MICRONOVA
Centre for Micro- and Nanotechnology

Cleanroom Training

Micronova Aalto Nanofab

Aalto University
Aalto Nanofab

Cleanroom Training Course

Course program:

Introductions and questions regarding the homework

Cleanroom visit

Visit to Subfab, Thin Film Lab and 4th floor labs

Wrapping up, exam and paperwork

Contents of the slides

1. Micronova's Cleanroom
2. Clean ways of working
3. Safety
4. Contamination

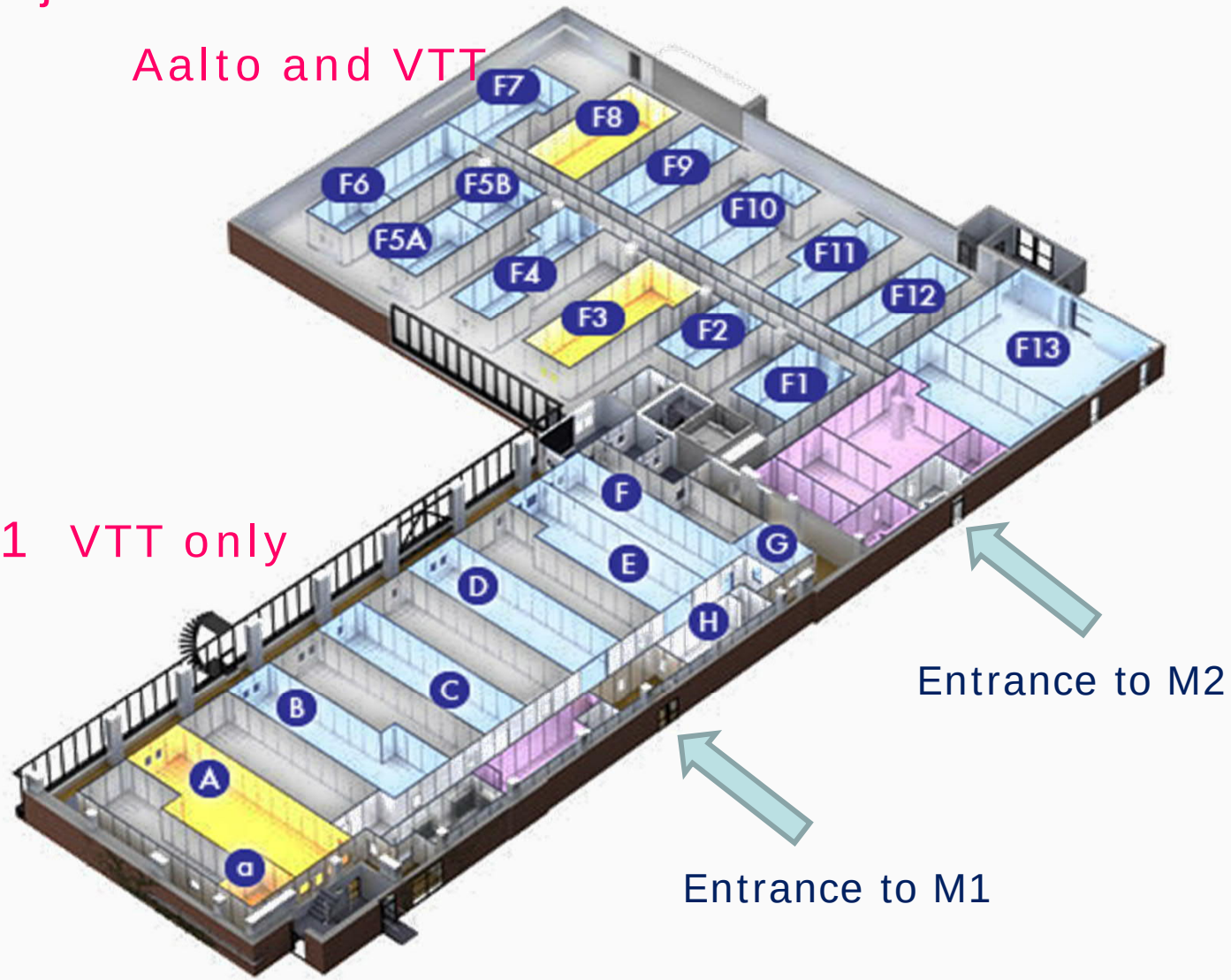
Cleanroom

Cleanroom Layout

M2 joint cleanroom

Aalto and VTT

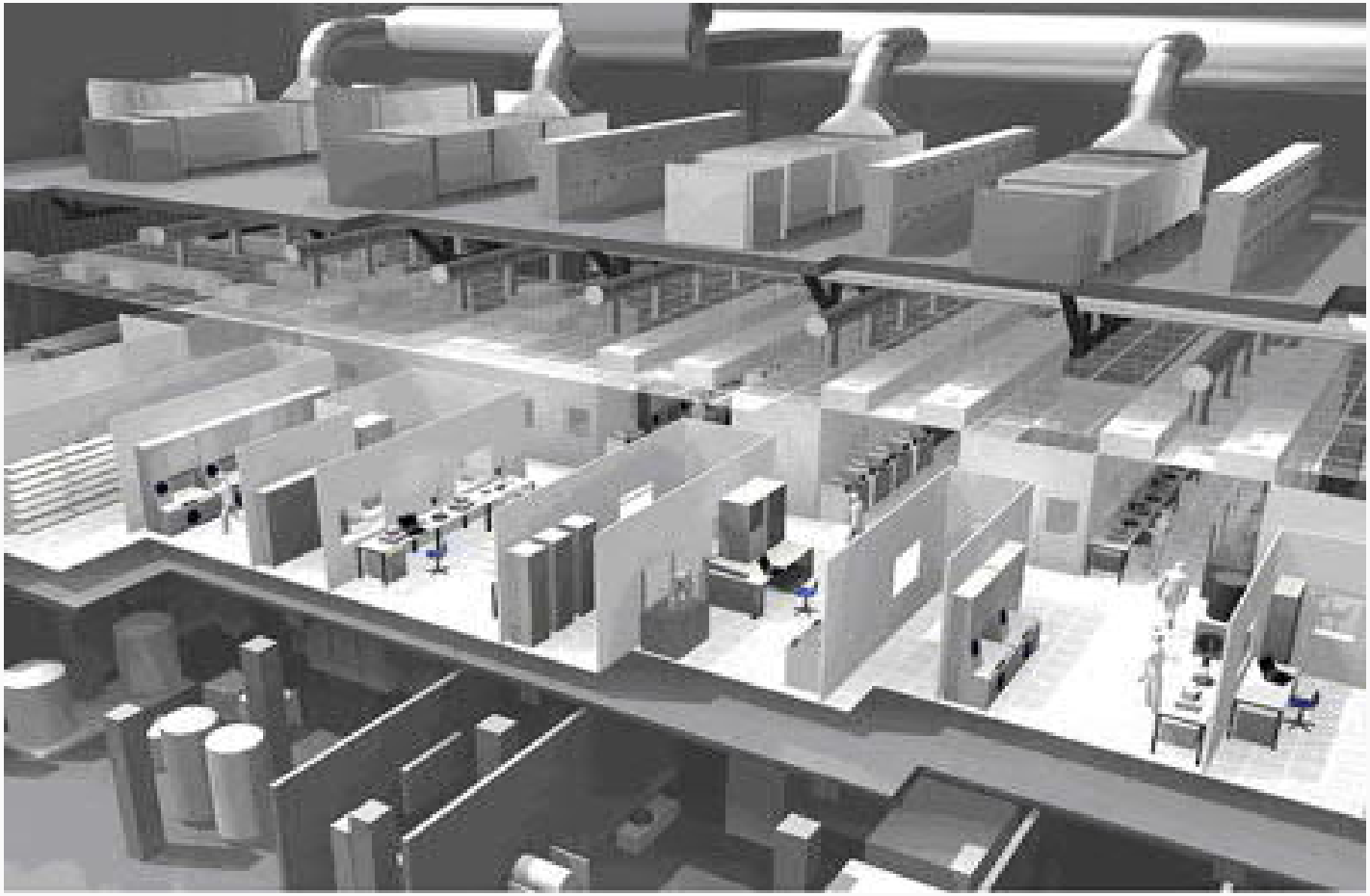
M1 VTT only



M2 cleanroom bays

- F1 Flip-chip Bonding
- F2 Wet Processing
- F3 Nanolithography
- F4 Plasma and Sputtering
- F5 Plating
- F6 Metrology
- F7 Furnace
- F8 Lithography
- F9 ALD
- F10 Plasma
- F11 Wafers
- F12 Chemistry
- F13 Analysis Lab

Structure of the Cleanroom



Air conditioning plant
4th floor; processes incoming outside air.

Plenum
3rd floor; recirculates air through filter-fans into the cleanroom

Cleanroom
2nd floor

Subfab
1st floor; support systems for gases, chemicals, water, waste, pumps

Overpressure in the cleanroom:

- Clean bays 35Pa
- Service areas 25Pa
- Gowning 15Pa

Cleanroom Guidelines

Access

- Only authorised persons may work in the cleanroom. The permission is given by the Cleanroom Engineer of Aalto Nanofab.
- After the training the Cleanroom Engineer arranges access to the cleanroom from VTT's security department. Within 1 week you will get a VTT key card which opens the cleanroom door.
- The key card is personal and you are not allowed to give it to anybody else's use.
- Visitors need permission to enter the Aalto Nanofab cleanroom from Aalto Nanofab. You must never leave a visitor alone in the cleanroom.
- Students of laboratory courses can work in the cleanroom only with the course assistant.

Confidentiality

- While using Micronova's cleanroom you may receive confidential information belonging to users from Aalto, VTT or private companies.
- You must be aware that such confidential information is not generally available to the public and may contain trade secrets.
- The use of confidential information is usually restricted by NDAs (Nondisclosure Agreements) between Aalto University and the other parties.
- You are required to sign the User Commitment form, in which you promise to protect confidential information belonging to others.
- You shall use the confidential information solely to carry out your work in Micronova's cleanroom.
- You must maintain the confidentiality of the confidential information and protect it with a reasonable degree of care.

Taking Items into the Cleanroom

- You are allowed to bring along smaller items like wafer boxes etc., when entering the cleanroom.
- Clean them in the air lock with 50% IPA (IPA+DIW). Do not touch them with bare hands after cleaning.
- Larger items, chemicals as well as equipment should be brought into the cleanroom through the rear entrance. Contact Nanofab personnel for details.
- No food, drinks, cigarettes or chewing gum are allowed.
- Do not bring any notebooks or papers. Suitable paper is available in the cleanroom.
- Forbidden items: Pencils, cardboard, Styrofoam, tissues, mobile phones and own cameras.
- Borrowing or taking marked items from storage shelves is forbidden. They are personal items purchased by research groups or companies.

Telephones in the Cleanroom

- Analog phones are installed in cleanroom bays F7 – F13.
- You can take the mobile phone with you, but must keep it inside your overalls. (For instance in your pocket.)
- Use of mobile phone is allowed only with a hands-free system, while keeping the phone inside the overalls all the time.
- If you must operate your mobile phone:
  1. go into the gowning area;
  2. undo the zip of your overalls, take the phone out.
  3. after finishing the call, put the phone back into your pocket, zip up overalls
  4. change your gloves before entering the cleanroom.

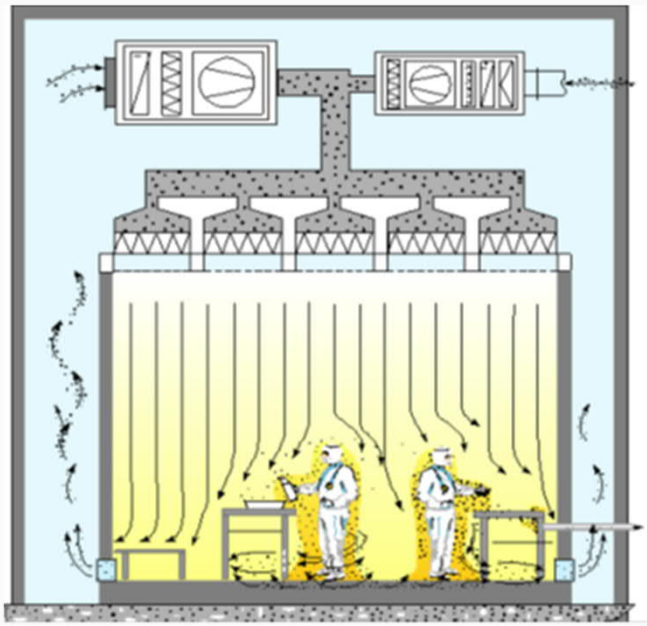
Note: Technical personnel of Aalto Nanofab and VTT Nanofabrication Center personnel are allowed to use their mobile phones in the cleanroom, but the phone must be packed in a plastic bag and carried in a pouch.

Clean Ways of Working

- You must wear protective clothing: overalls, boots, face mask, gloves and goggles.

  You will find instructions in the airlock and gowning area.

- Clean air is flowing down from the ceiling. Lower means dirtier!
- You must remember that contamination may spoil not only your own work but that of others!
- Desks, equipment, wetbenches, fumehoods are not a storage space!
- Only you can make sure that the workstation is clean and tidy for the next user.

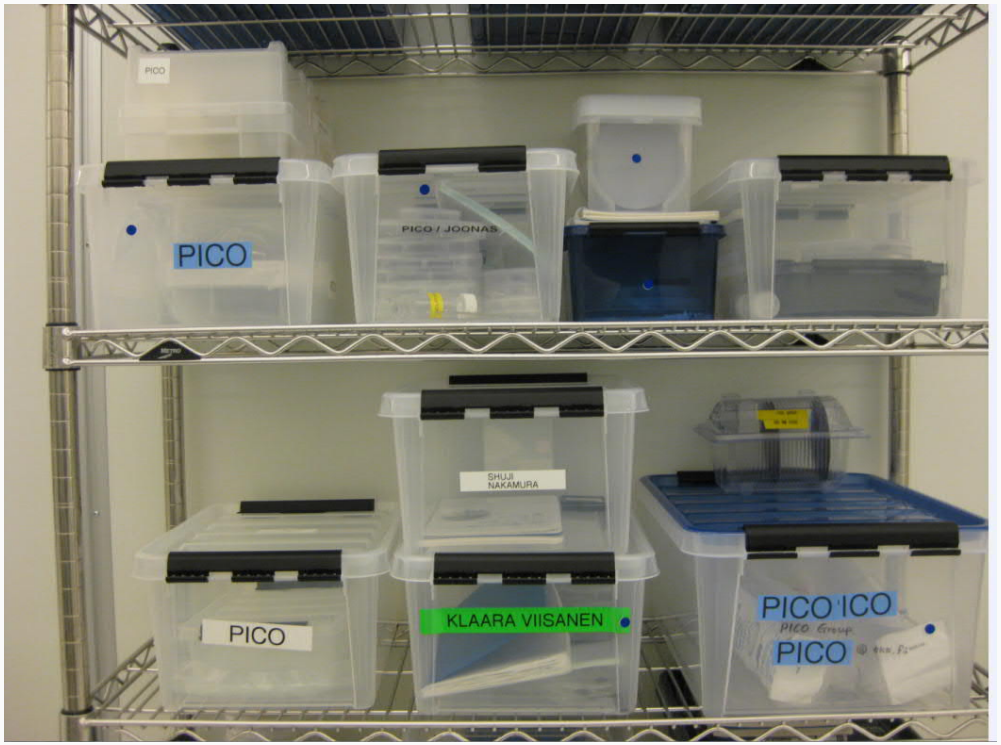


Clean Ways of Working

- Avoid rapid walking and quick motions that create turbulence.
- Do not use the floor or tables for storage.
- Clean all items which have been on the floor .
- Cosmetics are not allowed when working in the cleanroom.
- Do not touch your face/eyes with gloves.
- Do not lean on the wet benches or equipment.
- Do not sit on tables.
- If you suspect that your gloves are dirty, change them!

Storing things in cleanroom

Storing personal things in the cleanroom

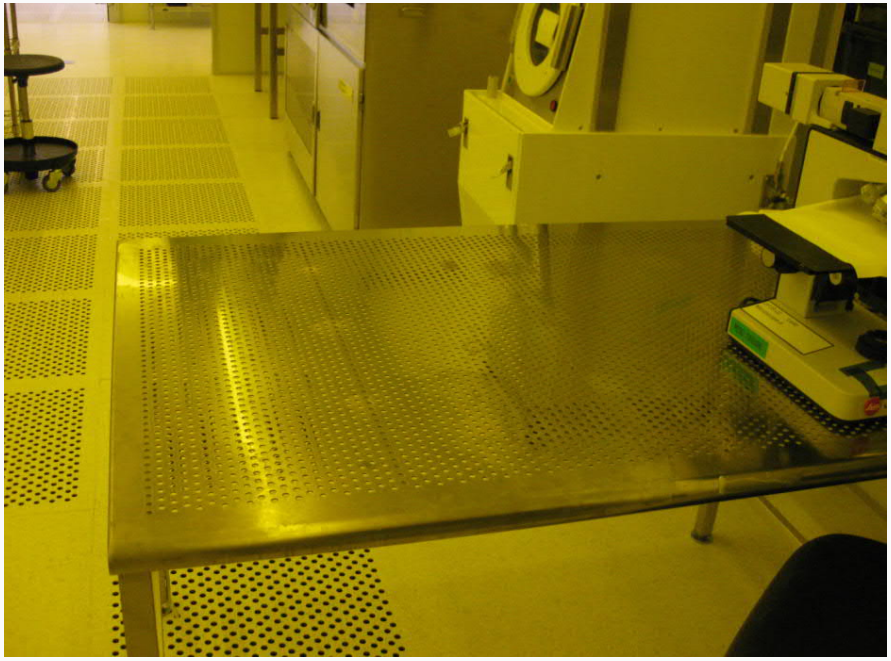


Keep your things in boxes and name the boxes

Don’t fill shelves with separate vessels, samples, tweesers etc.

Storing things in cleanroom

Tidiness of workstations



Make sure that the workstation is clean and tidy for the next user.

Desks, equipment, wetbenches, fumehoods are not storage space.

Contamination

- Particles
- Metals
- Organic compounds

Sources of Particles

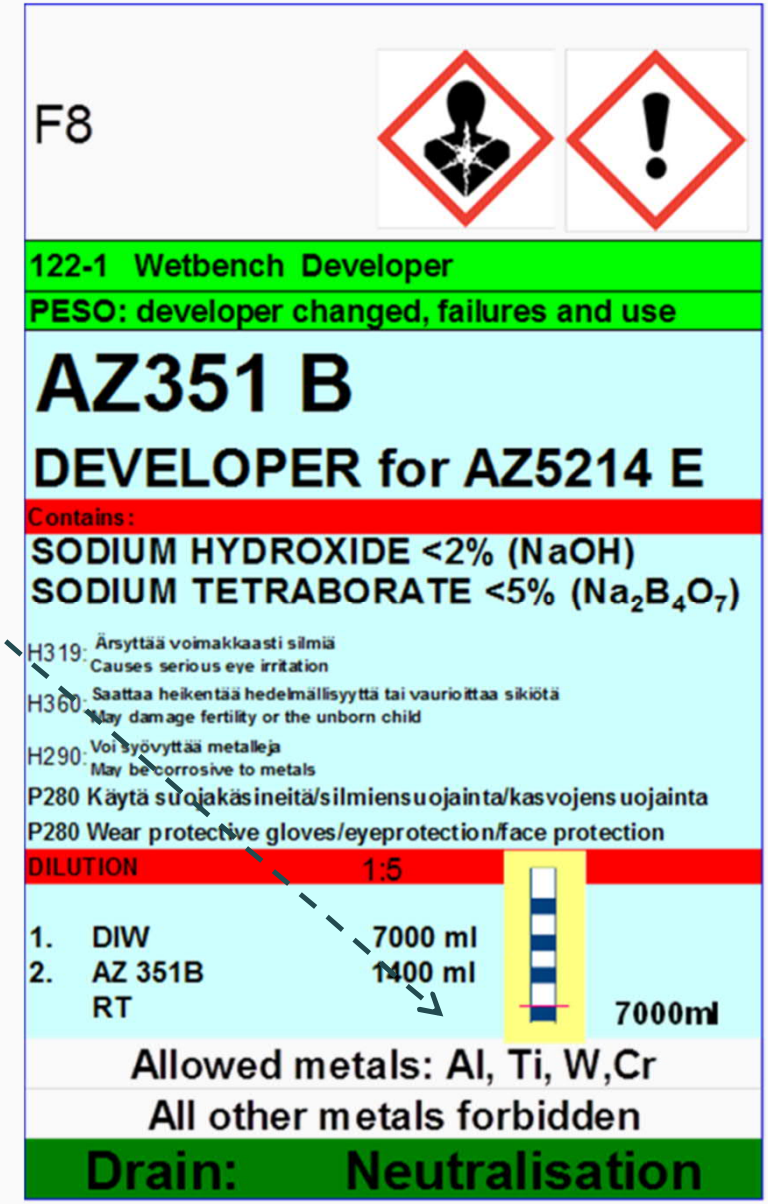
- Operators (40-90% of the contamination)
  - People generate particles in the form of skin flakes, lint, cosmetics and respiratory emissions
- Materials (substrates like silicon and glass)
- Substrate handling
- Tools and containers (e.g. quartz boats and tubes)
- Gases
- Chemicals (there can be unwanted reactions)
- Processes
- Maintenance work

Metal Contamination

- Many metals can seriously degrade the operation of processed devices. (e.g. Au, Ag, Pt, Cu, Ti, Fe, Ni…)
- For this reason processing tools have restrictions on the metals that are allowed on your samples.
- Removal of trace metals is a major reason for wafer cleaning prior to sensitive processes.
- There are numerous sources of metals even though materials like Teflon, SiC and quartz are used in equipment and wafer handling tools.
  - structural parts of equipment (e.g. ion implanter or sputter shutter blades)
  - piping for gases and liquids
  - tweezers and jigs
  - chemicals (some photoresist developers have NaOH as an essential constituent)
  - sweat (esp. sodium)
  - plastic containers, plastic vessels

Metal Contamination

- Several type of metals are used in our cleanroom processing. Metal etching, as well as developing of metallised substrates is allowed only in the cleanroom bay F12
- Some metals are allowed to be developed and etched in the tanks of Lithography bay F8.
- Follow the instructions given on the signs above the tanks.
- Only the metals shown in the labels are allowed.



Sources of organic contamination

- Solvent vapors (e.g. lithography processes, HMDS priming and resist baking).
- Wafer boxes (plasticizers).
- Etch and deposition gases.
- Vacuum pump oils.
- Equipment O-rings (vacuum grease is forbidden).
- Cleanroom construction materials (avoid silicone containing materials).

Avoid Contamination

Good working habits are essential to avoid spreading contamination:

- Think clean. Can your gloves, samples, vessels and tools spread contamination?
- Be sure your gloves are clean and dry. Change them if needed.
- Avoid cross contamination. Do not move beakers and tweezers from bay to bay.
- If you bring samples into the cleanroom, make sure they are cleaned prior to processing (check with Cleanroom Engineer for procedures).
- Check restrictions for the tool or workstation. Don’t process forbidden materials!
- Be careful how you mount your sample on a carrier prior to processing. Check with the Main User for correct ways to avoid contaminating the tool.

  Generally the use of tape and glues is forbidden!
- If you make a mistake, promptly notify Nanofab personnel or the Main User of the tool. This allows us to minimize the damage.

By following the rules you can help us to maintain a clean cleanroom.

Safety Instructions

Locations of Manual Alarms

- Fire alarm
- Toxic gas alarm
- Chemical alarm

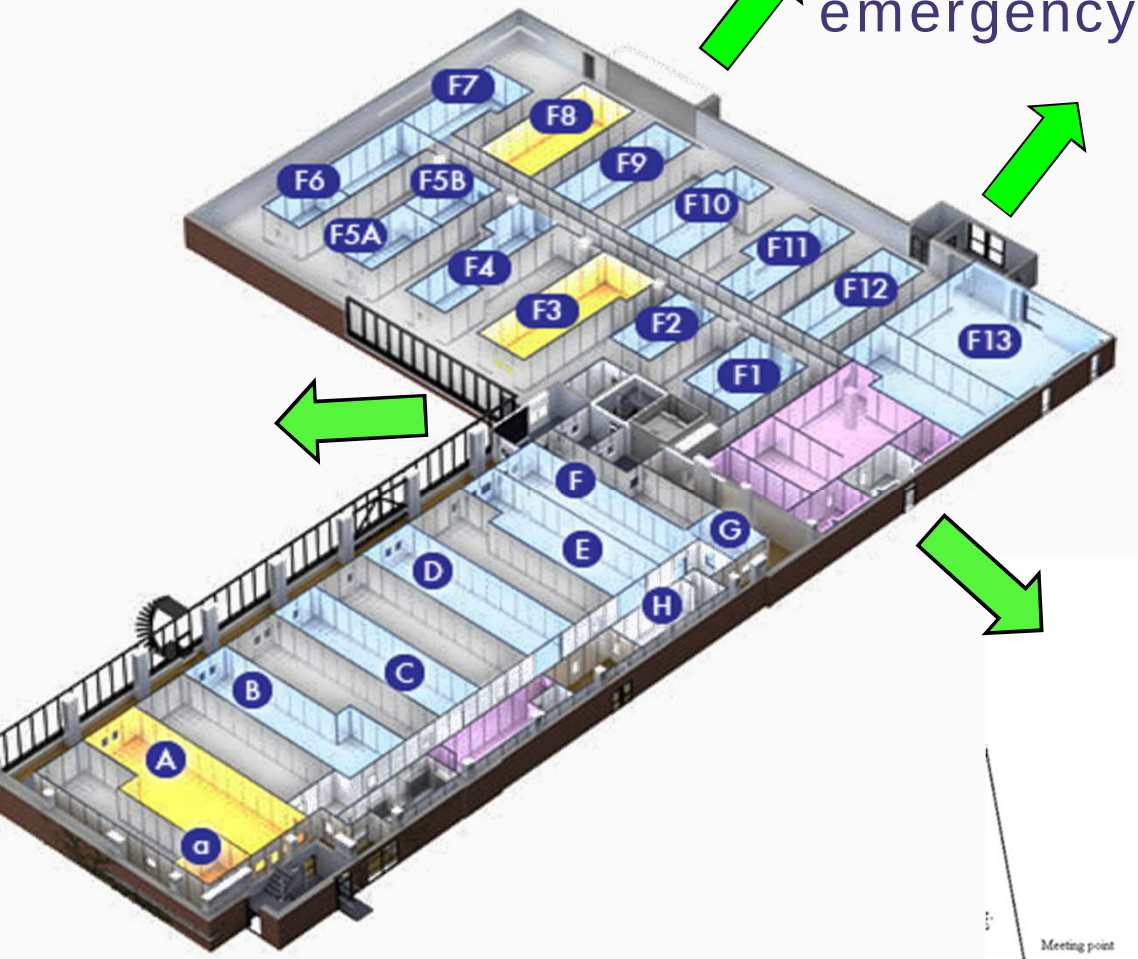
Near the M2 cleanroom entrance

Action During an Alarm

1. Look around and help your collegues if they need it.
2. Leave the cleanroom as well as the offices using the nearest emergency exit.
3. Keep calm, do not rush.
4. Go to the assembly point.
5. Wait at the meeting point until you get permission to return to the building.

Cleanroom exits and assembly points

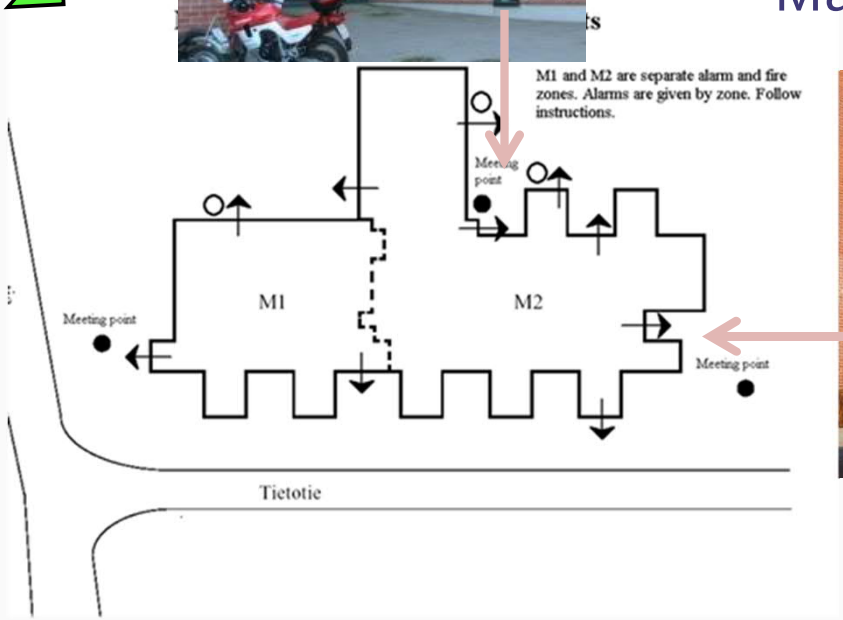
M2 cleanroom
emergency exits



Assembly points

D door

Main entrance



Actions in case of personal injury

Personal Injuries

1. Shout for more help
2. Press alarm button
3. Rescue people
4. Prevent victim from further damage
5. Call for help 112 and person on call 040 527 4840

Using equipment

- PESO
- LIMS
- Acknowledgement policy

Using Equipment

- All tools have a Main User. The Main Users grant the right to use each equipment after giving the required training. To get the training, contact Main Users through the booking system LIMS (labbooking.micronova.fi).

  Remember that the Main User is a volunteer. (S)he is happy to help you but has also other worries, like completing her/his thesis…
- The use of equipment is controlled through our database PESO and all equipment use must be marked on PESO.

You must always make the first PESO entry (user, project, date) before you start using the tool.

- When using wet benches and fume hoods always mark the change of the etching solutions.
- If you notice equipment failures contact the Main User of the equipment or Aalto Nanofab personnel. Also register your observation on PESO.
- Never use equipment marked with a “Out-of-Use”-sign.

PROCESSING DATABASE PESO

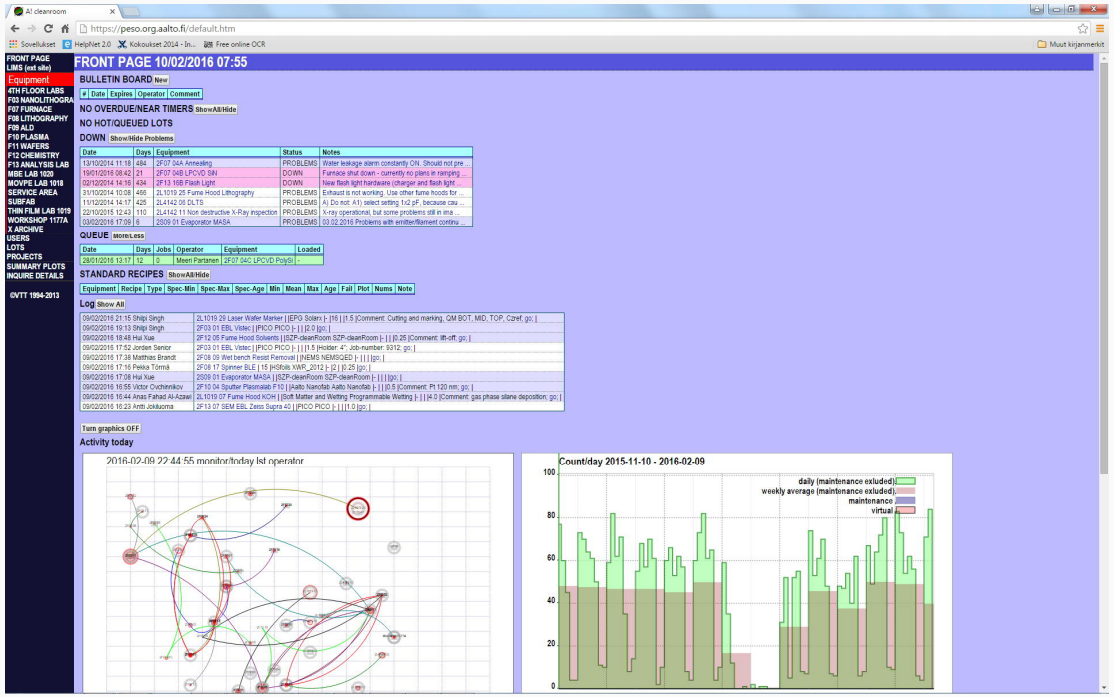
PESO is our equipment and processing database.

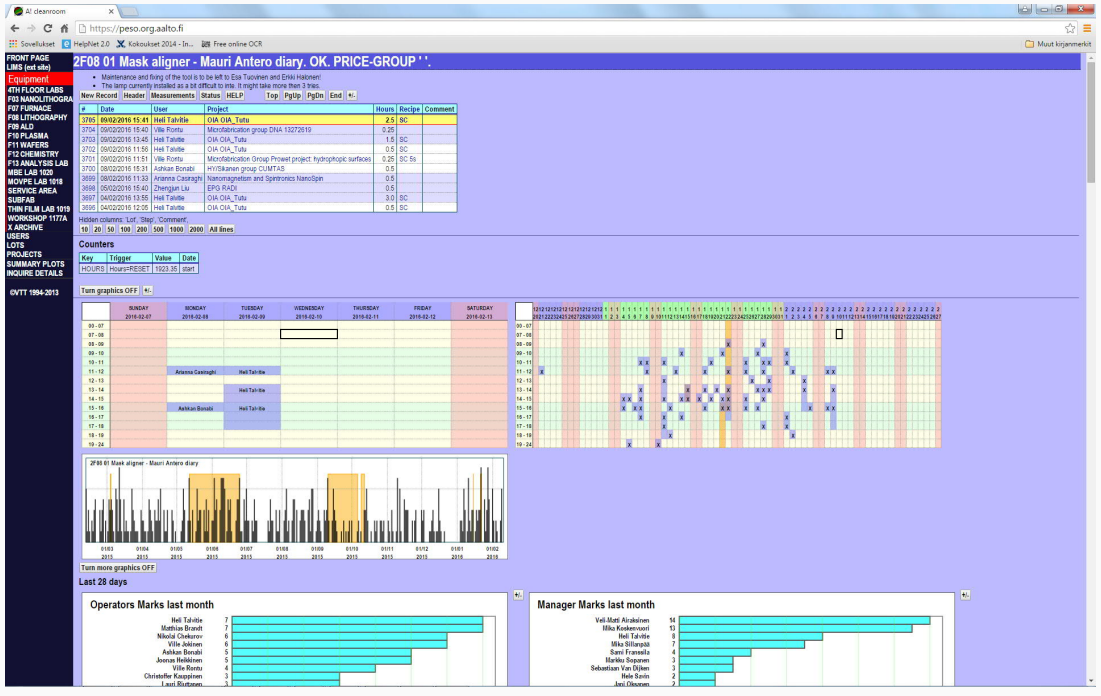
- Always record your tool use – immediately, and make your first entry before starting to use the tool!
- Check the PESO (LIMS) label (code) on the tool.
- Use ”Comments” field freely to write anything interesting to you or others. PESO is the equipment diary!
- All tool maintenance on project Maintenance Aalto Nanofab.
- All training on project Training and Process Support.
- Main Users: if ”Training and Process Support” does not require actual use of equipment, use imaginary tool ”Process Support” in PESO.

PROCESSING DATABASE PESO

PESO is our equipment and processing database.

- Always record your tool use –make your first entry before starting to use the tool!
- You are allowed to use only tools with the status “OK” or “PROBLEMS”. For any other status – do not use the tool!
- For more information, consult the PESO manual.

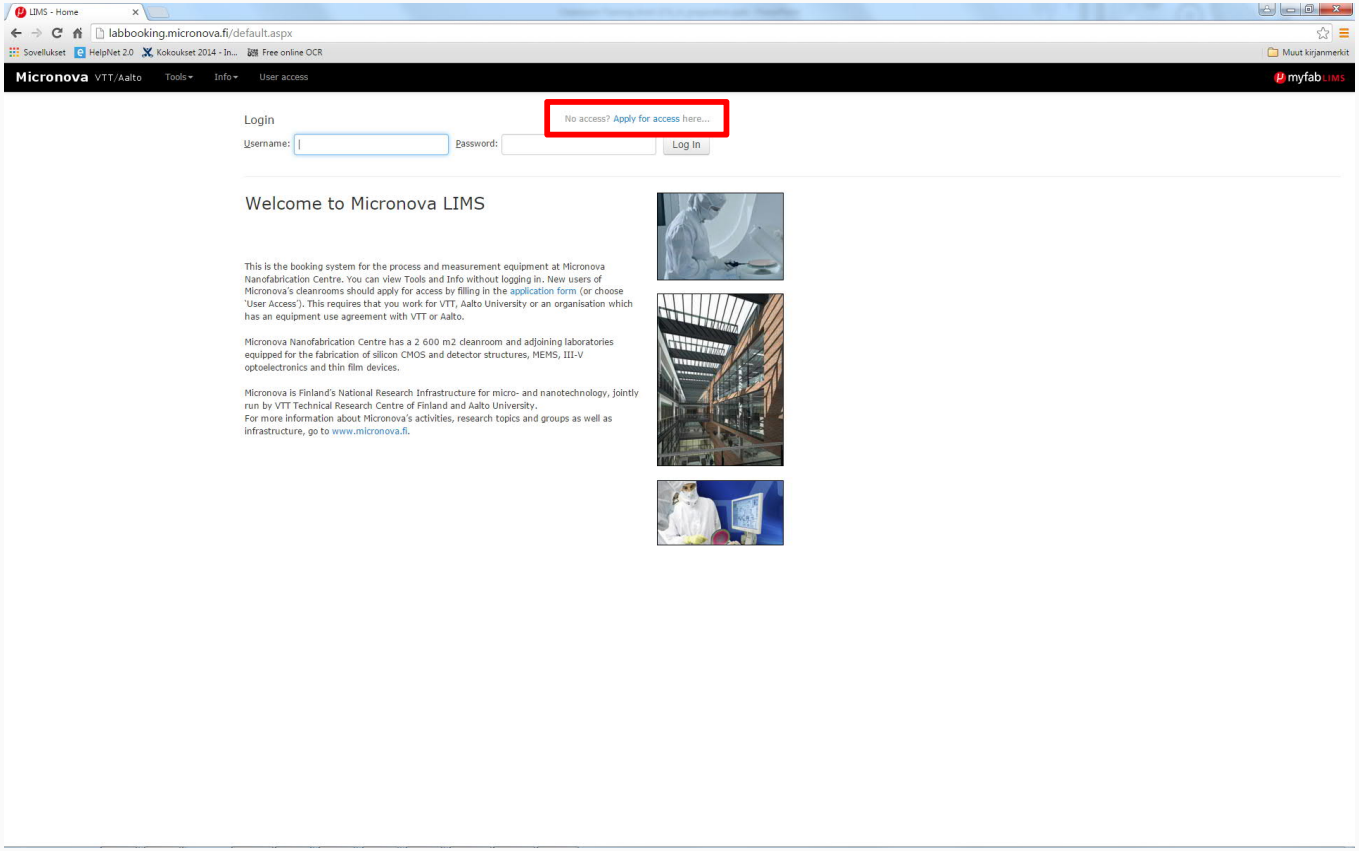




Booking System LIMS

- The equipment booking system is called LIMS.
- After the cleanroom user training – apply for a LIMS license
  - You will be granted the license after your process flow has been accepted
- You need a permission to use cleanroom equipment.
- You can apply for permissions through LIMS.
- The tool's Main User will give the user training and grant the permission.

http://Labbooking.micronova.fi



Remember Micronova in your publications

- Cleanroom is an expensive facility to maintain
- The university and it's schools pay a significant amount of the costs
- We need to make the results visible!
- Therefore it is important to mention Micronova (OtaNano, Nanofab) in the publications!
- Also remember to tag the infrastructure in ACRIS for your publications!

Aalto University

MICRONOVA
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Acknowledge Micronova in Your Publications!

Dear user of OtaNano - Micronova research infrastructure.

Your work at Micronova is heavily supported by Aalto University financially and through technical assistance. The existence of the expensive infrastructures must be constantly justified and the best way to do this is to show the results that our research infrastructure helps to generate. Therefore, *it is very important that Micronova is appropriately acknowledged in all your publications* that have benefited from Micronova's facilities. This applies to journal articles, presentations and theses.

Some form of attribution is required in the 'Acknowledgements' section of your publication. For publications without an 'Acknowledgements' section, the attribution should be made either as a footnote to the title, or included as a reference when the work is described in the 'Experimental' section.

Micronova is part of OtaNano Research Infrastructure (www.otanano.fi) and thus the words "**Micronova**" and "**OtaNano**" should always be included, but otherwise you are welcome to use any acknowledgement that suits your preferences

To make it easier, here are some suggested examples of attribution:

- "We acknowledge the provision of facilities by Aalto University at OtaNano - Micronova Nanofabrication Centre."
- "We acknowledge the provision of facilities and technical support by Aalto University at OtaNano - Micronova Nanofabrication Centre."
- "This research was undertaken at the OtaNano - Micronova Nanofabrication Centre of Aalto University."
- "Part of the research was performed at the OtaNano - Micronova Nanofabrication Centre of Aalto University."

When you have a paper accepted for publication, please do let me know by e-mail (mika.koskenvuori@aalto.fi) with a link or a copy of your paper. I'll be pleased to add it to our growing archive, and also use it in our own presentations as an example of successful research at Micronova.

Mika Koskenvuori / Aalto Nanofab

Handling of Chemicals

General Advice

Before you can start handling chemicals:

• You must attend our “Chemical Training” course to learn the correct ways of handling chemicals!

CLEANROOM BUDDY

•For safety reasons, after office hours (7:00 – 17:00) and during weekends it is forbidden to work alone with chemicals that require full protection.

• You must have another operator (“Cleanroom Buddy”) working in the cleanroom at the same time. The name of the buddy must be noted in PESO.

MSDS – Material Safety Data Sheet

MSDS (also called Material Safety Data Sheet, MSDS) are a widely used documents for cataloguing information on chemical compounds, and chemical mixtures. MSDS information may include instructions for the safe use and potential hazards associated with a particular material:

- Procedures for handling or working with that substance in a safe manner.
- Physical data (melting point, boiling point, flash point, etc.).
- Toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill handling procedures.

You can find the MSDS files from LIMS but they must be available also during power failures
→ paper copies are available next to the cleanroom entrance.

Additional Information

Micronova's cleanroom is a complex environment with over 250 users, 30 supporting staff and over 330 equipment listed on LIMS.

It will take time for you to learn most of what you need.
Your knowledge will never be complete as changes happen continuously.

Here are some useful sources of additional information:

- Micronova Nanofab Cleanroom Guide:

  Cleanroom operation and safety information, updated annually.

- LIMS:

  Documentation: manuals, MSDS, etc.

- Display outside cleanroom entrance:

  Current information.

- Main Users and Nanofab's personnel are glad to help. Just ask.

Welcome to work in the Micronova Cleanroom!

Aalto Nanofab

MICRONOVA

Centre for Micro and Nanotechnology

Aalto University