
DTU

Agenda for TechForum 2023#1

- **Misc. Updates**
- **Energy Savings**
- **Lab expansions**
- **Facility projects and closures**
- **New equipment**

Impact of DTU's Economical Situation

- All DTU entities have been "asked" to improve their finances
- We are not able to provide same or better services across all technology areas with less resources

A decision was made not cut all things a bit but to look after actual usage and cut idle technology areas that only use resources (time, money, space)

Gone through numbers and usage logs in Labmanager

- Injection molding and electroplating took up more service hours than usage hours the last years
- We will discontinue to offer services regarding injection molding and electroplating
- We will try to find alternatives for those who have planned to use these technologies in the near future.
- We are working on moving the injection molder to DTU Construct, B427

It is strongly advised to consult us if you plan a major research initiative on technologies offered by Nanolab.

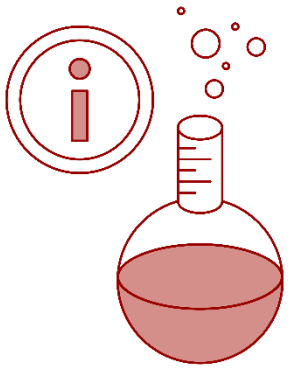
MISC. UPDATES

Bringing samples into the Cleanroom

- Please avoid!
  - Every sample taken in from the outside means increased risk of contamination of cleanroom or tools.
  - Samples just to be characterized will in general not be accepted

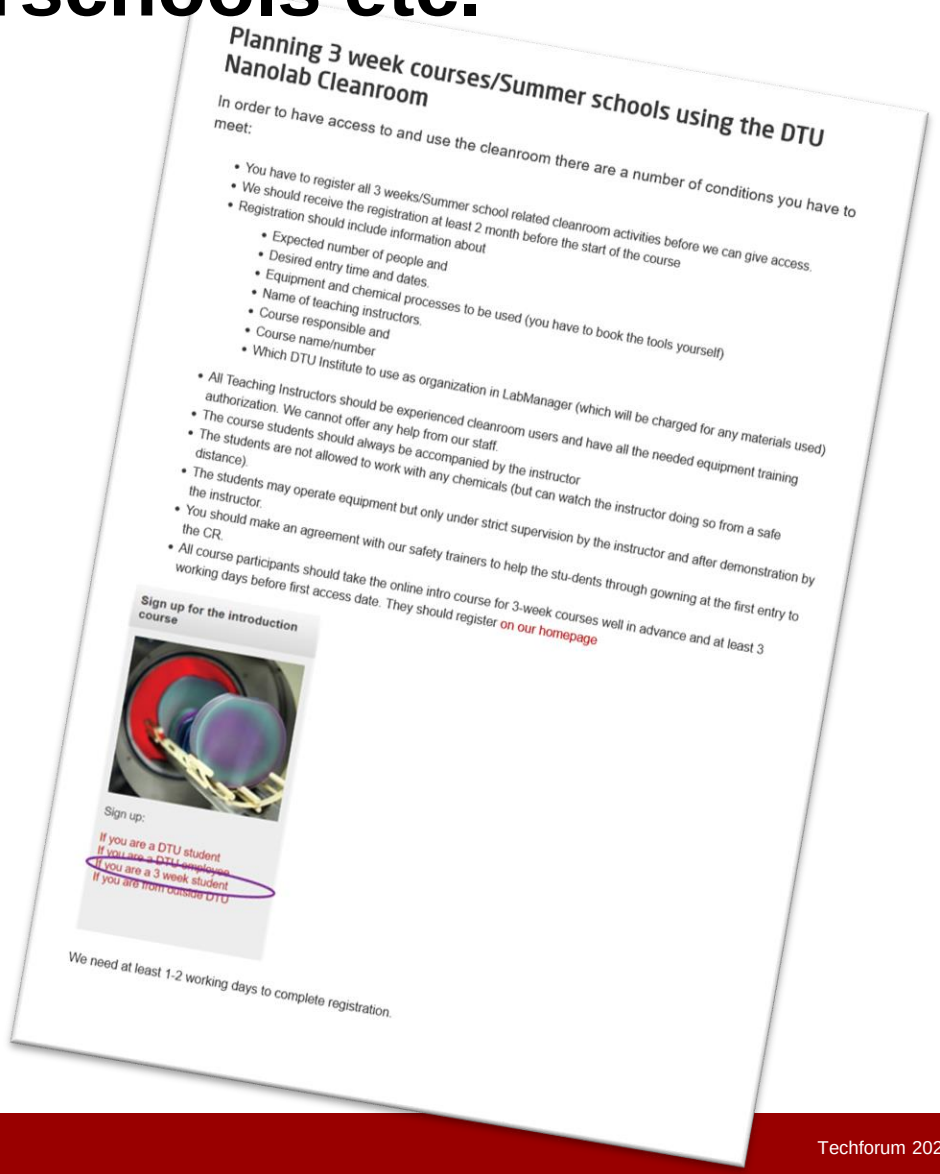
- Not previously approved materials/process:
  - write APV (find template in kemibrug)
  - in doubt ask Majken Becker

- Formalized procedure:
  - Get request form
    - find under “Cleaning Bench” in LabManager or send an e-mail to training@nanolab.dtu.dk
  - Fill in form, include process flow description and return to
    - training@nanolab.dtu.dk or
    - jehan@dtu.dk
  - Wait for reply



3-weeks courses, summerschools etc.

- Plan in good time - NOW!
- Follow the guidelines given in
  - https://www.nanolab.dtu.dk/About-DTU-Nanolab/FAQ/3weekCourse
- Please spread this information to colleagues and “Institutstudienævn“



Planning 3 week courses/Summer schools using the DTU Nanolab Cleanroom

In order to have access to and use the cleanroom there are a number of conditions you have to meet:

- You have to register all 3 weeks/Summer school related cleanroom activities before we can give access.
- We should receive the registration at least 2 month before the start of the course
- Registration should include information about
  - Expected number of people and
  - Desired entry time and dates.
  - Equipment and chemical processes to be used (you have to book the tools yourself)
  - Name of teaching instructors.
  - Course responsible and
  - Course name/number
  - Which DTU Institute to use as organization in LabManager (which will be charged for any materials used)
- All Teaching Instructors should be experienced cleanroom users and have all the needed equipment training authorization. We cannot offer any help from our staff.
- The course students should always be accompanied by the instructor
- The students are not allowed to work with any chemicals (but can watch the instructor doing so from a safe distance).
- The students may operate equipment but only under strict supervision by the instructor and after demonstration by the instructor.
- You should make an agreement with our safety trainers to help the stu-dents through gowning at the first entry to the CR.
- All course participants should take the online intro course for 3-week courses well in advance and at least 3 working days before first access date. They should register on our homepage

Sign up for the introduction course

Sign up:

If you are a DTU student
If you are a DTU employee
If you are a 3 week student
If you are from outside DTU

We need at least 1-2 working days to complete registration.

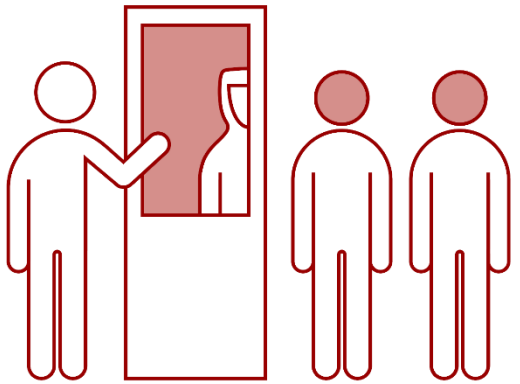
Nanolab temporary moving out of building 347

Moving out to give room for establishing the PolyFabLab.

- Packlab closed
  - Ball bonder, Tabletop SEM and Dektak 150 will move to building 451 room 913
  - Other equipment in storage

- Computers for E-beam and Stepper lithography preparation:
  - Now located in building 346 room 055 ground floor

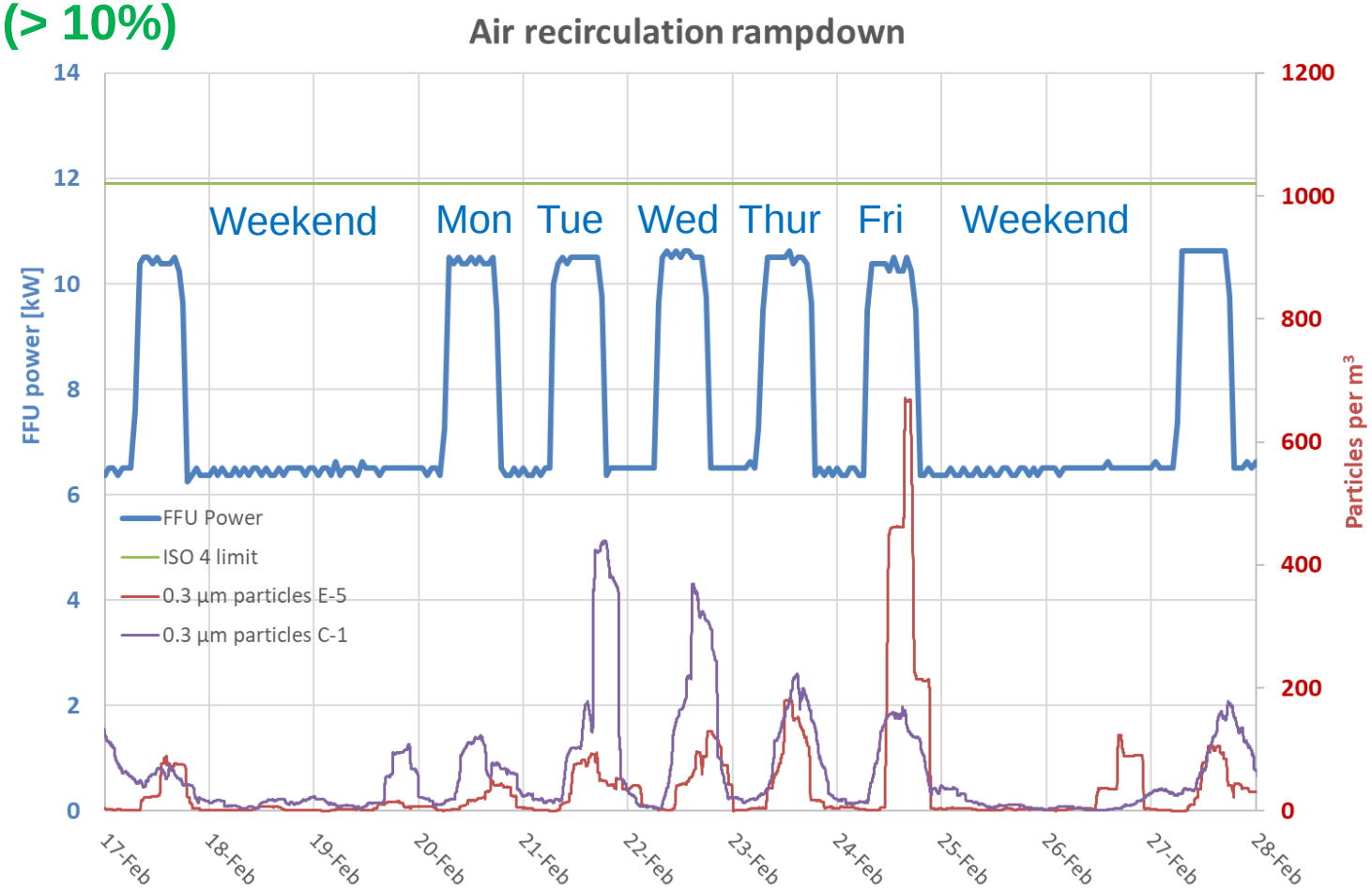
- People:
  - Detailed information will be found at the end of this presentation



ENERGY SAVINGS

Implemented energy savings - facility

- **Implemented savings: > 400.000 kWh/yr (> 10%)**
- Cleanroom light
  - From fluorescent to LED light
  - Switch off LED light when no one inside
  - Intelligent power-up via PIR sensors
- Old cleanroom (sections A, B and C)
  - Reduced air recirc. 18:00 to 06:00 + weekends
  - Better control of room overpressure (15-25 Pa)
- New cleanroom (sections D, E and F)
  - Ramp FFUs from 35% to 30% (507 to 435 rpm)
  - 18:00 to 06:00 + weekends
  - E-beam room and stepper not affected
- Measured impact:
  - Particles appear not a big issue
  - Room temperature on target
  - Air flow change has impacted one sensitive tool



Energy Savings – Equipment (so far)

Furnaces (power + nitrogen savings)

Standby Temperature reduced from 700 to 400 °C:

A1 (B-Drive), A2 (Gate), A3 (P-Drive), C3 (Anneal-Bond)

Pumps (power + nitrogen savings)

Loadlock pumps turned off when not in use: **Metal-ICP, III-V ICP**

Chillers (power + nitrogen savings)

Stand-by temp @ 20 °C - reduce both power and nitrogen consumption: **AOE**

Low-use systems turned off (power + nitrogen savings)

Request turn-on or get trained: **III-V RIE, Thermal Evaporator**

more to come…

LAB EXPANSIONS

PolyFabLab in B347:

DTU – LLYN.347

Indretning af nyt PolyFabLab samt kontor, møde- og køkkenfaciliteter

Udarbejdet af H+ A/S | MOE A/S | CHRISTOPHER PERRY

PolyFabLab (B347) time line – very loose

- 8 March 2023: People move out (see next slides for new office locations)
- 13 & 15 March: Packlab moves (partially) to B451. Some tools warehoused.
- 17 March: Beamer, Prolith servers will have moved to B346, room 055
- End March: Contractors take over B347
- Ca. Q1 2024: Project complete
- Q1 2024: People move back to B347
- Q2 2024: installation of tools in PolyFabLab


“Invite the curious and innovative to explore and exploit nanofabrication”
346A – Nanolab Phase 4

Situation for Nanolab Phase 4

- Cleanroom and structural design has been tendered
- Standstill until March 21st 2023 – then contract can be signed
- Plan to open in 2026

Design goals

– Mission-critical facility
– Technology at the forefront
– Open and inspiring building
– EMI and vibration sensitivity
– Deep sub-fab for 200 mm toolsets
– Full ISO 4 possibility – ISO 4 to 6 initially
– Total area in excess of 4000 m^2
– At least 700 m^2 cleanroom under filter
– Budget of 345 Mkr (2020 kr)


Concept drawing – do not
take too literally!


Concept drawing – do not take too literally!

Concept drawing basement column forrest – do not take too literally!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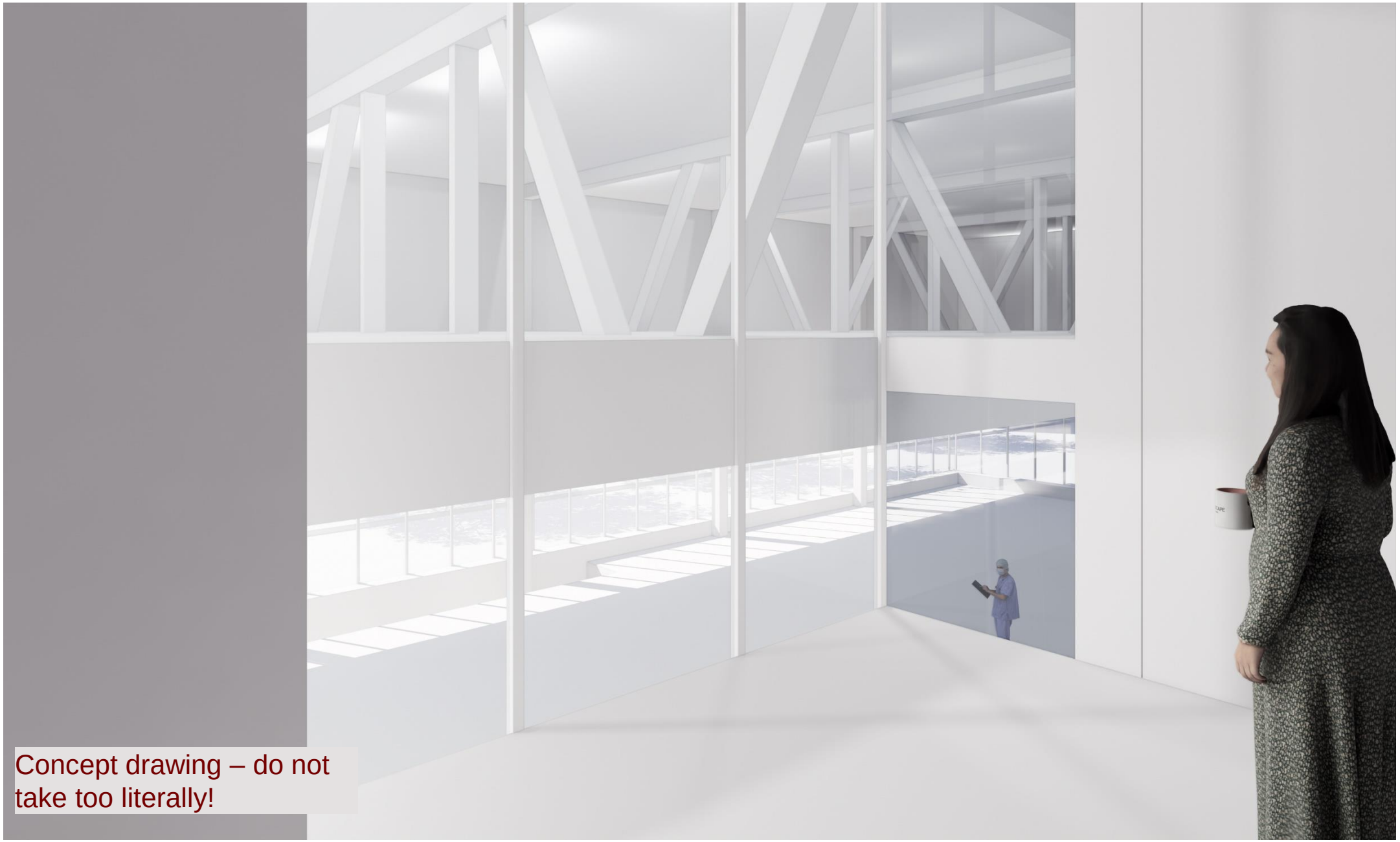


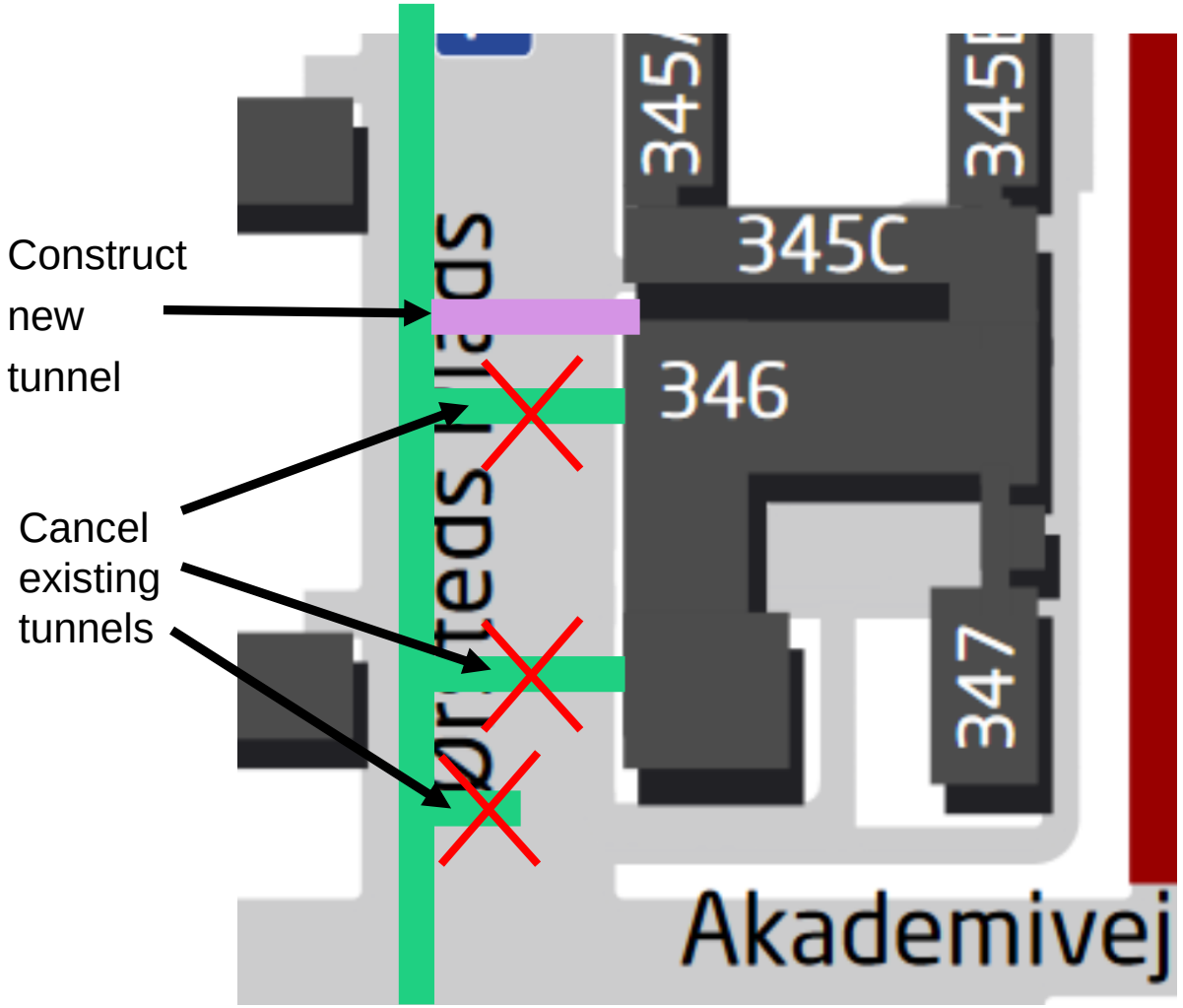
Concept drawing – do not take too literally!

Concept drawing – do not take too literally!

FACILITY CLOSURES AND PROJECT UPDATES

Enabling works – tunnel, cooling building, roof

- Before B346A construction, we need to get rid of
  - B346K (black cooling building in parking lot)
  - Old tunnels in the way
- Establish
  - 4°C cooling water in B346 2nd floor for dehumidifcation
  - New tunnel north of B346A
- Impact
  - Power
  - Heat
  - Cooling water
  - CDA
- Schedule presently unknown – ca. Q3/Q4 2023
- Discussions with CAS and contractors ongoing
- Aim for “minimal impact” (but this is a <u>big</u> project)



Decommissioning of equipment

- Nickel electroplating
- Polymer Injection machine
- Old Thickness Measurer (Wafer)
- Imprinter 02
- Inclined UV
- RTP Jipelec 1
- Wordentec (2024)

SOI wafers on sale!

Advertisment

And now a commercial break …

- Specs:
  - Type: Silicon on Insulator; ø150 mm; <100>; DSP
  - Device layer: 60 +/- 1 µm
  - BOX layer: 400 +/- 20 nm
  - Handle: 525 +/- 5 µm
  - Doping: Phosphor. 1-20 Ωcm

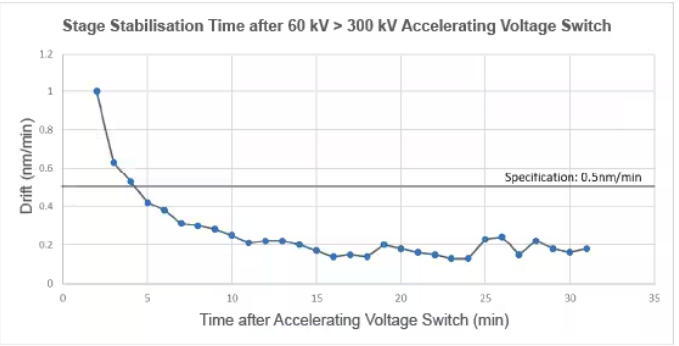
Price:
1000 DKK/wafer

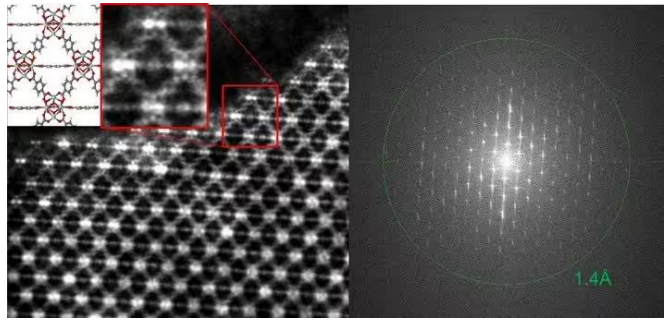
SALE !

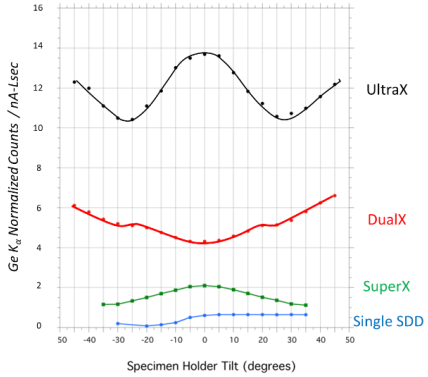
Contact thope@dtu.dk or kabi@dtu.dk if you want to purchase.

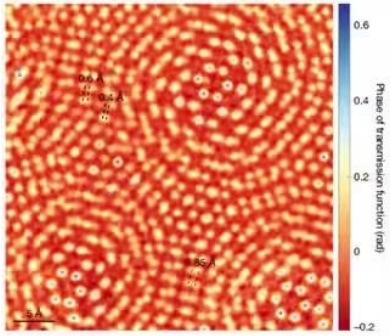
NEW EQUIPMENT

Spectra Ultra









- Probe and Image Cs correction
- 60kV, 120kV, 300kV (X-FEG)
- Ultra X-EDS detector (>4srad)
- Piezo-enhanced CompuStage
- Monochromator, OptiMono+
- Corrected TEM Lorentz mode
- Pressession Diffraction
- EMPAD (Electron Microscope Pixelated Array Detector)
  - 128x128 direct electron detection
- 4D STEM, OptiSTEM+ (Panther segmented detector – iDPC)
- Ceta-S Camera (speed enhancement)
- GIF Continuum HR 1066
- Tomography Software

- Energy spread: 0.05 eV (0.025 eV @ 60kV)
- Information limit: <60 pm
- STEM resolution: <50 pm at 300kV >30pA of probe current
  STEM resolution: <125pm at 30kV with >20pA of probe current

Installation Q2+Q3 2023 in 314

Raith e-Line - smaller add on

- Laser height sensor installation
  - Automatic focusing
- Chuck for 6” wafers
  - field of view 100x100mm

Need additional training:
thope@dtu.dk or rawta@dtu.dk

- A vibration damping platform has been purchased (Q2 2023)

Idea | Users | Funds | Tender | Contract | FAT | SAT | Manual | Released

MLA2 – upgraded from Write Mode 1 to Write Mode 2

Has been changed from WM1 to WM2:

- A new write head is mounted
- All optics are changed
- The OAF adjusted to fit the new write head

- It is compatible with both wavelengths (375nm,405nm)
- It is compatible with both autofocus modes (optical/pneumatic)
- Small chip exposure is still possible

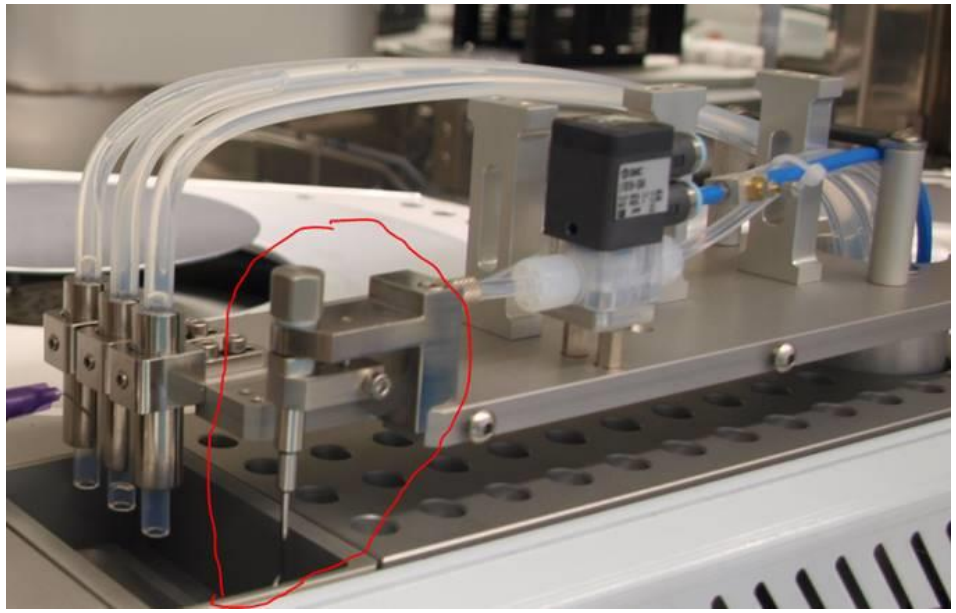
- High resolution option no longer an option
  - Resolution as MLA3 (>1 µm)
- Faster writing speed ~ half the speed of MLA3

- To regain your authorization please contact:
  jehem@dtu.dk or Meenadh@dtu.dk

Edge bead removal and backside rinse on Spin coater: Süss Stepper

- Issues with contamination on backside of wafers when spincoating
- Issues with uniformity on some wafer types due to heat transfer from end effector to wafer

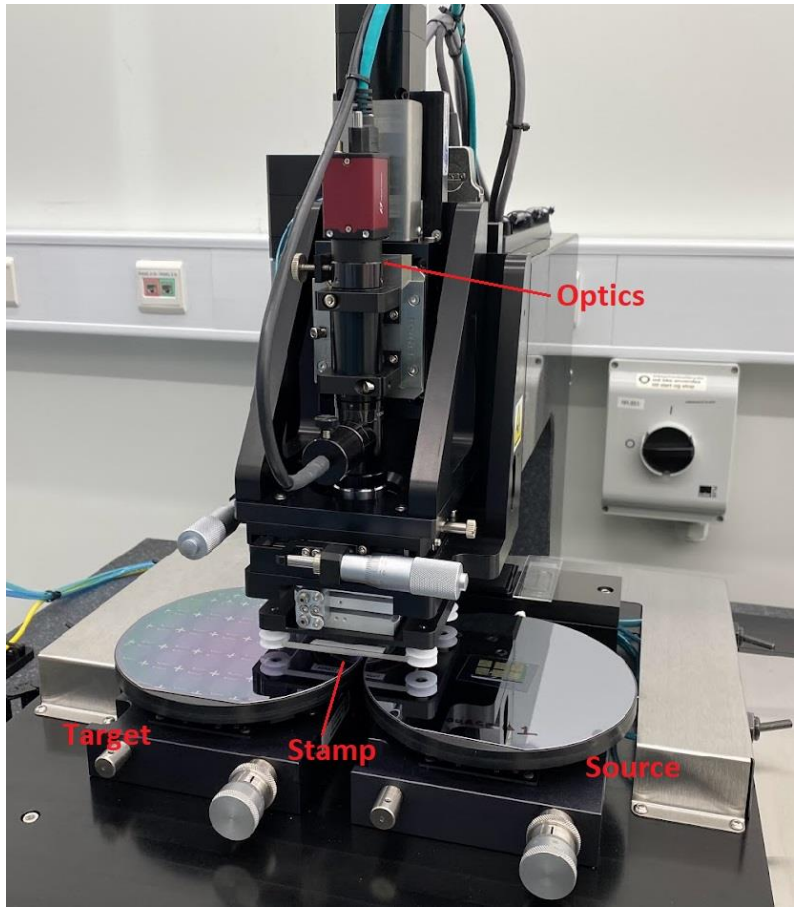
➢ Edge bead removal and backside rinse make it possible of spin coat all wafers first and then do the pre exposure baking afterwards without contaminating the tool



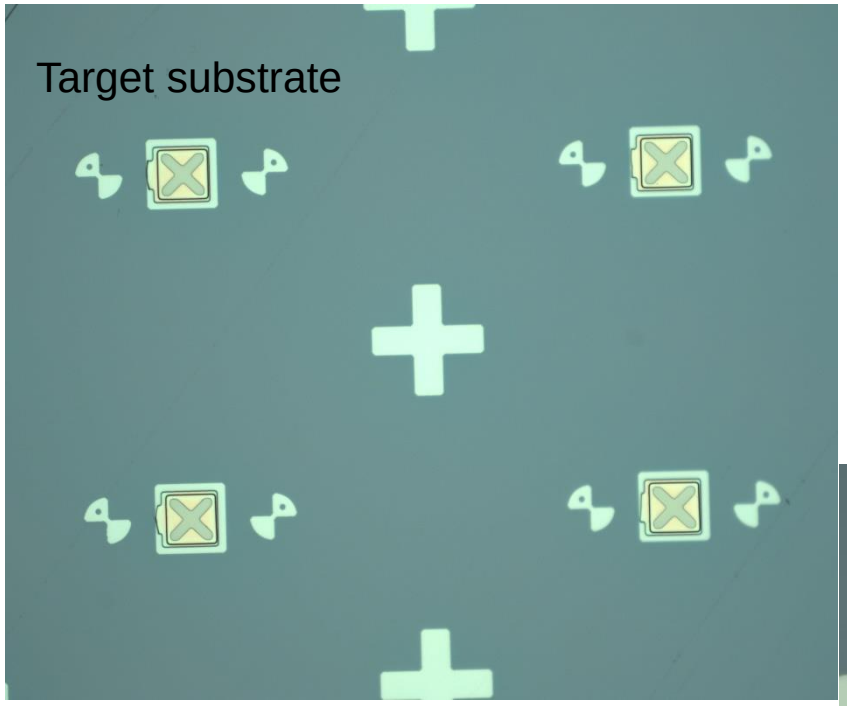
EBR-needle will fit through existing nozzle holder

Solvent supply by existing TS1

µTransfer printing ready for use



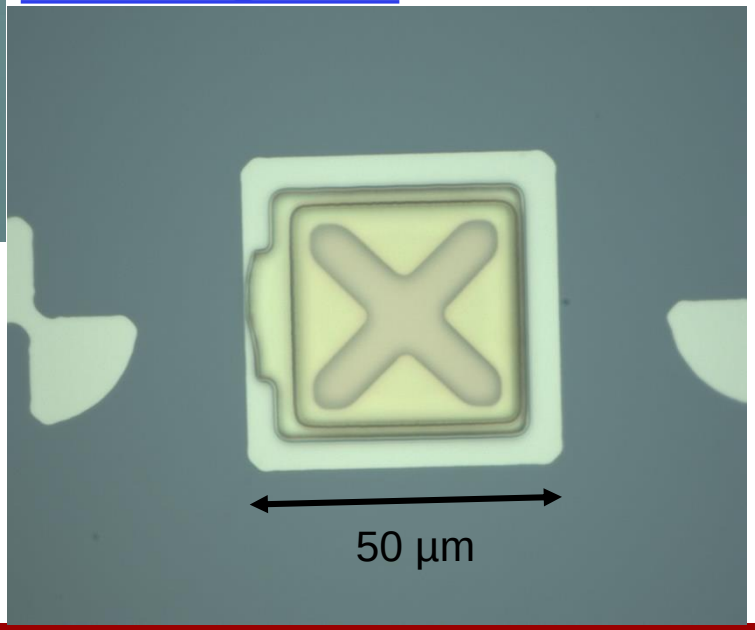
Purchased in cooperation with DTU Electro



Simultaneous transfer of multiple coupons using elastomer stamp

Alignment accuracy within 1 um

For training please contact:
Meenadh@dtu.dk



Replacement of SU8 developer bench and Fumehood (RCA)

Delayed due to supply shortage of stainless steel

FAT expected to be in Autumn 2023

Next SEM in 346

GeminiSEM 560 from Carl Zeiss

- **Sophisticated in-column detectors:** The detectors have seen a lot of development since the Supra models. The column now hosts detectors with **energy-selective filtering** to reveal **subtle material contrasts** – from both secondary and backscattered electrons.
- **Greatly improved low vacuum modes: Local charge compensation** that enable the use of in-column detectors (usually reserved for high vacuum) of secondary and backscatter electrons thus dramatically **improving the imaging capabilities on non-conducting samples**
- **STEM detector**
- **Also: A variety of automated features, beam deceleration…**

Expected delivery: Ultimo June 2023

Next E-Beam Evaporation System

FC2000 from FerroTec-Temescal

Features in general

- Robust & reliable system – easy maintenance
- High flexibility (substrate sizes)
- 10-pocket crucible
- High throughput - loadlock
- High-uniformity deposition
- Low sidewall deposition (for lift-off)

Expected delivery: Ultimo May 2023

New Particle Scanner – Takano WM-7SR

- to replace our current KLA-Tencor Surfscan 6420

Special agreement with ClassOne/Takano:

- Demo-site for Takano
- 3 months trial period before decision (compare with Surfscan)
- Contract includes trade-in of Surfscan

Major Specification	WM-7S
Wafer Size	50mm~200mm
Sensitivity(Bare-Si)	0.079μm
Throughput	55wph@200mm 60wph@150mm
Reproducibility $\sigma/\bar{x}$	1.0% or less
Dynamic Range	0.079μm~5.0μm
Coordinate Precision 3σ	100μm or less

Coming up – 2024

X-Ray Diffractometer – outside the cleanroom

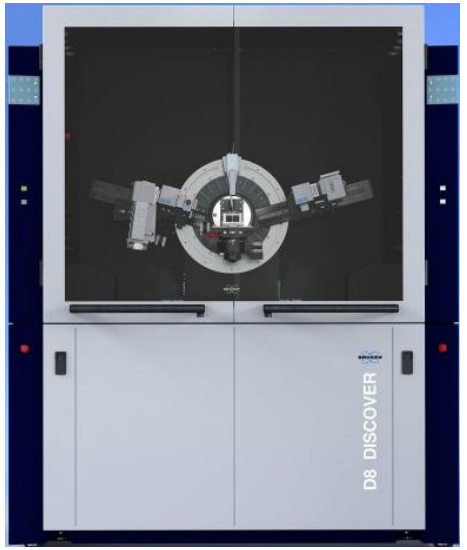
Material properties (crystalline/ poly/nano-crystalline):

- crystal orientation
- grain size
- electron density
- film thickness

Hardware improvement: Rotating anode source / 2D-detector ?

Visits at demo-sites with own samples (last week + ??)

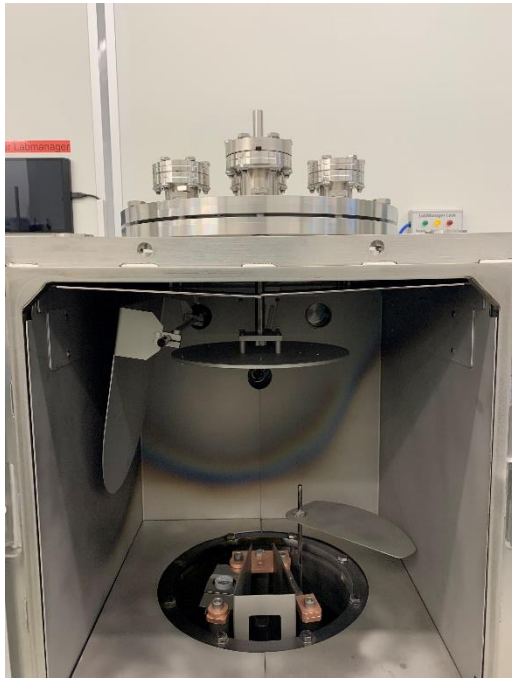
Tender process to be started



Upgrade of Thermal Evaporator (KJL-NANO 36)

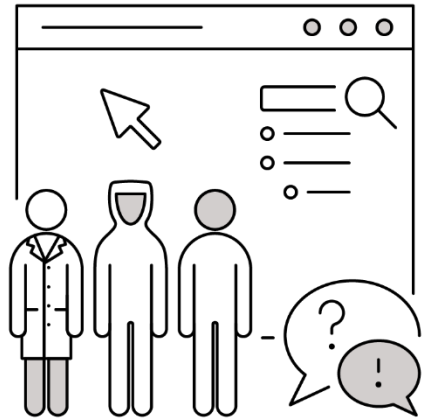
Substrate rotation for improving uniformity

- preparation for end-of-life of Wordentec
- Expect installation 17 April 2023



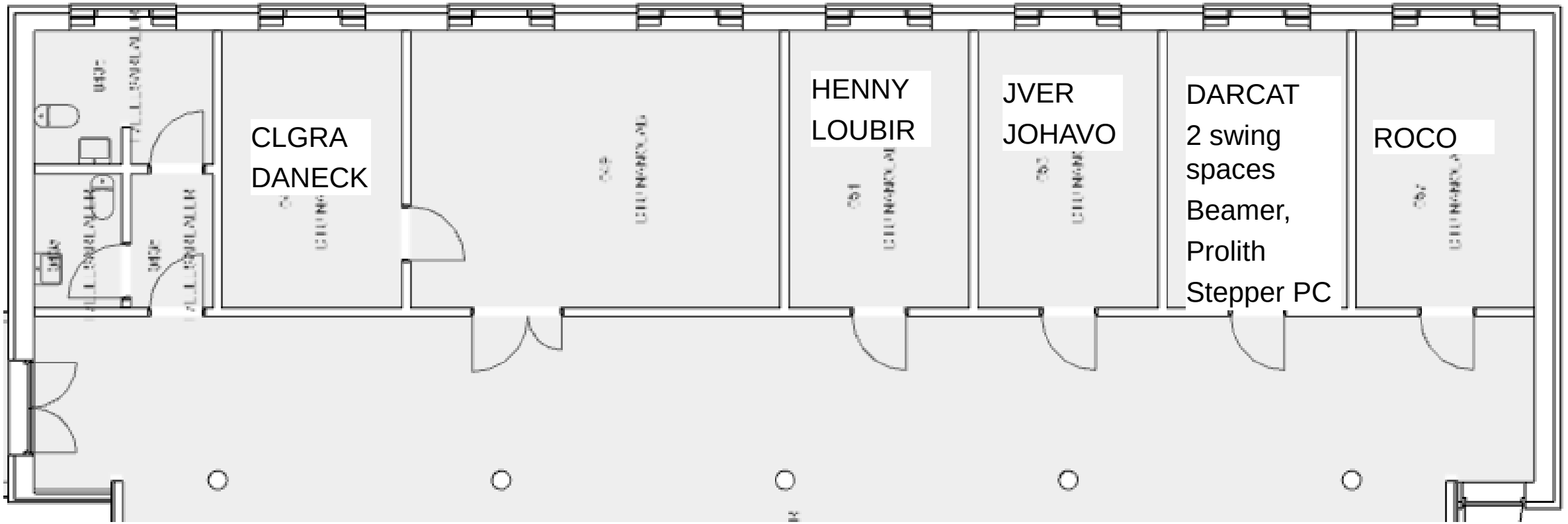
End of Presentation

- DTU economical situation
- Building 347 incl. Packlab activities relocation
- Energy savings
- PolyFabLab
- Building 346A – Cleanroom Phase 4
- Possible interruptions due to 346A enabling works – tunnel work
- Decommissioning of old equipment
- New tools and upgrades of existing
- Slides will be available online

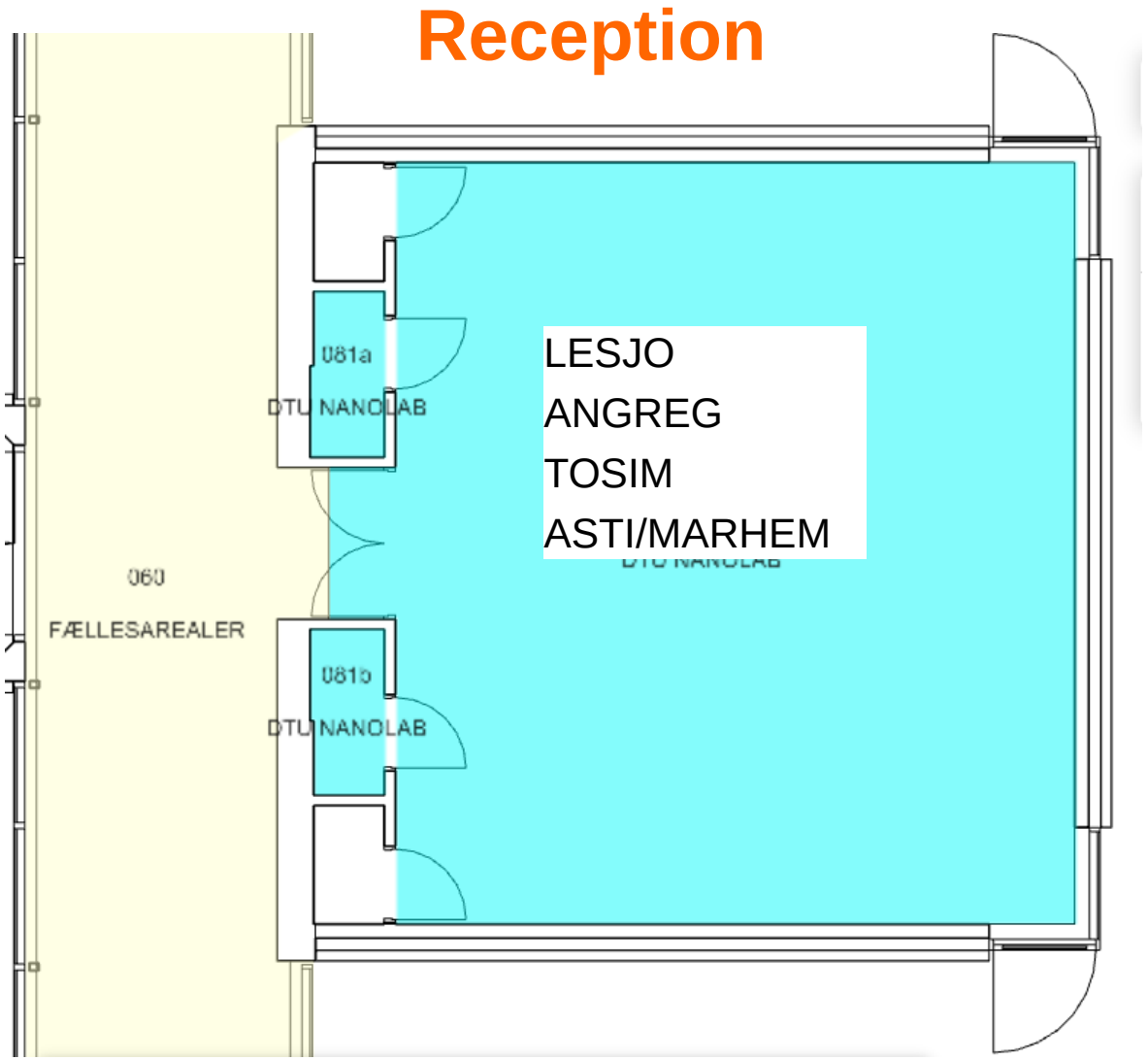


B346 Offices

(Most of) Facility



B347 Seminar Room

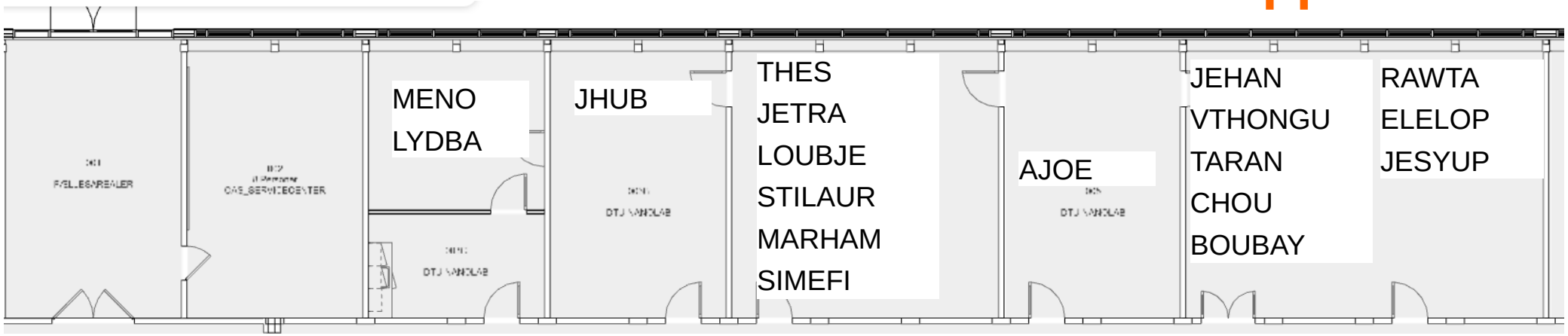


B358 ground floor

Cleanroom

Akademivej

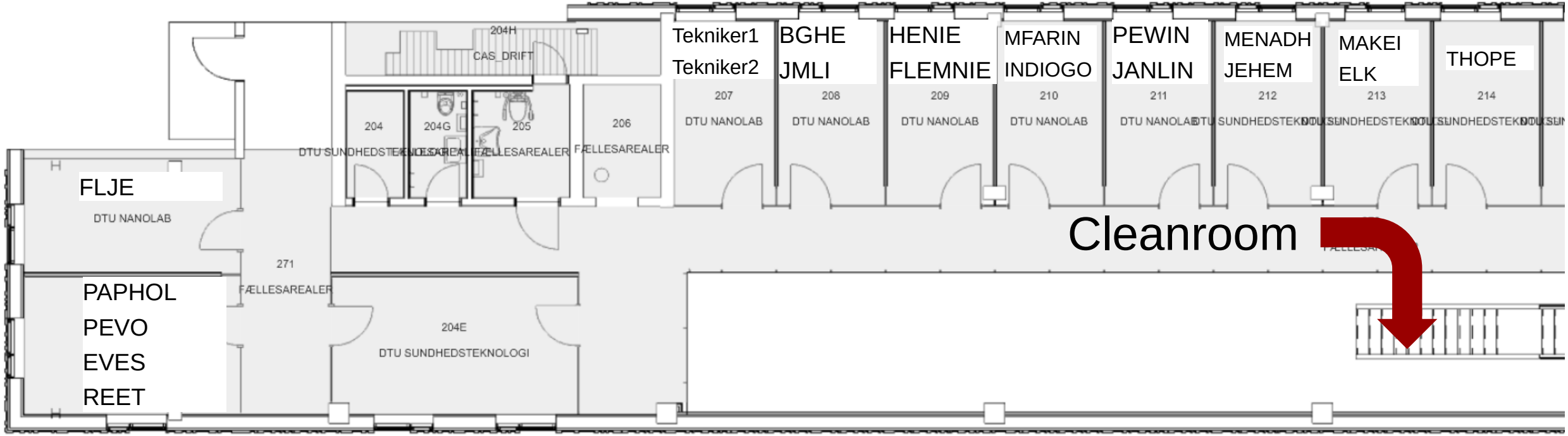
Fabrication support



B345C 2nd floor

Ørsteds Plads

Thin Film & Dry Etch



345B ground floor

Cleanroom

Wet chemistry