

DTU



Agenda for TechForum 2021#3

- **Nanolab management changes**
- **Courses and lab access**
- **Lab expansions**
- **Facility closures and project updates**
- **Decommissioning of equipment**
- **Changes in AZ resist**
- **New equipment**

Near miss incident

- Accident with aggressive chemicals caused a near miss incident last week
- Primary cause for incident
 - Used existing chemical bath for cleaning wafer
 - Topped up with more chemicals
 - Did not mix solution before or after adding chemical
- Result:
 - Violent chemical reaction of chemicals with overflow and spill of aggressive chemicals
- Increased severity because the user was not wearing Personal Protection Equipment (PPE)
 - No chemical gloves
 - No chemical apron
 - No chemical face shield
 - Cleanroom goggles was on top of head



Restructuring of Nanolab's management group

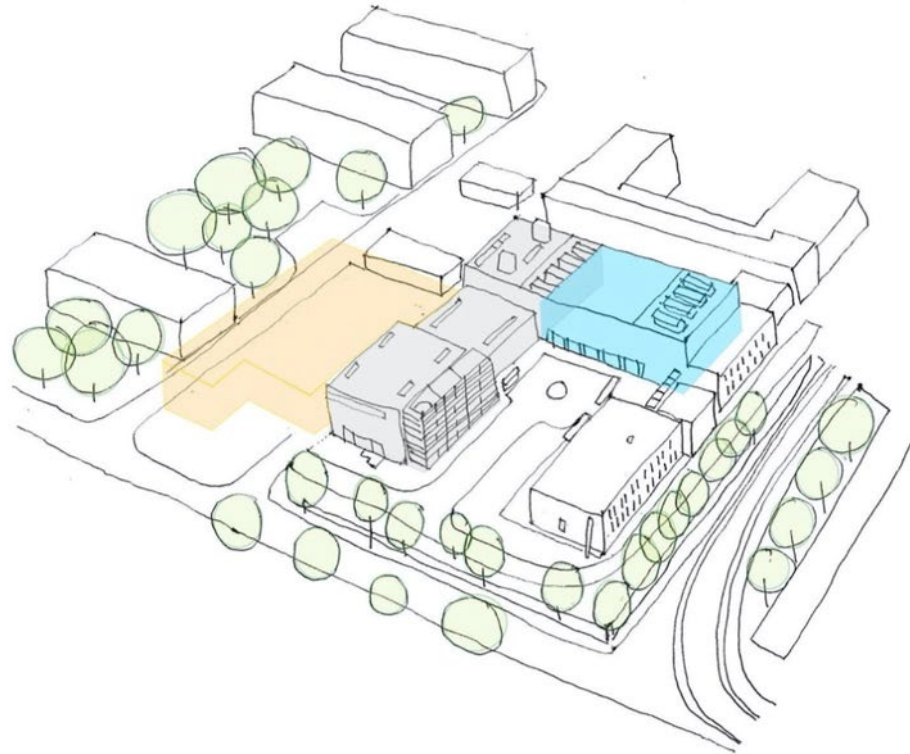
Scientific Management Group

- Rafael Taboryski (section leader Fabrication)
- Jakob Wagner (section leader Characterization)
- Anders Jørgensen (Deputy Director and Master of Coin)
- Jörg Hübner (Director of the Realm)

Operations Management Group

- Karen Birkelund (Head of Litho and WetChem)
- Mette Noer (Head of Administration and PA for Jörg)
- Jesper Hanberg (Head of Fabrication Support)
- Leif Johansen (Head of Operations)
- Flemming Jensen (Head of Process Engineering)
- Anders Jørgensen (Deputy Director and Master of Coin)
- Thøger Eskildsen (Manager Systems and Quality)
- Jörg Hübner (Director of the Realm)

Cleanroom Expansion bldg 346 A and bldg 313 - an update

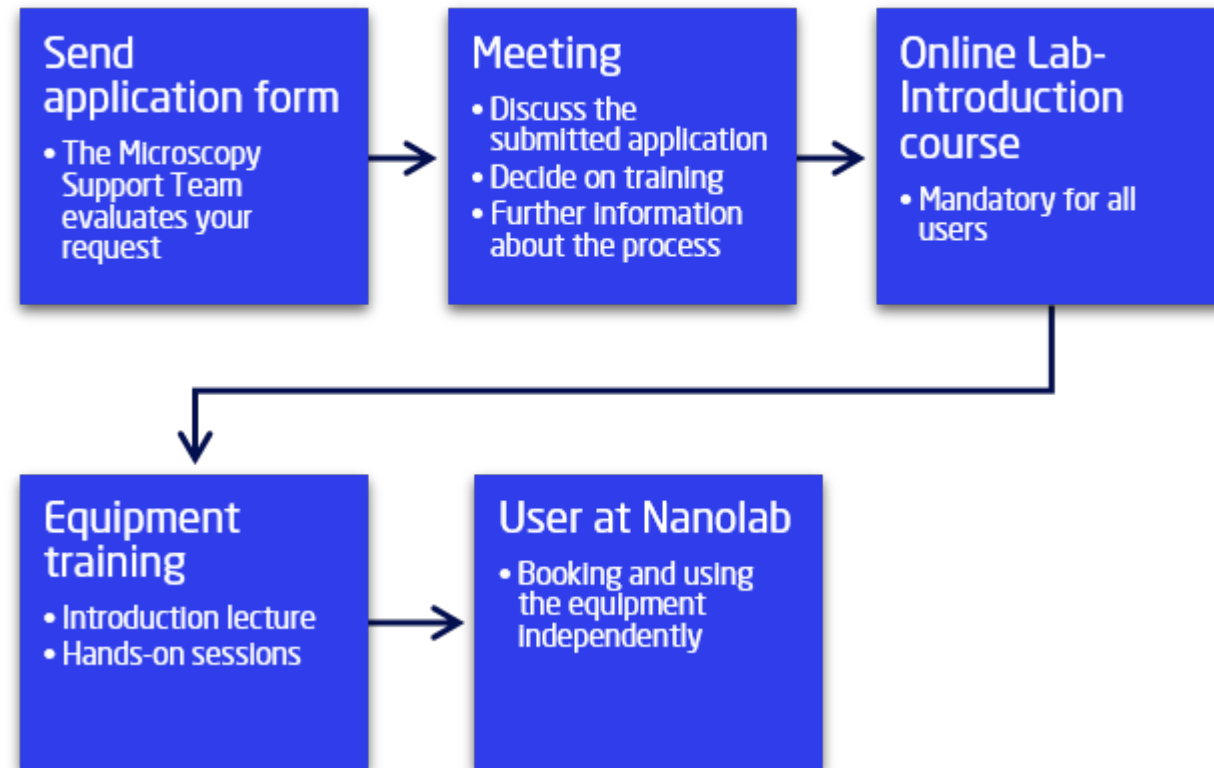


COURSES AND LAB ACCESS

Waiting time to get access to characterization

- Bottlenecks
 - DTU Learn Safety course (user should pass before continue)
 - SEM TPT
 - Mutual availability of trainer, trainee, and instrument

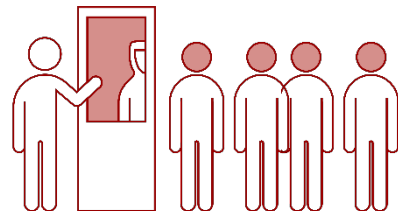
- Application process





Waiting time to get access to Cleanroom

- **Reasons for bottleneck**
 - High demand
 - Until mid August only two participants was allowed due to Corona
 - Master Course
 - FFU install
- **Cure:**
 - Groups with three participants
 - Extra sessions
 - Increase staff for hands-on sessions



Dato	tid	comment
to 02-09-2021	9-11:30	
on 08-09-2021	9-11:30	extra
on 08-09-2021	13-15:30	extra
to 09-09-2021	9-11:30	
ti 14-09-2021	9-11:30	
on 15-09-2021	9-11:30	extra
to 23-09-2021	9-11:30	
ti 28-09-2021		Cancelled (FFU)
to 07-10-2021		Cancelled (FFU)
ti 12-10-2021	9-11:30	full
to 14-10-2021	9-11:30	full
ti 19-10-2021	9-11:30	1 seat free
to 28-10-2021	9-11:30	3 seats free

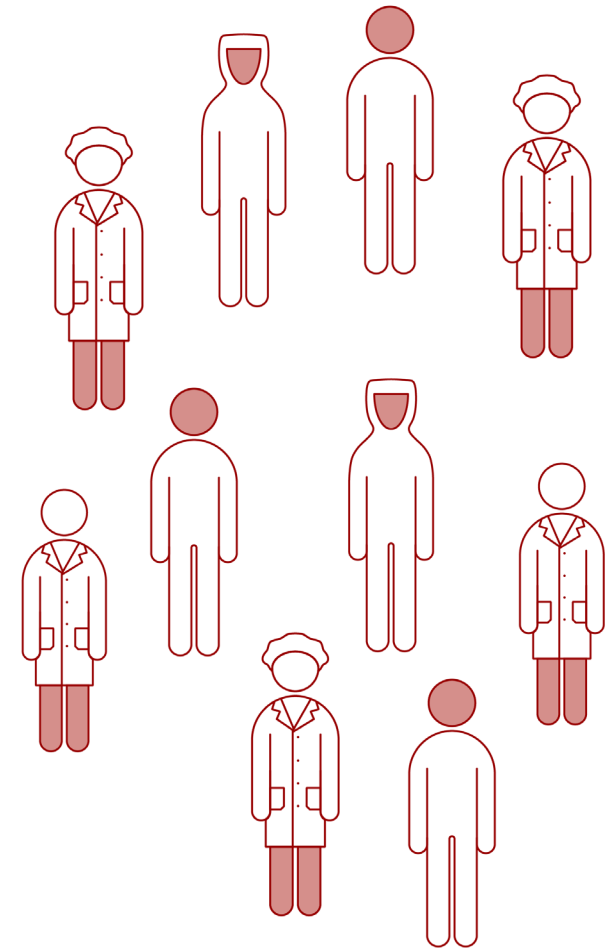
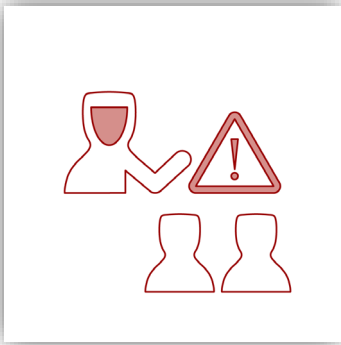
Waiting time to get access to “other facilities”

- **Reasons for bottleneck**

- Introduced mandatory safety course to get access to “other facilities” including basement 346 with SEM supra 1
- Moved Tabletop SEM to Packlab
- Hands-on for Packlab
- Moved on-line part to DTU Learn
 - Errors in the setup caused increased response time

- **Cure**

- All with access to cleanroom is now authorized to use basement 346 too
- Trainers for tools in Packlab can all give hands-on
- Errors in DTU Learn setup fixed



Customer survey highlights

Survey from June 2021

- Cleanroom:

Date	Average score	Individual categories					
		Availability of equipment	Performance of equipment	Cleanroom Conditions	Overall satisfaction with DTU Nanolab	Staff Helpfulness	Timely and Relevant information level
June 2021 Survey	4,3	3,9	4,0	4,4	4,4	4,7	4,3
November 2019 Survey	4,3	3,7	3,9	4,6	4,2	4,8	4,2
May 2018 Survey	4,2	3,9	3,9	4,1	4,2	4,7	4,2
November 2017 Survey	4,1	3,7	3,8	4,5	4,0	4,3	4,1

- Answers from **42%** of users receiving the mail - Good!
- Continued high score – Thank you!
- User comments with answers – find details on LabAdviser:
http://labadviser.nanolab.dtu.dk/index.php/Surveys_and_statistics

Customer survey highlights (cont'd)

- **Microscopy:**

Område	Availability on equipment	Performance of equipment	Microscope environment	Staff helpfulness	Timely and relevant information level	Overall satisfaction with DTU Nanolab	average
Score	4,26	4,31	4,36	4,7	4,31	4,36	4,38

- Answers from **61%** of users receiving the mail - Fantastic!
- Continued high score – Thank you!

Safety courses on the DTU LEARN platform

- DTU Nanolab Introductory Course: Cleanroom
 - DTU Nanolab Introductory Course for 3 week students: Cleanroom
 - Lab-Intro course DTU Nanolab (NOT Cleanroom)
-
- Request access on our homepage:

Cleanroom based
Fabrication - ISO 9001



Advanced
characterization

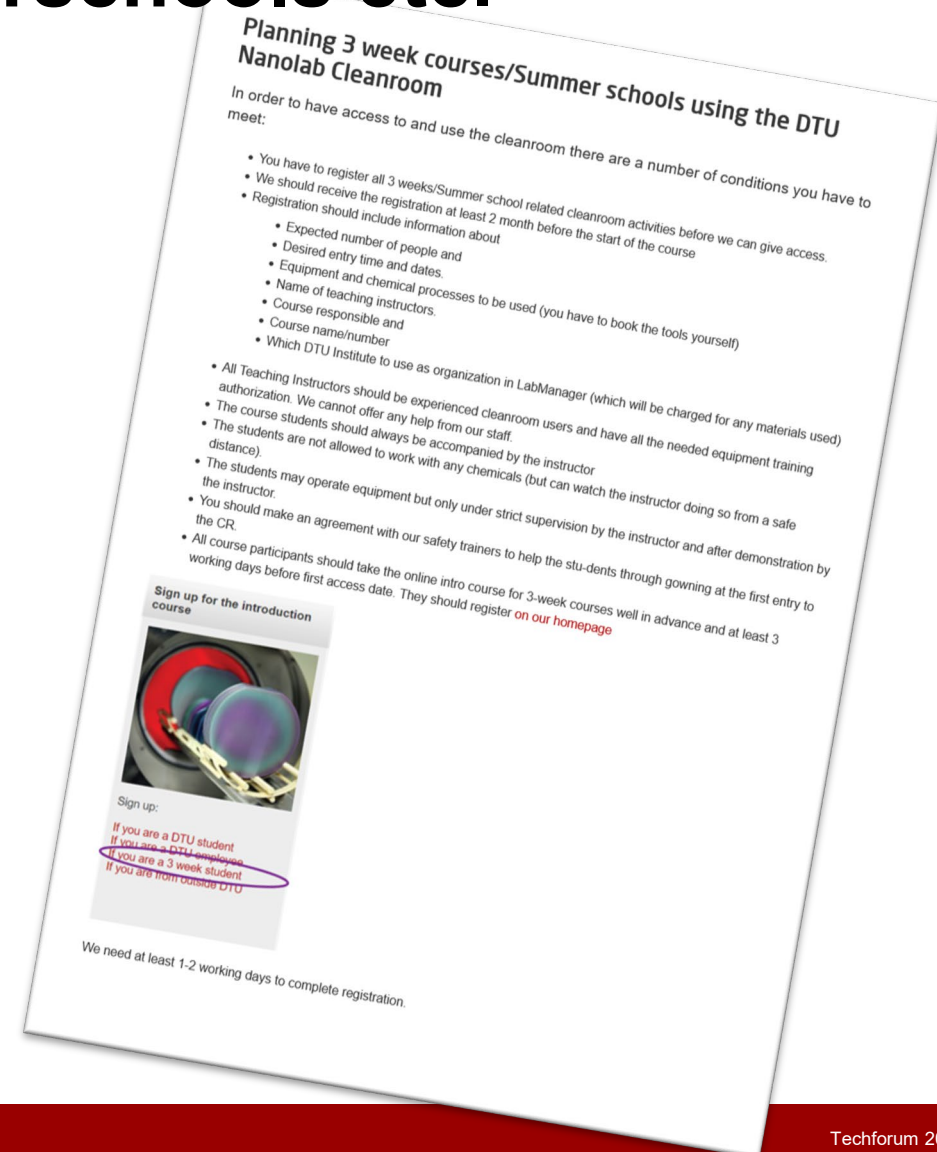


Other Nanolab facilities
and equipments



3-weeks courses, summerschools etc.

- Plan in good time (two months ahead)
- Follow the guidelines given in
 - <https://www.nanolab.dtu.dk/About-DTU-Nanolab/FAQ/3weekCourse>
 - (Nanolab homepage > About > FAQ)
- Please spread this information to colleagues and “Institutstudienævn“
- If you are late consequence may be that we deny access due to:
 - No room in gowning or CR for students
 - Machines not available
 - No time for registration or proper introduction of students
 - ...





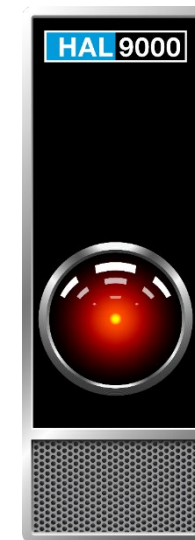
Biometric Access to Labs

Biometric access is on hold awaiting policies from DTU's GDPR officer

Existing new card readers have migrated to DTU CAS' common access platform. Only card information will be stored.

The old User Gowning card reader will be changed when the CAS system works.

Responsible: Thøger thes@dtu.dk



Access card for company and other external users

- Guest cards now expires after 1 month
- We implement new NANOLAB USER cards valid for up to 1 year
- We have used NILT employees as test users
- Will continue with groups of ~20 users at a time when start issues are solved



LAB EXPANSIONS

Expansion of Cx1

- Expansion almost complete
- Planning of the future use of Cx1 now in progress



The PolyFabLab Vision

- Fill the gap between research labs and existing cleanroom facility.
- Maximise flexibility, accessibility and visibility.
- Showcase the processes to the world around us.
- Rapid exchange of various tabletop and stand-alone equipment.

Enable work within fields like:

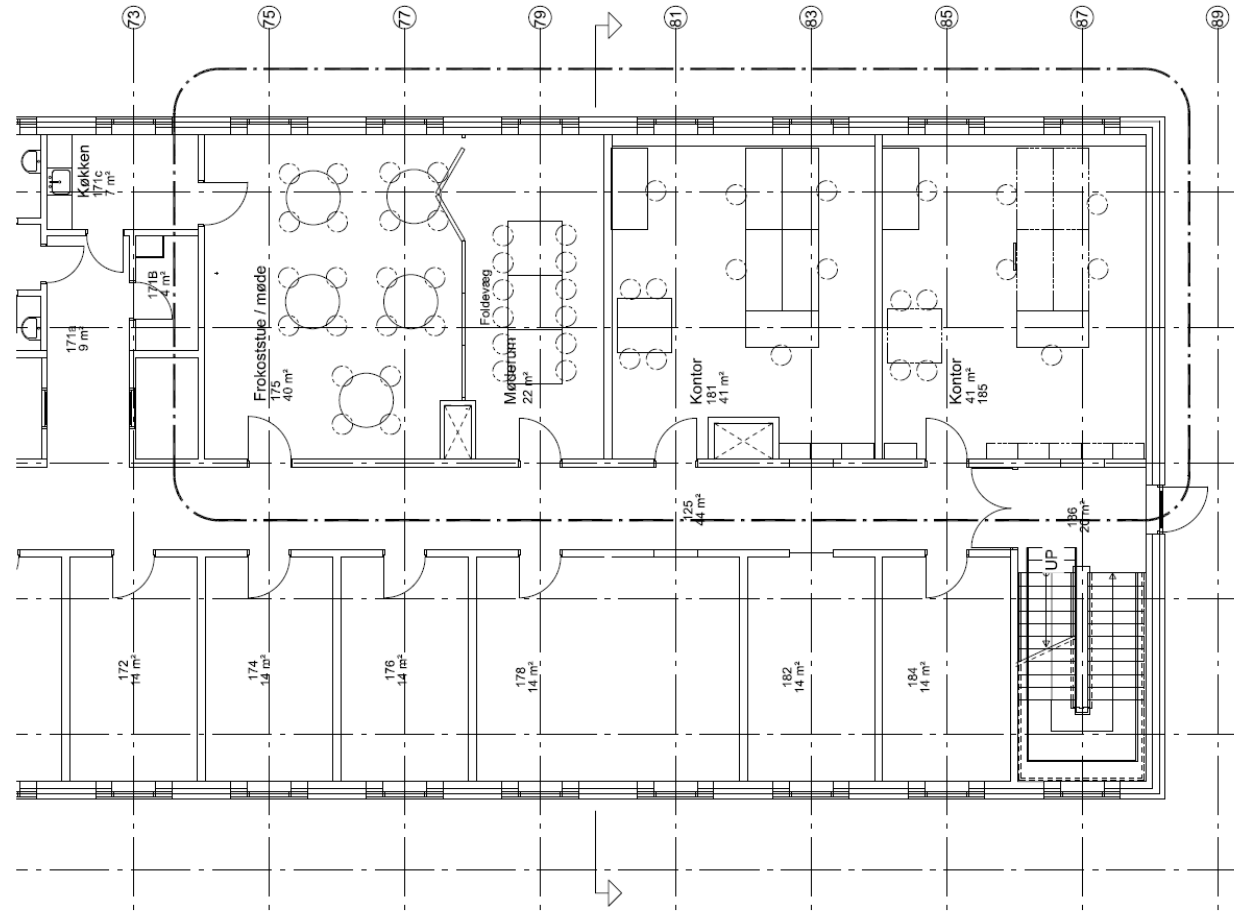
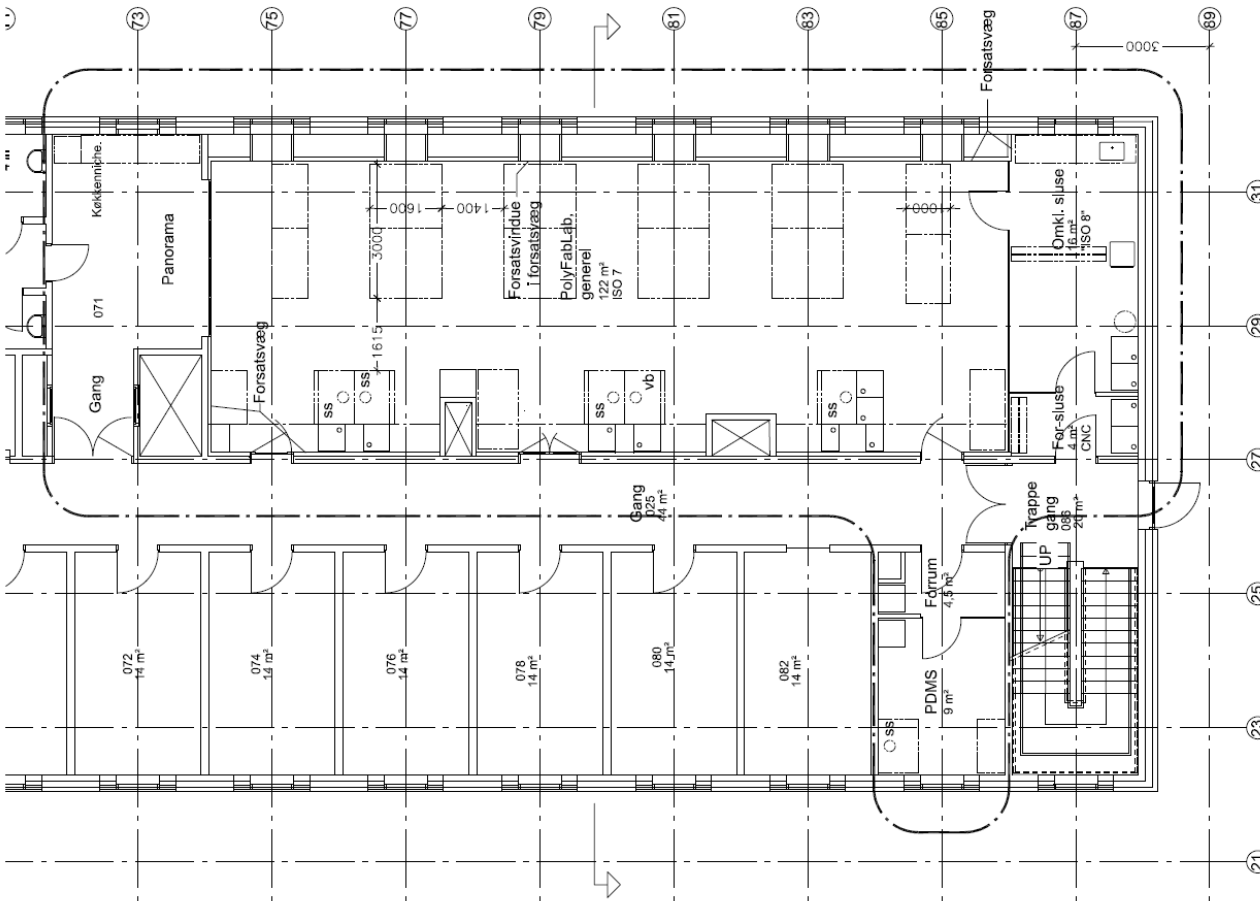
- Wirebonding.
- Polymer printing.
- Prototype equipment.
- Spin coating, UV exposure and development. (Photo lithography)
- Various wet chemistry work.
- PDMS work (Silicone based polymers)



Future layout

Ground floor: PolyFabLab (ISO 7)

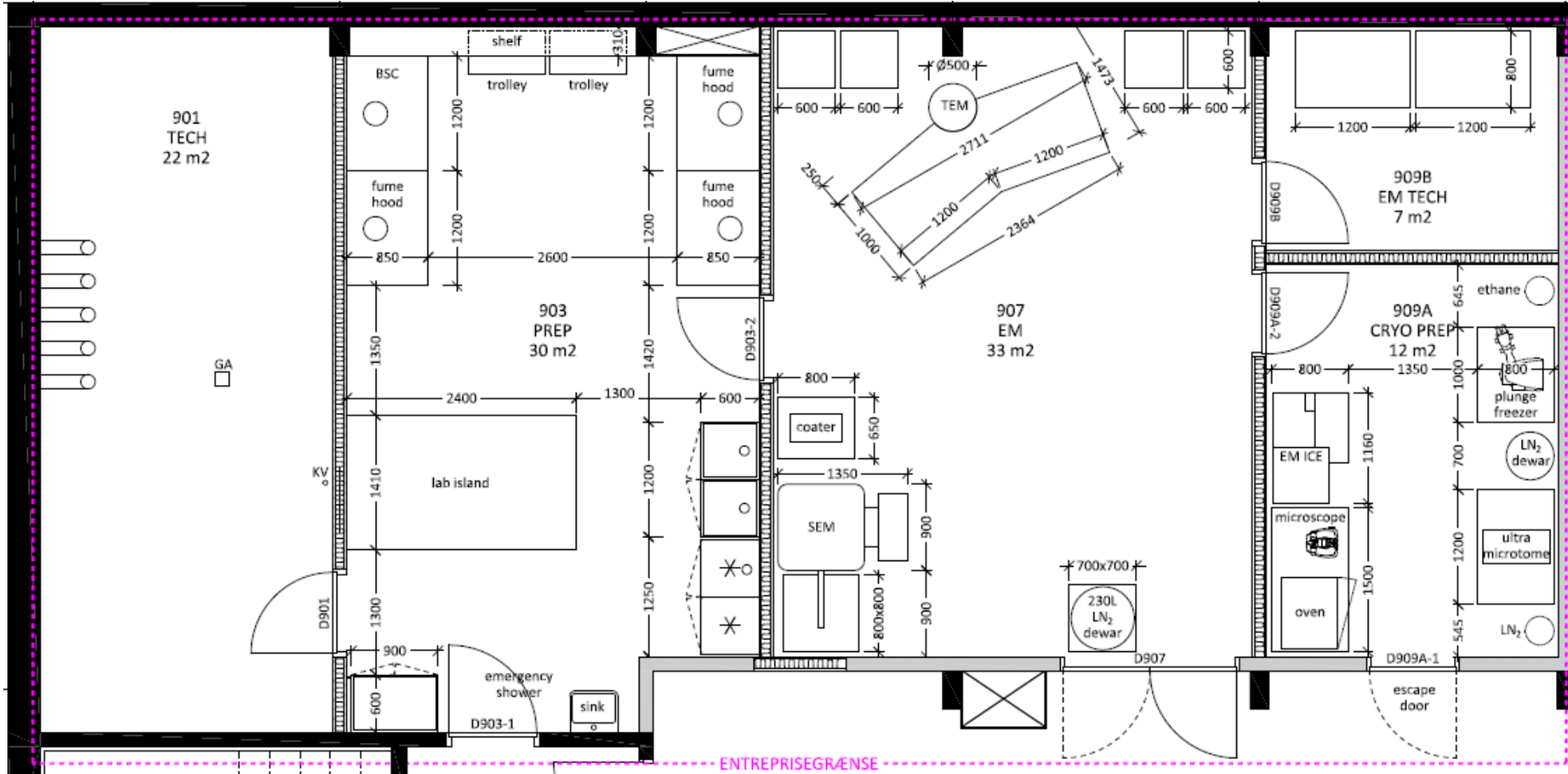
First floor: Office and meeting space



FACILITY CLOSURES AND PROJECT UPDATES

B307 basement Soft Matter Lab Sketch

- Soft Matter lab for:
 - Sample preparation
 - Cryo SEM and TEM
- Key requirements include:
 - Temperature stability 1°C P-P/24hrs
 - Low vibration levels
- Lab area >100m²



B307 basement Soft Matter Lab Sketch

- Soft Matter lab for:
 - Sample preparation
 - Cryo SEM and TEM
 - No Cell Growth
- Key requirements include:
 - Temperature stability
1°C P-P/24hrs
 - Low vibration levels
- Lab area >100m²



B307 basement Soft Matter Lab

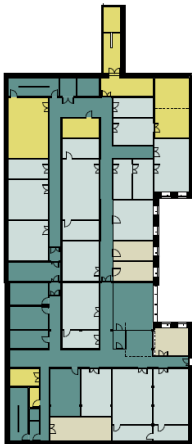
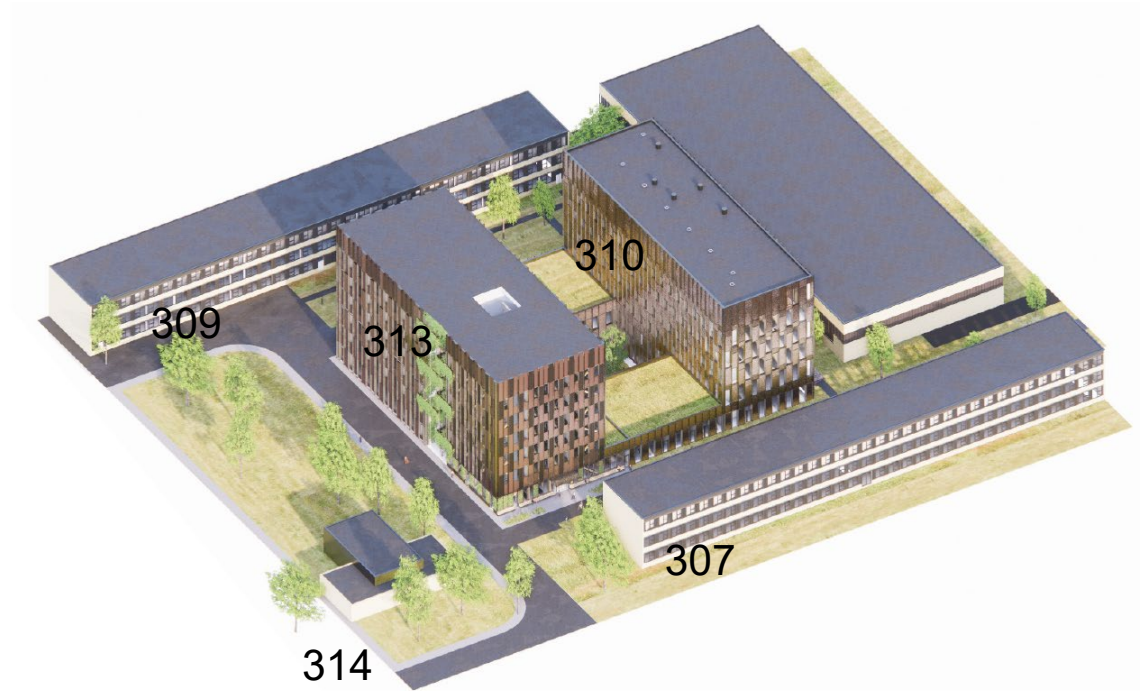
!!! B314 is CLOSED week 41 !!!

This shunt, which provides filtering, pressure and hammer control to the process water in B314, is in the way of our Soft Matter Lab expansion in B307 and will be relocated week 41



‘Climate Challenge Laboratory’ B313 update (JABW)

- Generic labs and offices
- Basement ready for sensitive instruments
- Building 313 is connected to 310
- Building site will occupy area between 307, 314, 309, and 310
- Building site from Nov. 1 2021 – Oct. 1 2023



Basement



Above ground

B346 UPS update

- Entire B346 will be protected against power glitches < 2 min
- Should minimize tool downtime

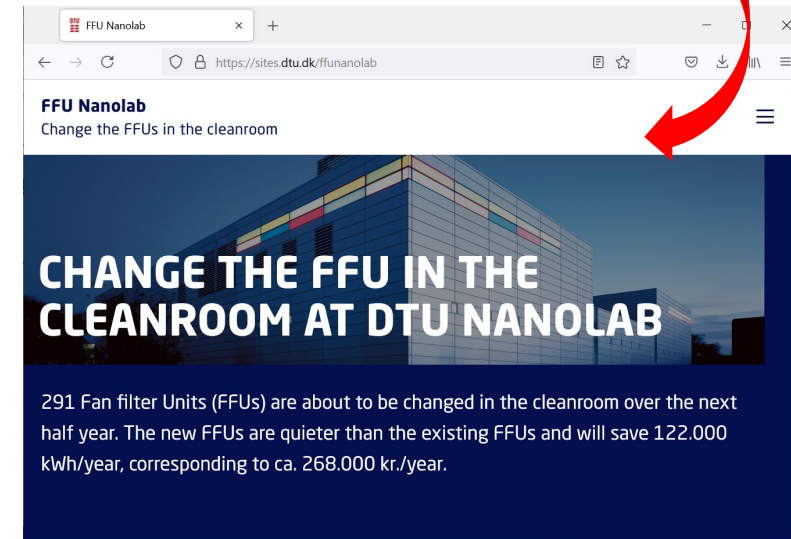
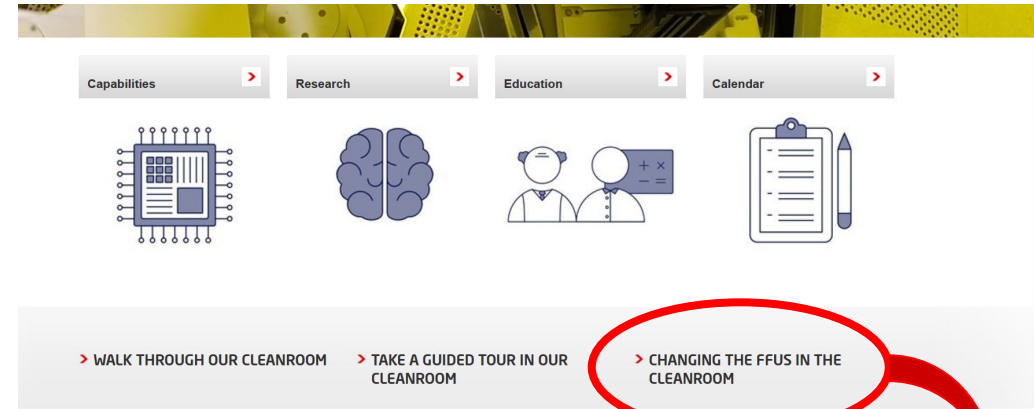
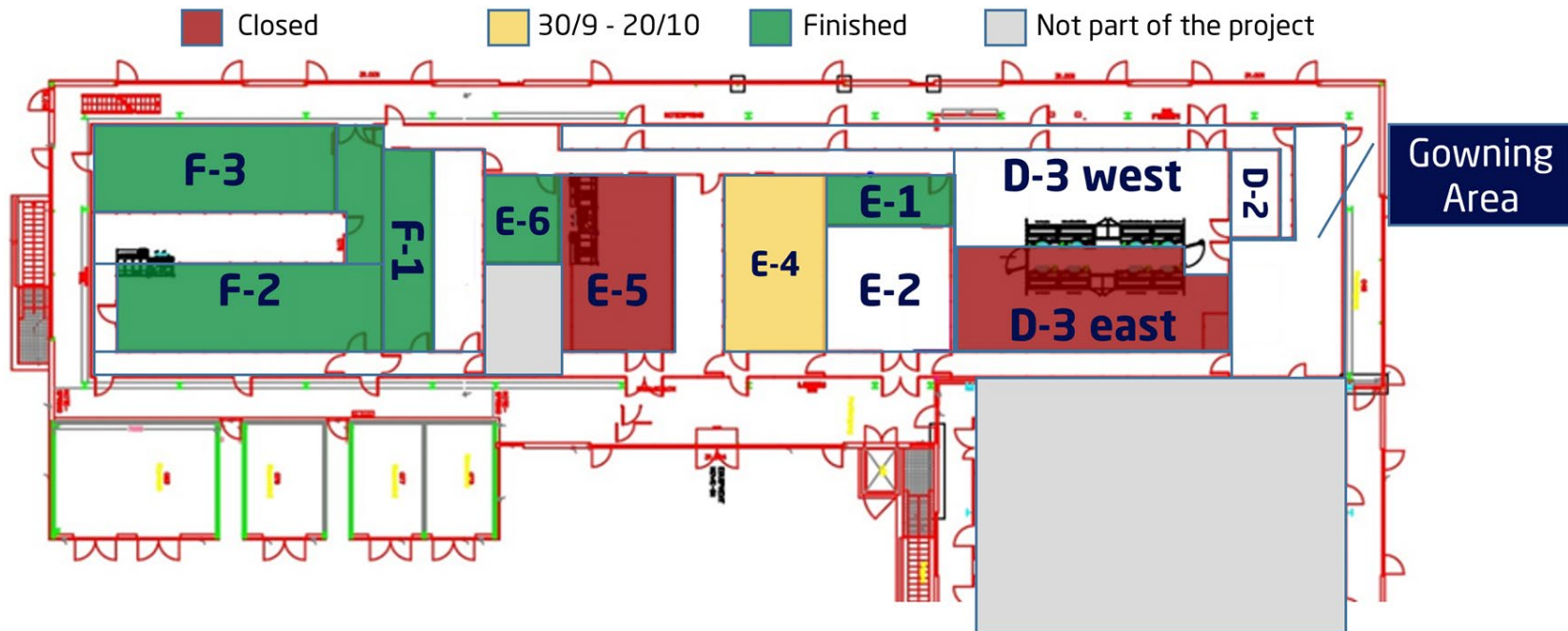
- Construction in progress
- Li-ion batteries will arrive late 2021
- Full protection from end December 2021



New UPS controller units + cooling unit

DTU FFU exchange (LESJO update)

- Progressing according to plan
- Finished rooms: Clean & low noise.
- September – October will be very painful
- Cleanroom closed two weekends for gowning FFU change
– 30-31 October + 6-7 November
- **See time schedule etc. at <https://sites.dtu.dk/ffunanolab>**



Shelves for user samples

- Too many inactive user samples on shelves
- More cleanroom users than before
- Out of shelf space
- FFU project is a good opportunity to clean up
- Everybody will get their personal shelf space
- Many users will be contacted soon



EQUIPMENT DECOMMISSION

Tools leaving the cleanroom

- Jipelec RTP (decommission after new Jipelec runs properly)
- C-1 fume hood
- Hardness tester (moves to basement)
- Tresky bonder in PackLab (cannot be repaired)



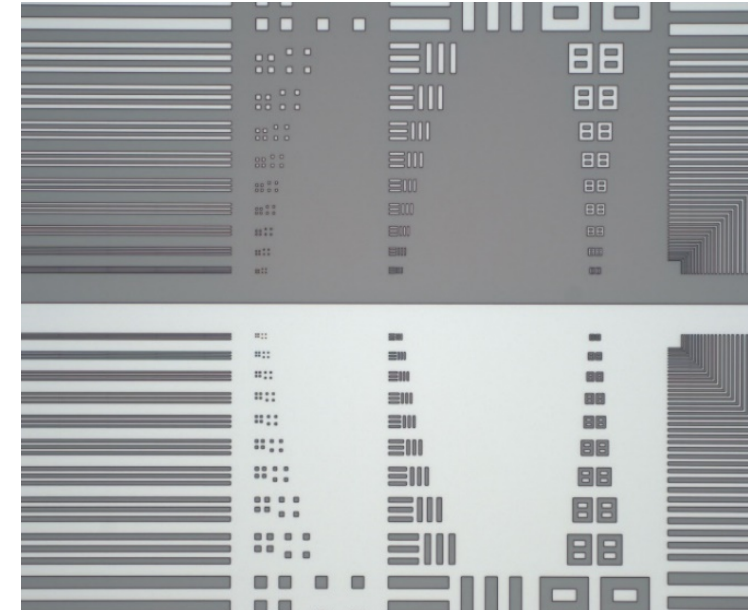
CHANGES IN AZ RESIST

Photoresist changes

- AZ resist production moves from Germany to Japan
 - AZ 5214E, AZ 4562, AZ MIR 701
- Merck: *"Performance is similar but not identical"*
- Nanolab will test:
 - Standard recipes on Gamma spinners
 - Dose-to-clear on aligners and Developer: TMAH UV-lithography (1.5 μ m, 10 μ m and 2.2 μ m image reversal)
- Status right now
 - *Spin Coater: Gamma e-beam & UV* has the **new** AZ resists.
 - *Spin Coater: Gamma & UV* has the **old** AZ 5214E as long stock last (approx 4-5 months)

Nanolab will not test:

Spin parameters on manual spinners
Dose-to-clear for other thicknesses
Etch selectivity etc.



Please test your processes before it is too late

NEW EQUIPMENT

Standard RTP system: Jipelec JetFirst 200C

Purpose/specs:

Replacing current Jipelec system

- Cold-wall system (water cooled stainless steel)
- Temp range: ambient to 1000 C (1200 C for 1 min)
- Temperature control: TC & Pyrometer
- 3 gas lines (MFCs) + purge line
- Dry pump (nXDS6i scroll)



- **“Fixed” susceptor** set-up: Better temp-control (TC)
BUT restrictions (gas flow and max temp)
- Contact us (thinfilm@nanolab.dtu.dk) for new processes
- All processes (old RTP) since January 2021 transferred => old RTP is leaving

CRAIC MSP 20/30 PV, advanced optical measurements



Selected features

MSP (MicroSpectroPhotometer)

Reflection/transmission/absorbance/polarization measurement

Wavelength range: 200 nm to 1700 nm

Minimum aperture size: 1.5 μm by 1.5 μm

Calibrated system with standards

Colormetric/mapping functions

Possibility for Raman/fluorescence/photoluminescence add-on

Please write to Thin Film (thinfilm@nanolab.dtu.dk) / Bingdong Chang bincha@dtu.dk (Postdoc) for questions

High Vacuum RTP-system for sidewall smoothing

ANNEALSYS: AS-Premium

Purpose/specs:

Sidewall smoothing after DRIE nano etching

- high vacuum (10^{-6} mbar base press)
- ultra-clean (load-lock)
- cold-wall chamber technology
- up to 1200 C

Configuration:

- turbo/dry scroll pumps (chamber + load-lock)
- 4 process gas lines
- water-cooled stainless steel chamber
- up to 1200 C (max rate 100 C/s)



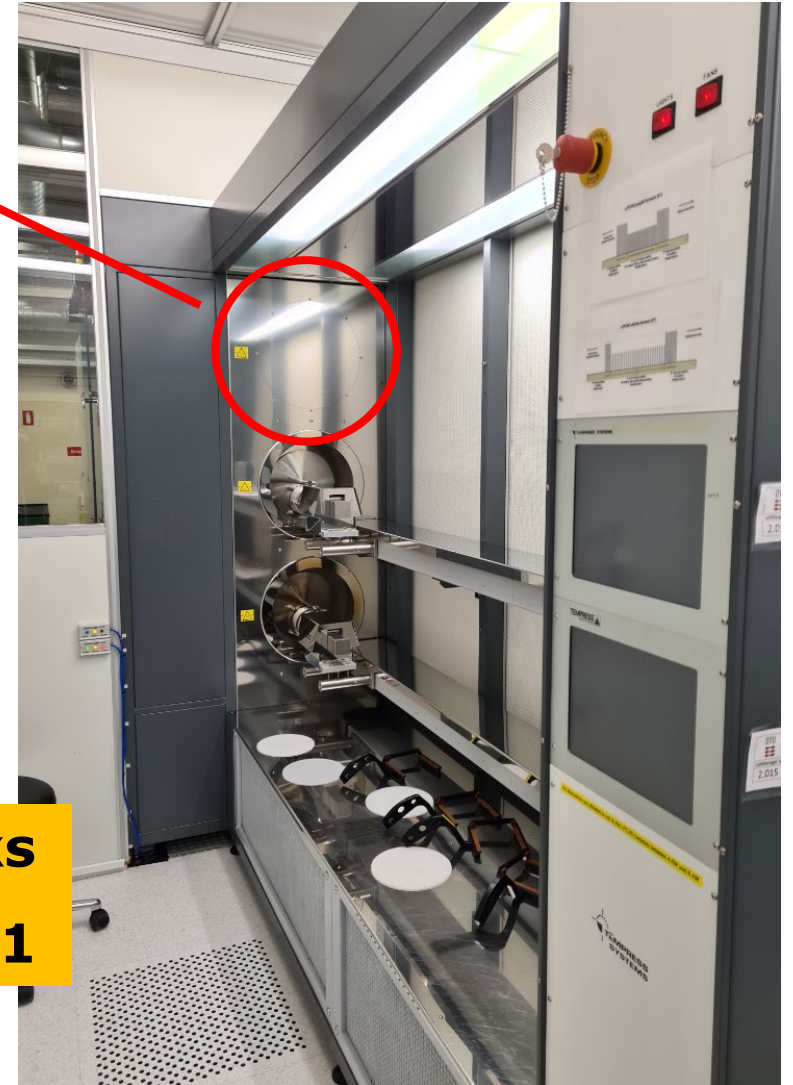
Re-built: New version
- to be installed/tested week 43

200 mm Oxidation Furnace – retrofit

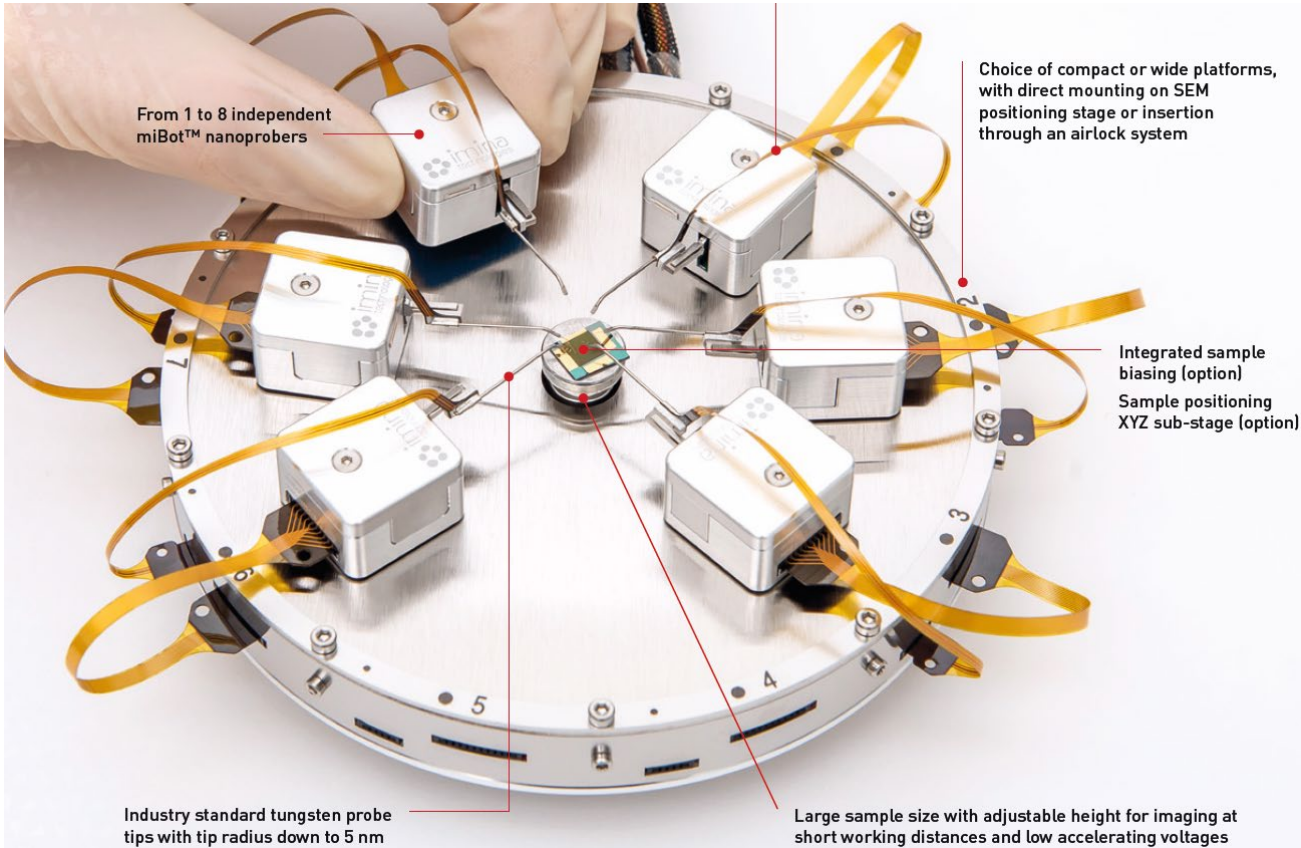
Purpose:

- Furnace tube for 200/150/100 mm dry-wet oxidation
- Retrofit in E-stack (one vacant slot)
- Process specs & qualification included (dry & wet)
- Expected ready Q1-2022

Will be **built on-site** (Nanolab): **1 November + 2 weeks**
LPCVD Nitride (6") / Poly-Si (6") **out-of-use 1/11-14/11**



miBots - Nanoprobng system (SEM integrated)



Shared investment: DTU Fotonik & Nanolab

- Compact 4 degrees of freedom robot



Selected features:

- platform for SEM-install (quick exchange)
- highly flexible miBot set-up (# and placement)
- 4 miBots: 2x electrical probes, 2x optical fibres
- tunable laser (1500-1630 nm)
- optical spectrum analyzer



Dicing saw

- Dicer Disco DAD 3241
 - for wafers up to 200 mm
 - Silicon, Glass/quartz, ...
 - Touch screen interface
 - Many advanced features but easy to work with
- Wafer cleaner Disco DCS 1441 (cleaning after dicing)
 - High pressure and Atomizing Nozzle water cleaning
- Various accessories
 - Tape mounter
 - UV tape release
- Expected ready for use in Q3 2021
- Preparing user manuals



Thomas P and Disco technician Brian

Descum asher

Requirement

Controlled descum of resist



From Packlab -> Cleanroom

Diener Plasma asher Pico

Sample size: up to one 4" wafer
places horizontal in chamber

Gas 1: Oxygen

Gas 2: Argon

Plasma power: 0-100% (0-100Watt)

Process time: 0:01-99:59 minutes

New Plasma Asher

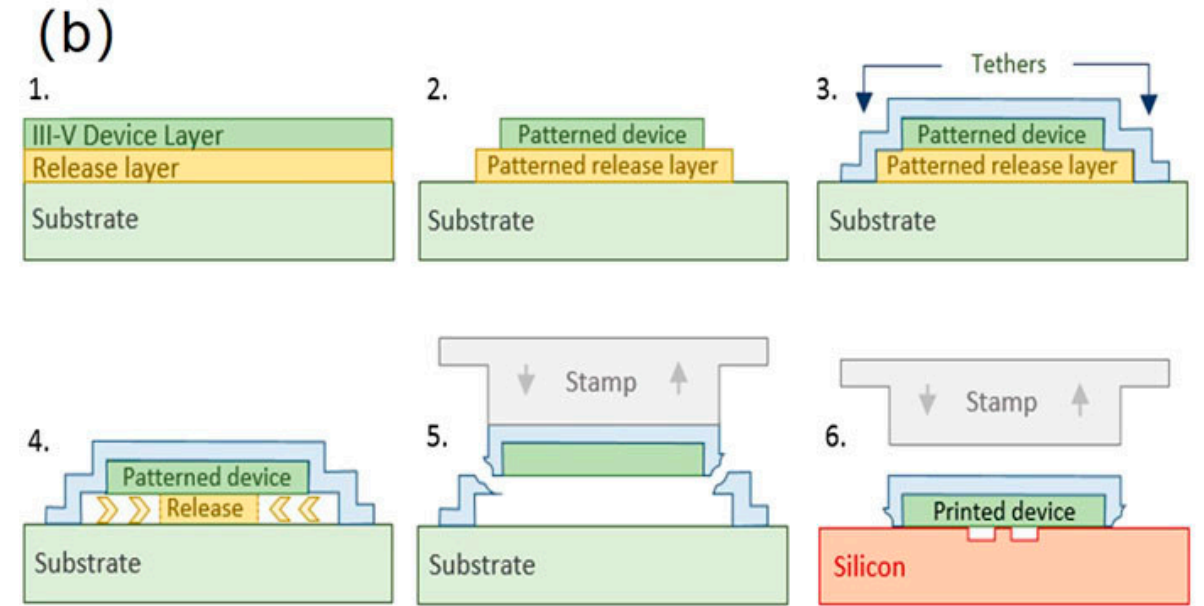
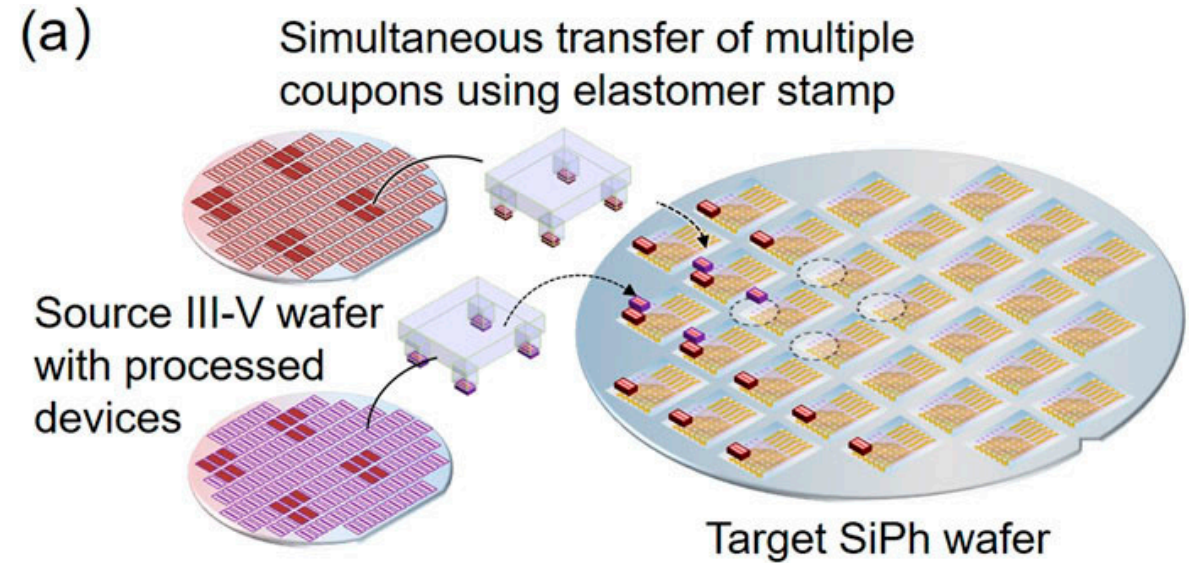
Controlled descum of resist



Sample size: up to one 6" wafer
places horizontal in chamber

μTransfer printing

- Aligned transfer of coupons from one wafer to another.
 - Accuracy like optical aligner.
 - Single more accurate than many.
- Good for moving expensive/incompatible material to larger wafers (silicon/glass etc)
 - Processed III-V semiconductors (or pieces).
 - Processed CMOS chips
 - LiNbO₃, c-Si, BaTiO₃, ???, ???
- Purchased in cooperation with DTU Photonics.



Raith e-Line e-beam writer moves to cleanroom

- Originally installed in B314
- Will be moved to cleanroom late 2021
- Expected operational early 2022
- An alternative to the JEOL 9500

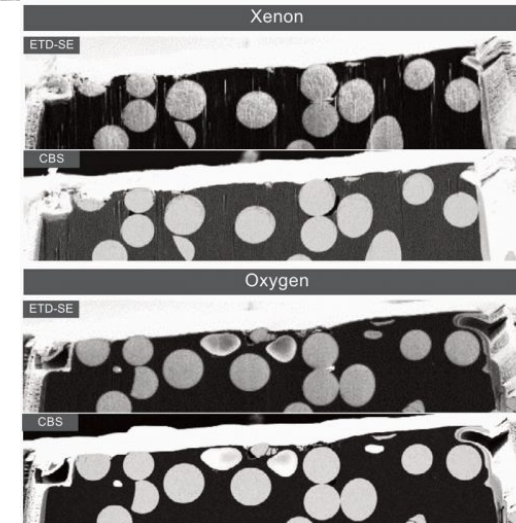
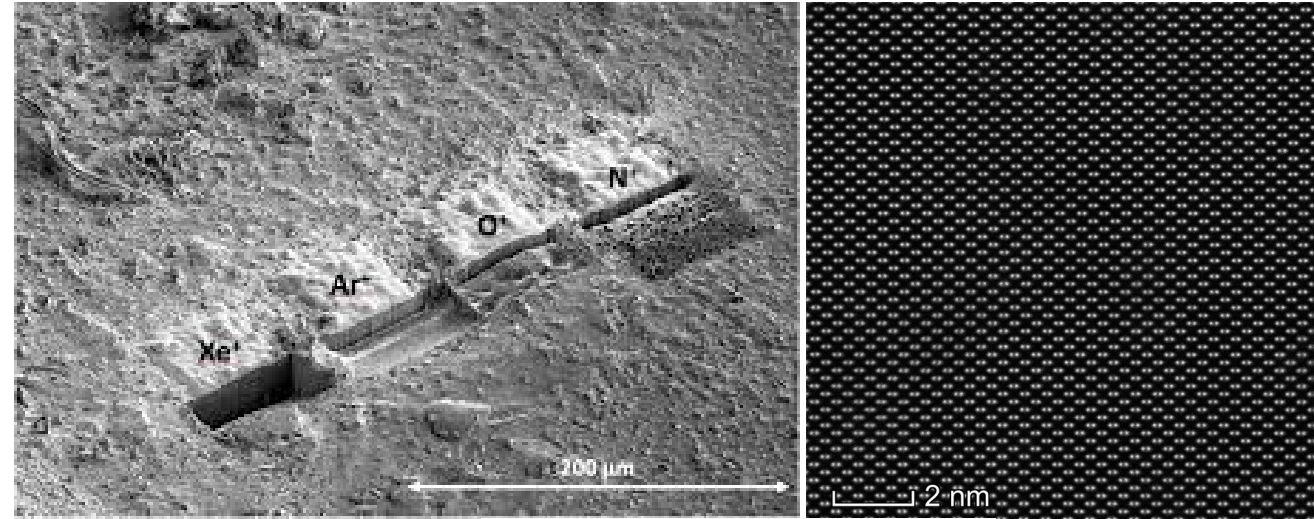


NEW Dual Beam Helios Hydra G5 (JABW/AFULL)

Purpose/specs:

Replacing current Helios G1

- Multi Gas Plasma FIB (Xe, N, O and Ar)
- Automated TEM Lamella Prep
- Automated Atom Probe Tomography
- Monochromated E Beam for sub nm resolution down down to 500eV



Status: Instrument installed SAT begins next week (expected release October 2021)

End of Presentation (JHUB)

- Several restructuring projects: soft matter lab, packlab
- **Major facility upgrades/replacements cause closures and inconveniences, FFU,**
- Slides will be available online at LabAdviser