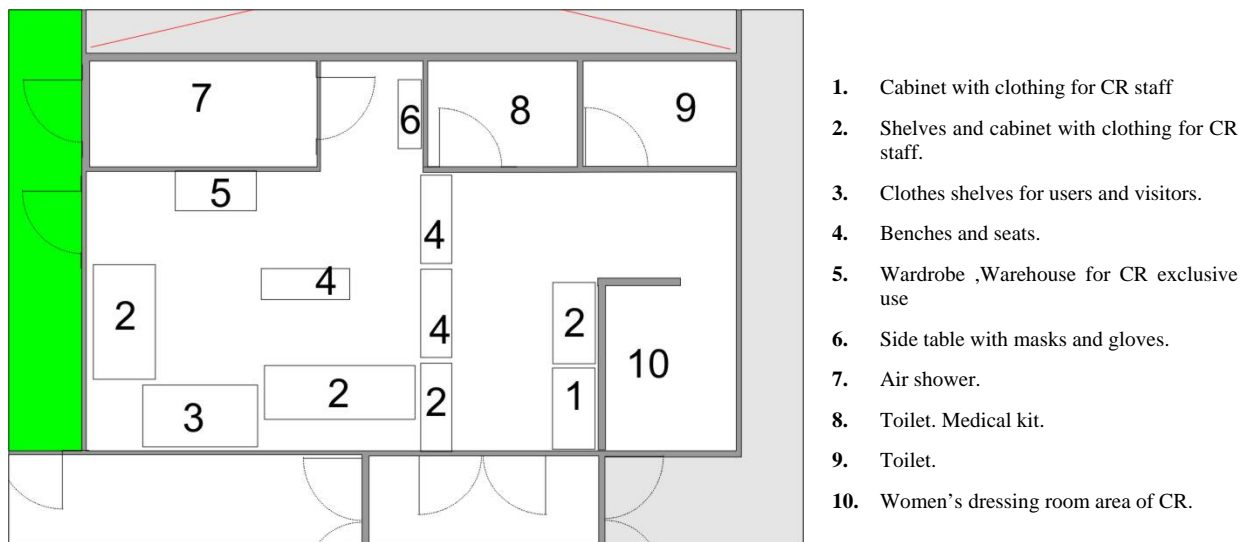


Fig. 05. SAS: Components of the Dressing Room Area.


2.3.2 Step the blue carpet only after having the shoe-covers put, never with your bare shoes.

2.3.3 The engineering, maintenance or process staff of the Clean Room uses the white work suits and the rest of Clean Room users must clothe the green ones.

The dressing instructions are available in each SAS. To identify which suits must be used, follow the instructions in the SAS, or ask to the clothing responsible (see Annex III) in the case of any doubt.

Get dressed according to the established sequence: hood, coverall or work suit, booties or gaiters, mask and gloves as shown in Figure 06.

¹ SAS 1 – Video clip entry through the SAS 1 (see web e intranet)

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 11 of 34
			DATE 16/06/2014
			VERSION 8.1_english

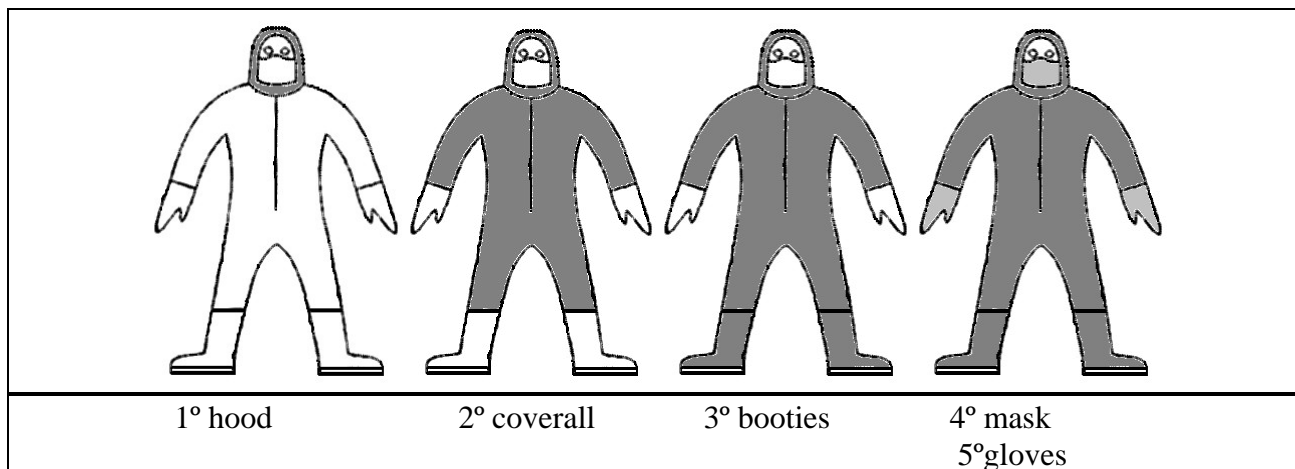



Fig. 06. Proper dressing sequence.

Verify that the neck of the hood is completely inside the work suit. The gaiters should cover legs of the coverall work suit. The hood should fit the head. Check this by turning your head; it should not rotate within the hood. Put the mask on first and gloves after. The mask should completely cover the mouth and nose, and mustache and beard if any. Both the mask and the gloves can be found on the table in front of the shower entry.

- 2.3.4 Look at yourself in the mirror and check that you wear your cuffs and the neck of your clothes properly closed before entering the air shower.
- 2.3.5 The entrance to the Clean Room from the SAS is exclusively done through the air shower. Note that the door that connects the SAS with the Clean Room is only to get out (from CR to SAS). Thus, if you got out to the SAS, and want to get back into the Clean Room, you must go through the air shower again.
- 2.3.6 Pull out the door to access to the air shower corridor. The air shower will start automatically once you close the door. If it does not start, please re-open and close the door again. Note that the air shower system has on/off controls outside, in addition to an emergency stop button inside.
- 2.3.7 The use of the air shower is intended for a maximum of four people. Please stand in line, each person should remain located in a different section of the air shower.
- 2.3.8 Once the airflow of the shower starts, separate your arms slightly from your body and rotate slowly so that the air jets of the shower can act on the entire surface of your Clean Room clothing.
- 2.3.9 Once the shower stops, push the opposite door and enter into the Clean Room.

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 12 of 34
		DATE 16/06/2014	VERSION 8.1_english

2.4 Using SAS-1 to go out of the Clean Room.

2.4.1 Leave the Clean Room exclusively through the SAS except in emergencies.

2.4.2 Please, go out to the SAS only through the door on your right, not through the air shower.

2.4.3 See detailed information about how to un-dress and leave the clothes, in the SAS.

For undressing, act in the opposite sequence of dressing (see fig.07). Please do not remove your hood before taking out your coverall work suit, to avoid that the retained remains between the hood and your head go to your coverall work suit and gets dirty as a result.

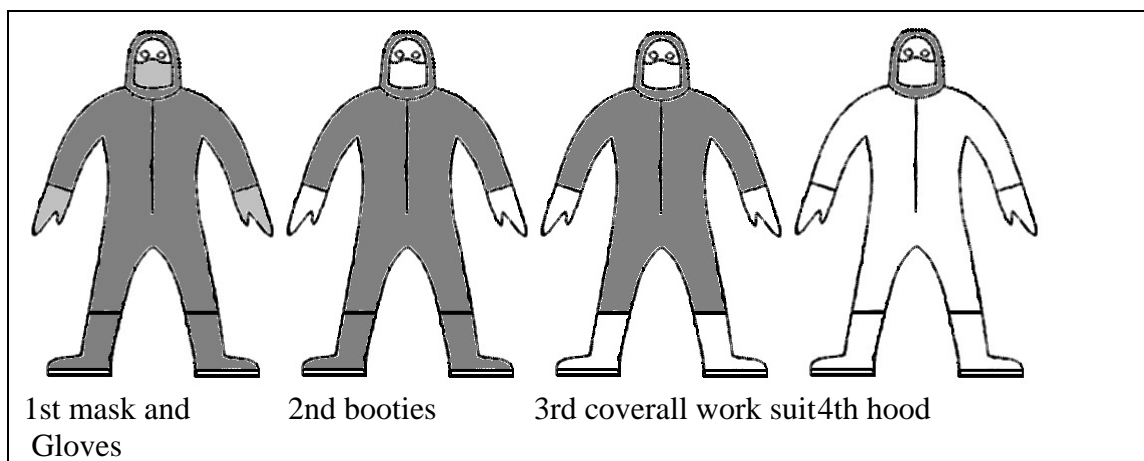


Fig. 07. Sequence to properly undress

The gloves and mask are non-recyclable. Please throw them to the dustbin of the SAS in the blue carpet area.

Carefully hang the coverall work suit and the hood up on the hanger. Place the booties on the bottom shelf as shown in figure 08.



Fig. 08. How to put the booties and the coverall work suit and hood on the hanger properly


	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 13 of 34
		DATE 16/06/2014	VERSION 8.1_english



Fig. 09. Improperly way of leaving the booties.

2.4.4 Once being outside the blue carpet area, take off your shoe covers, throw them in a dustbin and go out to the pre-SAS.

2.5 Use of SAS-2 to enter to CR (See video Clip² “Entry to CR”- [Link](#))

2.5.1 Enter to the SAS-2 with shoe covers.

2.5.2 The engineering, maintenance or process staff of the Clean Room uses the white work suits and the rest of Clean Room users must clothe the green ones.

2.5.3 You will find further specific instructions in the corresponding SAS.

To identify which suits must be used, follow the instructions in the SAS, or ask to the clothing responsible (see Annex III) in the case of any doubt.

Get dressed according to the established sequence: hood, coverall or work suit, booties or gaiters, mask and gloves as shown in Figure 06.


Verify that the neck of the hood is completely inside the work suit. The gaiters should cover legs of the coverall work suit. The hood should fit the head. Check this by turning your head; it should not rotate within the hood. In front of the entrance of the shower there is a table with gloves and masks. Put the mask on first and gloves after. The mask should completely cover the mouth and nose, and mustache and beard if any.

2.5.4 Look at yourself in the mirror and check that you wear your cuffs and the neck of your clothes properly closed before entering the air shower.

2.5.5 The entrance to the Clean Room from the SAS is exclusively done through the air shower. Note that the door that connects the SAS with the Clean Room is only to get out (from CR to SAS). Thus, if you got out to the SAS, and want to get back into the Clean Room, you must go through the air shower again.

2.5.6 Pull out the door to access to the air shower corridor. The air shower will start

² SAS 1 – Video clip on SB entry through the SAS 1 (see web and intranet)

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 14 of 34
		DATE 16/06/2014	VERSION 8.1_english

automatically once you close the door. If it does not start, please re-open and close the door again. Note that the air shower system has on/off controls outside, in addition to an emergency stop button inside.

- 2.5.7 The use of the air shower is intended for a maximum of two people. Please stand in line, each person should remain located in a different section of the air shower.
- 2.5.8 Once the airflow of the shower starts, separate your arms slightly from your body and rotate slowly so that the air jets of the shower can act on the entire surface of your Clean Room clothing.
- 2.5.9 Once the shower stops, push the opposite door and enter into the Clean Room.

2.6 Using SAS-2 to go out.

- 2.6.1 Leave the SB room exclusively through the SAS except in emergencies.
- 2.6.2 Please go out to the SAS only by the door on your right not through the air shower.
- 2.6.3 The process to undress and how and where clothing is stored is exposed in the corresponding SAS.

For undressing, act in the opposite sequence of dressing (see fig.10). Please do not remove your hood before taking out your coverall work suit, to avoid that the retained remains between the hood and your head go to your coverall work suit and gets dirty as a result.

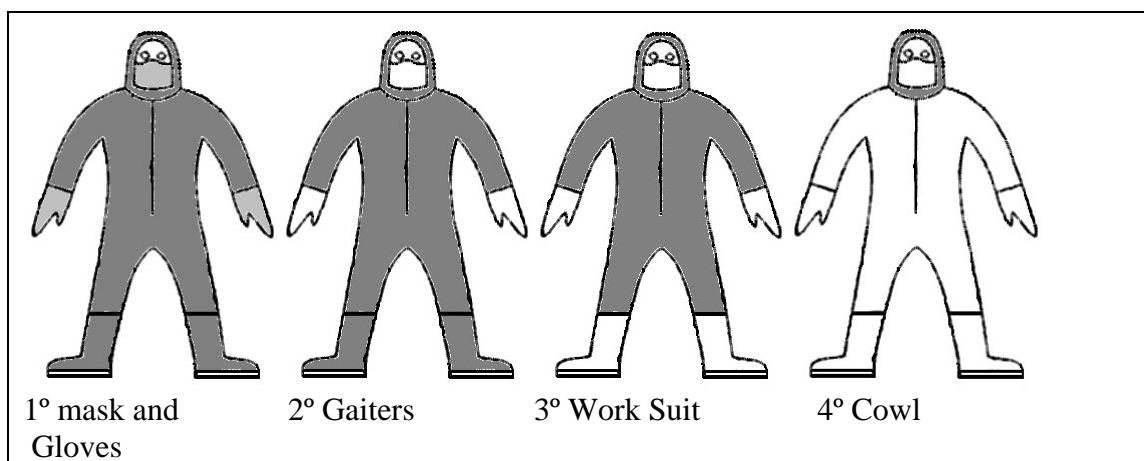




Fig. 10. Sequence to undress properly.

The gloves and mask are non-recyclable. Please throw them to the dustbin of the SAS in the blue carpet area.

 	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 15 of 34
		DATE 16/06/2014	VERSION 8.1_english

Carefully hang the coverall work suit and the hood up on the hanger. Place the booties on the bottom shelf as shown in figure 08.

2.6.4 Go to the corridor without taking your shoe covers off and go to pre-SAS.

2.7 Things to consider before leaving the pre-SAS

2.7.1 Check that you pick your objects back from the wardrobe.

2.7.2 Verify that the access doors of the perimeter corridors are closed.

2.7.3 Take your shoe-covers off.

2.7.4 Your exit has to be recorded for security reasons. Please slide the card through the reader on the right of the door. However, you can go out pulling the handle.

2.8 Access to the perimeter corridor.

2.8.1 If necessary, the access to the perimeter corridor is free to all staff that has the "Qualification 0.1" and it is accessible exclusively from the pre-SAS.

2.8.2 First, follow the instructions to access to the Pre-SAS (see point 2.2).

2.8.3 Go through the corresponding door on the left or right corridor and take a pair of shoe-covers and put them on.

2.9 Specific regulations on entering products and tools inside the cleanroom.



2.9.1 It is not allowed to enter any kind of equipment, material and/or consumable products without specific authorization of the Head of the ICTS.

2.9.2 The Clean Room provides you of any writing material that you may need to take notes, like special Clean Room paper or pens, so in principle it is forbidden to enter any similar material for that purpose.

2.9.3 It is not allowed to enter and store cardboard boxes or any type of packaging which are not specifically made for the Clean Room, although it could be allowed for maintenance reasons under the CR staff supervision. Remember that in any case such actions should always be performed away from clean process workplaces.

2.9.4 It is not allowed to introduce food or drinks, candies or chewing gums, etc.

2.9.5 All material (previously authorized) must be wiped and vacuum cleaned in the SAS area before being introduced into CR.

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 16 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

- 2.9.6 If you need to enter small size material (previously authorized) without going outside, you can use the wall-through window of the perimeter corridor (see figure 11).

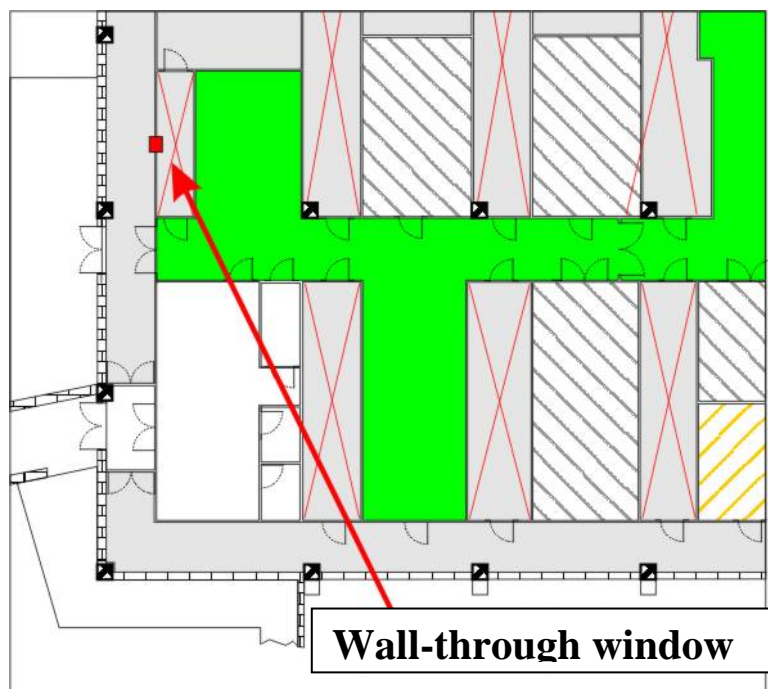





Fig. 11. Location of the wall-through window

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 17 of 34
		DATE 16/06/2014	VERSION 8.1_english

3 BEHAVIORAL RULES

3.1 Behavior in the Clean Room

- 3.1.1 The behavioral rules have been created in order to ensure safety of the clean room users and also to reduce particles in the ambient and wafer pollution or contamination.
- 3.1.2 For security and cleanliness/contamination reasons, wearing gloves and mask is mandatory inside the Clean Room. Only maintenance works can be done without gloves, whenever parts to be replaced or repaired are not going to be in direct or indirect contact with wafers or process samples.
- 3.1.3 Do not touch your face with the gloves to prevent they become dirty with fat from the skin and also to avoid contamination of your skin with dangerous substances (chemicals, nanoparticles...) that can be present in the gloves coming from process.
- 3.1.4 Do not touch the clothing with the gloves as far as possible. Despite clothing is special and clean, it is still the largest source of pollution that exists in the Clean Room. Gloves are also an important cause of pollution, specially as they use to be close to process and samples.
- 3.1.5 If at any time you touch your face, or the ground or any equipment part which is not perfectly clean you should replace your gloves with new ones.
- 3.1.6 Routinely, check if your gloves are clean and undamaged. Do not touch door handles with dirty gloves or with bare hands to avoid contamination through transfer.
- 3.1.7 When working in wet chemical benches, you should remain at least 5 or 10 cm away from the edge of the benches and rinse cuvettes. Notice that any person who is working in a chemical bench must be authorized by the corresponding qualification process and must observe the handling rules for chemicals.
- 3.1.8 During wafer inspection, keep a straight body posture and keep the samples, wafers and their transport or storage boxes at a certain distance away from the body so to assure the cleanliness.
- 3.1.9 Do not run and try not to make sudden or violent movements within the Clean Room in order to avoid air turbulences and spreading of particles.
- 3.1.10 In the areas with laminar flow do not interpose objects or body parts between air flow and wafers. (E.g. in the area of photolithography do not put your hands or head on the vertical of the wafers).

 	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 18 of 34
		DATE 16/06/2014	VERSION 8.1_english

- 3.1.11 Do not form groups of people in order to avoid turbulences and spreading of particles.
- 3.1.12 In case the forced air system of the Clean Room stops, the risk of contamination of the samples surface by dust and particles increases very much. Then any wafer/sample being inspected should be stored and any action that disrupts air quality should be avoided. In addition, if the airflow stop takes more than 15 minutes, all personnel should leave the Clean Room. In any case you must follow the instructions given in that situation by the members of Clean Room staff.
- 3.1.13 If the Clean Room gets dark due to a power supply failure, keep calm and stop processing wafers or equipment until the back-up power station switches on -it takes just a minute-. Leave the Clean Room if the lighting is not recovered.
- 3.1.14 Close the doors after entering in every Clean Room section. Do not keep the doors opened unnecessarily. If there are doors with automatic opening/closing system, use the buttons correctly and always ensure that the doors remain opened the shortest possible time. In case of power failure, the automatic doors remain in the "closed" position and you can open/close them manually pulling or pushing (there will be no opposition).
- 3.1.15 In case of any doubt please ask for advice from the Standard Production Responsible in the morning or afternoon shift or any other person of CR staff.



3.2 Cleanliness and Contamination

The CMOS and compatible technologies are the back-bone of the Clean Room, and thus, special restrictions are taken to ensure appropriate conditions for keeping its performance. For this reason potential contamination risks on equipment and other objects must be avoided. These risks are basically of two types:

- a) Alkali ions (Na⁺, K⁺), which can produce mobile charges inside the gate oxide of a transistor and the corresponding instabilities in threshold voltage.
- b) Metal contaminants, which can produce deep levels in the band gap of silicon, and may produce a reduction of the lifetime of the minority carriers within silicon wafers.

Some noble metals (Au, Pt, Pd, Ag,...) are specially problematic because they are almost impossible to be removed by the conventional cleaning processes used in a CR. The most critical systems/area at this concerning are the oxidation - diffusion furnaces, because of the high temperatures involved which facilitates the diffusion of metals inside the semiconductors.

Thus, a special effort is put in the Clean Room operation to avoid contamination and cross contamination of samples and equipment because of the manipulation of samples using non suitable tooling and equipment. In order to know which samples can be processed with which pieces of equipment, a simple classification of equipments and samples is used, as explained here:

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 19 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

- 3.2.1 “Clean equipment”: Equipment not contaminated with undesired ions or metals. It can only process samples that are of a contamination/cleanliness level compatible with CMOS technologies.
- 3.2.2 “MNC Equipment”: Equipment that can process "contaminated" samples, for example with noble metals.
- 3.2.3 “Mixt equipment”: clean and MNC samples can be processed with those equipments, as far as some specific accessories for each type of samples are used.



Also, for easy differentiation of samples, the wafers are stored in two types of boxes:

- (a) Blue and White (transparent) boxes for clean/CMOS wafers.
- (b) Black (or white with a red asterisk marked on the plastic) for MNC wafers.

In order to identify tools or accessories of MNC or potentially contaminated equipment, they are marked with a red asterisk or with the MNC letters on. This happens for example, with the tweezers used to pick and handle wafers. The basic rule to avoid crossed-contamination is to respect the boxes and tools associated with each equipment/process according to the explained typology and classification.

3.3 Specific Rules for inspection of samples

- 3.3.1 The users of the Clean Room (except for people of CR staff) are authorized to inspect ONLY the samples of the "runs" for which they are responsible.
- 3.3.2 Process wafers/samples are stored in a cabinet under a nitrogen flow. No one except people of CR staff is allowed to remove samples from there. Please ask the responsible of the Standard Production to locate and deliver them to you if necessary.
- 3.3.3 Once the inspection is finished, please place the wafers in the same box with the same distribution and position as they were found.
- 3.3.4 Note that the wafers deposited in a black box are contaminated or MNC. In that case and for inspection you must use the appropriated tweezers and holders and put a piece of CR wipe on the microscope stage to prevent cross contamination. Please ask to the Standard Production Responsible in case of any doubt.
- 3.3.5 After the inspection, please return the box with the samples to the Responsible who will take care of them. Don't return the box to the nitrogen cabinet by your own.
- 3.3.6 Each equipment and inspection system have their own tweezers and utensils with their specific use. It is important that they should not be used for another task, or equipment, and should not be moved to other locations under any circumstance.

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 20 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

4 ABOUT SECURITY

SECURITY SYSTEMS

The CR has the following security services and systems:

4.1.1 Leak detectors of toxic and explosive gases.

The leak detector status indicator consists of a set of 3 lights. Don't confuse them with the ON/OFF lights that some process equipments have installed. According to the map in figure 12, there are 4 of those leak detector indicators: One is located in the central corridor of the Clean Room, in front of the photolithography area. Another is in the central corridor in front of the wet benches room. The third is in the RIE-Sputtering area and the fourth above the Nanolithography access door.

The meaning of each colour is as follows:

Green (on): system is working correctly.

(off): a failure in the system is detected.

Yellow (on): gas is detected above a certain concentration, but below the level of risk.

Red (on): gas is detected above the level of risk. At the same time a loud and discontinuous alarm will sound.

(NOTE: The larger blinking red light next to the leak detection lights indicates only that some gas is about to end, and does not represent a dangerous situation).



4.1.2 Air/vapour extraction systems, which usually are individual to each gas cabin, chemical bench, oven or any other equipment that may need them.

There are independent circuits of extraction by risk areas:

- Acid vapours
- Solvent vapours
- Explosive vapours/gases
- Toxic vapours/gases
- Hot Air

4.1.3 Smoke detection system (fire system) with automatic "inergen" discharge.

This gas is a mixture of inert gases which reduces the oxygen concentration, so you can safely breathe for a time. The detection and firefighting is done in CR by compartments or areas of risk. In case of detection of a fire, an alarm will sound with acute noise, before to discharge or activation of extinguishing gas.

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 21 of 34
		DATE 16/06/2014	VERSION 8.1_english

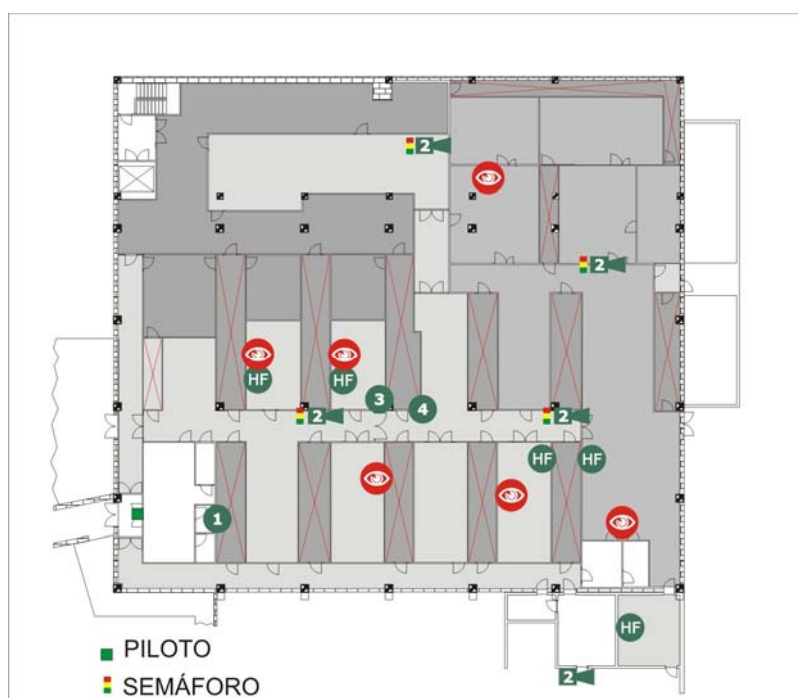
It should be noted that activation of the "inergen" produces a notable noise, due to the sudden expansion of the compressed gas. Take into account that there is a delay between the alarm activation and the activation of inergen (about 20 seconds)

4.1.4 Elements of personal safety.

- **Medicine first aid kit** (in the toilet in the main SAS),
- **Face masks and anti-acid gloves** available at several locations.
- **Masks for dangerous gases**, to be used for handling gas bottles and clean reaction chambers where these gases are processed, only by authorised staff having the necessary qualification accredited.



4.1.5 Other Safety elements

- **Emergency Shower, eye-wash and water pistols** close to all chemical benches and rinsers.
- **Fire extinguishers and hoses**, only in the perimeter corridor




- | | |
|---------------------------------|-----------------------|
| 1- Medicine First-aid kit (SAS) | 4- Emergency Shower |
| 2- Traffic Light gases. | HF- Calcium Gluconate |
| 3- "Fire break" Doors | 👁- Eye-wash |

Fig. 12. Location of Security elements inside the CR.

 	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 22 of 34
		DATE 16/06/2014	VERSION 8.1_english

4.2 BASIC SAFETY RULES

- 4.2.1 Do not access the CR if there is not at least another person inside or accompanying you. Please ask the reception staff to be sure that there is another person inside.
- 4.2.2 In the case that there are only two people in the CR and one of them has finished his/her work and decides to leave, this person should alert the other one about this situation before leaving the CR in order to prevent that the other person stays left alone
- 4.2.3 The CR staff may not follow rules 4.2.1 and 4.2.2 if they consider that it is strictly necessary and as far as somebody from the outside of the Clean Room, such as the guard/entrance concierge or someone with any CR responsibility (Director of operations of Clean Room, Facilities and Maintenance Responsible or Standard Production Responsible), know that there is a staff member nearby also working inside the CR, in the annex facilities building, or in the Institute of Microelectronics building.
- 4.2.4 Do not run in the Clean Room or perimeter corridor.
- 4.2.5 It is strictly forbidden the wafer handling, equipment processing and services or chemical material manipulation without the proper authorization.
- 4.2.6 Do not access to the service corridors without permission. Only CR and maintenance personnel are authorized.
- 4.2.7 Use face screen or safety glasses in the occasions when there is a high risk of breakage of the wafers or chemical splash.
- 4.2.8 Please, always use the gloves and keep them in good conditions.
- 4.2.9 Please, be careful and do not touch your eyes or your face with the gloves.
- 4.2.10 If you are inside the CR as an observer of chemical etching procedures, whereas the staff is working on a stack of rinse or chemical benches, you should use a facial protection screen, too.
- 4.2.11 If you think there is any chance that you have been in contact with acid, rinse the suspicious area abundantly during several minutes. There are emergency pistols and systems with deionized water close to all chemical benches and rinsing piles. Remind that there is also a shower with the same purpose in cases where the affected area is more extended.
- 4.2.12 In case of burns with HF, rinse the affected area thoroughly with water and apply a powder or gel composed of calcium gluconate. This compound can be found in the Wet attacks Room (to the right of the door), in the Mixt Room (on the Quimipol chemical benches) and in the Diffusion Furnaces Room (on top of the chemical bench).

	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 23 of 34
		DATE 16/06/2014	VERSION 8.1_english

4.3 GAS LEAK ALARM

4.3.1 When the presence of a toxic or explosive gas is detected in the exhaust/ventilation system in a proportion above the level of alert, a discontinuous Horn sound alarm is activated. The gas detectors are generally placed at:

- Gas pressure regulators panels
- Flow meter Cabin of the process equipments
- The gas supplying cabinets.

In this situation, the automatic security system will close the bottle and, through the extractions, the gas will be removed directly outside.

4.3.2 Do not hurry, leave what you are doing and obtain information about the incident from the Responsible of Standard Production or any other member of staff of CR Maintenance. Look at the Gas System indicator lights. If the yellow light is on you can wait for a responsible to check the alarm and who will give you the appropriate information about it. If the alarm remains it is advisable to leave CR within few minutes. If the red light is on, you must leave immediately CR. In any case, especially in case of any doubt, you can evacuate the CR and inform to the maintenance and emergency phone numbers listed in Annex I. Exit through the SAS if it is possible.

4.3.3 Do not open any gas pressure regulators panel, vapor extraction cabin or flow meters cupboard. The system automatically closes the affected bottles.

4.3.4 Do not open any equipment which operates with toxic or explosive gases.

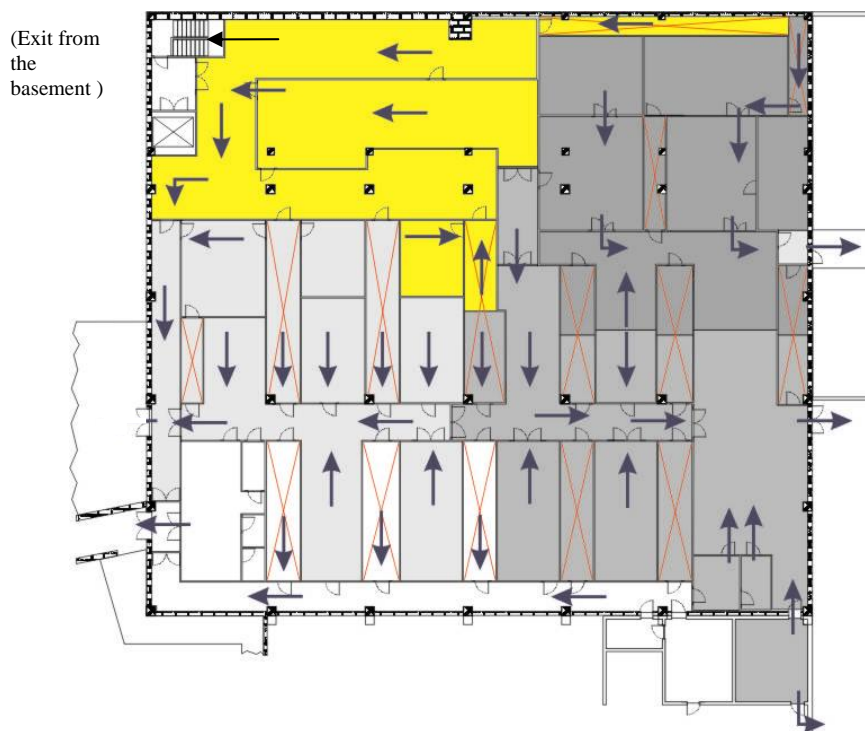






Fig. 13. Evacuation routes.

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 24 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

4.4 FIRE ALARM

- 4.4.1 When the Fire alarm (a continuous strident tone) is activated, please stop immediately what you are doing and leave the CR. Take the nearest emergency door to go outside according to the map enclosed. It is not necessary to use the SAS to get outside.
- 4.4.2 It is very important TO CLOSE ALL THE DOORS when leaving CR. The opened doors facilitate the spread of fire.
- 4.4.3 You can only take your CR clothing off once you are safe outside from the CR enclosure.
- 4.4.4 The meeting point is at the entrance of MATGAS building, next to Cerdanyola - Bellaterra road.
- 4.4.5 Please wait at the meeting point for some responsible to verify if all the people that were inside the CR are present.

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 25 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

ANNEX I : EMERGENCY SUMMARY

INSIDE OF SB

Continuous siren: **EVACUATE**

Discontinuous and Strident Hooter: **ALERT**

Please follow the instructions of the closest Responsible person, or if the light on the gas detection system is red

Gas detector light in red: **GET OUT**



In case of doubt: **GET OUT**

TO ENTER

Pilot light of Pre-SAS off **NO ENTRY
WARNING**



If the pilot repeater system state gas at the entrance of SAS is not in green NOT ENTER. Please notify and wait for the Maintenance of facilities Responsible, or in his absence, to the Standard Production Responsible or to the CR Coordinator Manager.

Caution: Do not confuse the traffic lights detection of gases with those who have certain process equipment (Implanter, RIE...) to indicate its operational status.

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 26 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

Emergency telephones

IMB-CNM Management:	(Extension no. 2478)
Campus UAB Security:	93 581 25 25
Emergency Service:	112
Health Care Service:	061
FREMAP (Occupational	
Insurance Accident: 24 hours):	900 61 00 61
UAB Health Care Service:	93 581 18 00 / 19 00
National Institute of Toxicology:	91 562 04 20

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 27 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

ANNEX II: SB BANNERS.

ACCESS TO THE PERIMETER CORRIDOR

**Abans de passar,
RECORDEU...!!!**



**Antes de
pasar**

RECUERDA...!!!



**Before to
go in**

REMEMBER...!!!

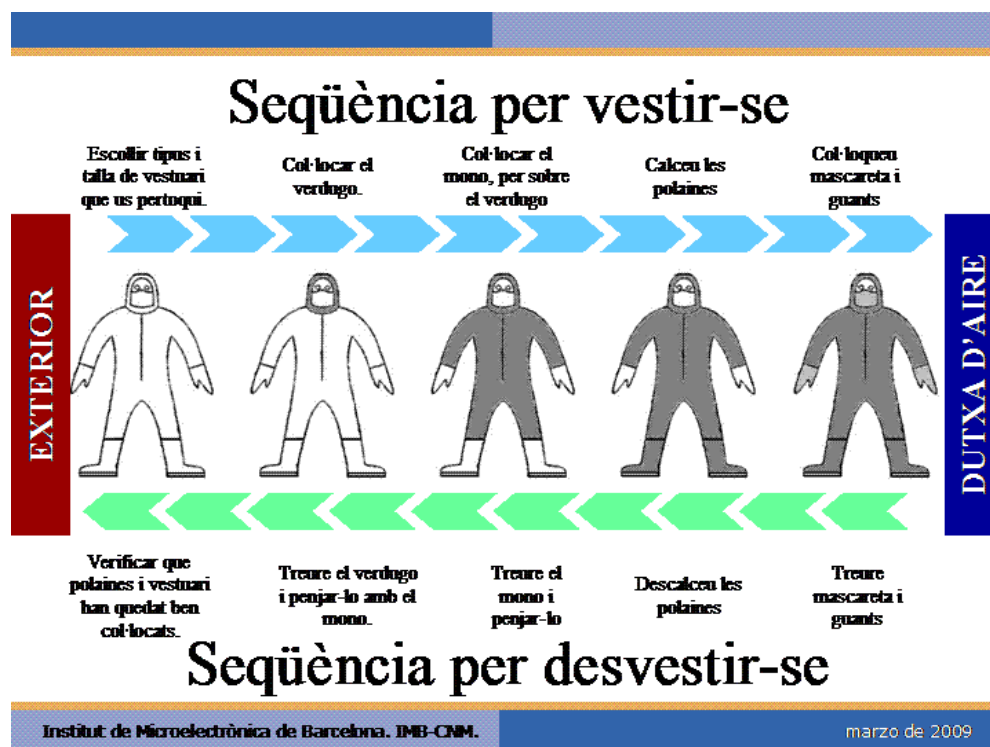
Institut de Microelectrónica de Barcelona. IMB-CNM.


marzo de 2009

REMIND BEFORE ENTRY

 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 28 of 34
 <small>CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS</small>		DATE 16/06/2014	VERSION 8.1_english

SAS BANNER



 <small>Centro Nacional de Microelectrónica CSIC</small> <small>Instituto de Microelectrónica de Barcelona IMB-CNM</small>	PROTOCOL 0.1 OF ACCESS TO THE INTEGRATED MICRO&NANOFABRICATION CLEANROOM	CODE Protocol_0.1	PAGE 29 of 34
		DATE 16/06/2014	VERSION 8.1_english

ANNEX III: *ICTS Directory*

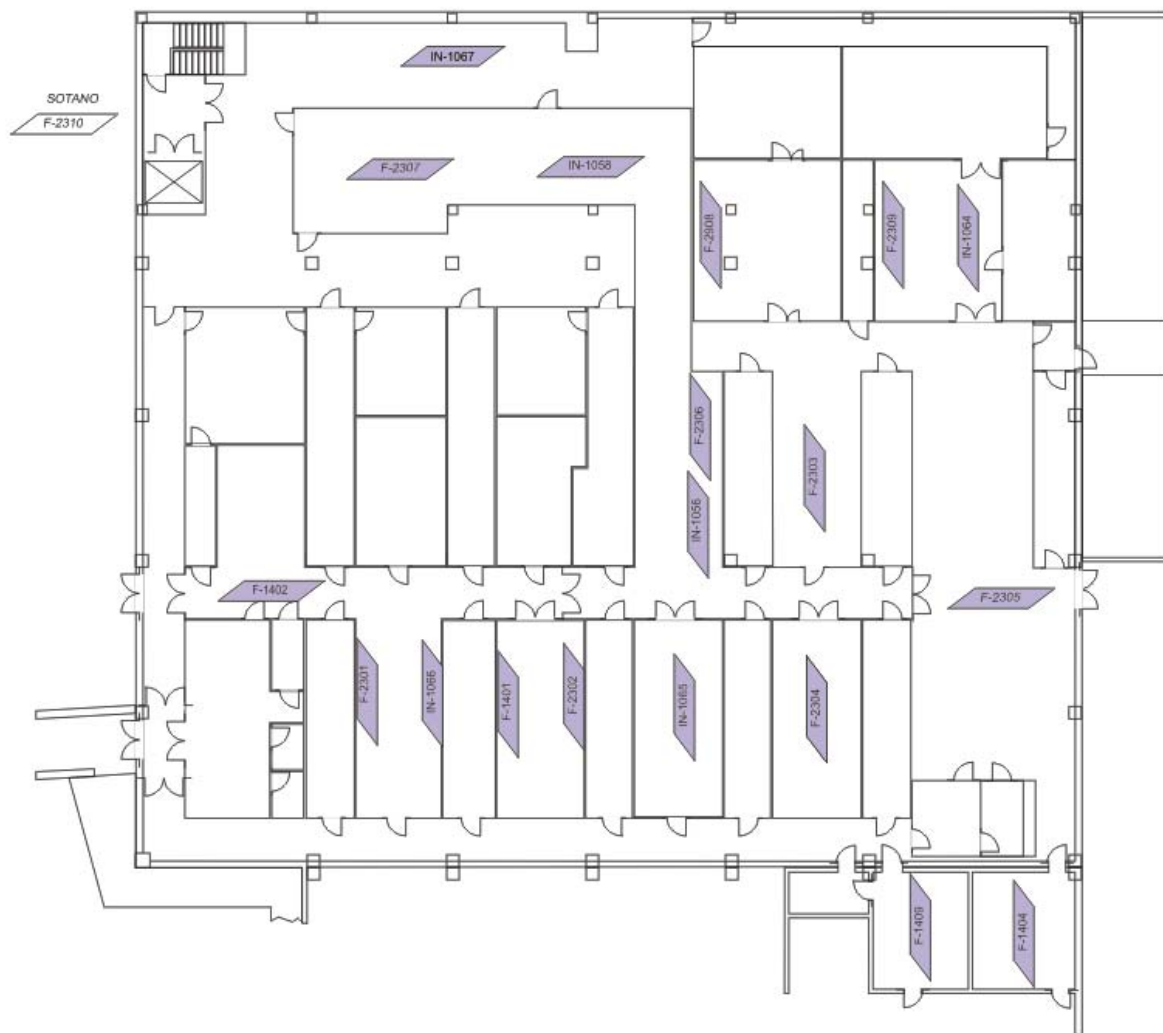
Index of staff with specific responsibilities in this document (Protocol 0.1 access to Integrated Clean Room for Micro and Nanofabrication of ICTS) and their telephone extensions:

- ICTS Management: Carles Cané Ballart	2478
- Clean Room Manager: Miguel Zabala García	1060
- Technical Facilities and Maintenance Director: Xavier Mas Pla	1068
- Clean Room Facilities	
Mornings: Xavier Mas	1068
Afternoons: Roger Cot	1074
- Machinery Workshop	
Antonio García Simón	2538
- Machinery Electronic Workshop	
Juan Cusso	1061
Antonio Garzón	1055
Javier Bermúdez	1054
- Processes Standard Responsible	
Nieves Alonso	1056
- Clean Room Costume Responsible	
Mornings: Elena Chica	1056
Afternoons: Marcos Lechón	1402

- **Clean Room staff** (Alphabetical list)

Alonso Castillo, Nieves	Montero Suárez, Isabel
Ayesta Urquiza, Xabier	Montserrat Martí, Josep
Bermúdez, Javier	Muñoz López, David
Borrisé Nogué, Xavier	Pardo Esteban, Emilio
Calvo Angós, José	Pérez Osuna, Julia
Castillo Espinosa, M ^a Encarnación	Sáenz Gacía, Antonio
Cirera Perich, Josep Maria	Sánchez Amores, Ana M ^a
Cot Borràs, Roger	Sánchez López, Javier
Cussó Díaz, Joan	Sarrión Romero, Mónica
Chica Gordillo, Elena	Solé Díaz, Libertad
Duch Llobera, Marta	Suárez Narbona, Fernando
García Simón, Antonio	Xinxó Muro, Ferran
Garzón Rus, Antonio	Zabala García, Miguel
Gerbolés Gibert, Marta	
Gibello Bote, Carmen	
Lechón Alonso, Marcos	
Mas Pla, Xavier	
Mas Colomina, Roser	
Mateu Mañé, Carles	

Clean Room telephones



Showers gate from SAS (principal)	1402
Inspection Area 2301/1066	
Photolith CMOS Area	2302
Steppers Area	1065
Planning Area 1056/2306	
Photolith MNC Area	2308
Ries Area	1058
Metal Area (New zone)	2307
New Zone Corridor	1067
CMOS Lavatory Room	2304
Microsystems Laboratory	1404
Pump Room	2310
Nanotechnology Area 2309/1064	
MNC Area (Mixt Area)	2305
(electroplating/CVD-MNC)	2303
Control Room	1409

ANNEX IV: “Qualification 0.1 Application Form”.

Separate the next sheet, this is the Application Form, which can additionally find in the web / intranet / portal ICTS. Fill , deliver or send it to MIGUEL ZABALA, (Clean Room Manager of IMB-CNM), he will send you the confirmation acknowledgement that the applicant has been included in the REPAS and / or REPASS list which will enable you to access to SB and/or SBS.

“Qualification 0.1” Application Form

The undersigned, Mr/Ms

With ID/Passport

Is asking for

- ☐ “0.1Qualification” that enables you to access to the IMB-CNM (CSIC) Micro and Nanotechnology Manufacturing Clean Room of ICTS with the object of:

Admits that have read, understood and assimilated the document(s) entitled(s)

- ☐ “0.1 Protocol Access to the White Room (SB) of ICTS”, 8.0 Versions.

Undertakes to access it and will comply the standards listed.

In addition you are committed to read and assimilate corrections, additions, or reissues versions, on documents that occur in the future. You will comply the standards it are stated. In particular undertakes to attend meetings and courses of information about conduct to follow inside of Clean Room, when requested to do so

Declares that until further communication in this respect, financial charges arising from their inclusion in the REPAS list, shall be assumed by (Project Department, center):

Bellaterra , on the of 2014

To be approved by the Responsible
to assume extra economical charges.

Applicant Firm

WORK ADDRESS

Centre:

Street :

Postcode , City , Country:

Telephone number:

Fax number:

e-mail:

Form 1-080810-PR-1

To be completed by IMB

YES / NO Obtain the Approval
to be include in the list of :

- ☐ REPAS

As a matter of

- ☐ Permanent Arrangement

- ☐ Temporal Arrangement

Bellaterra,201

Name and Firm of Person in
Charge