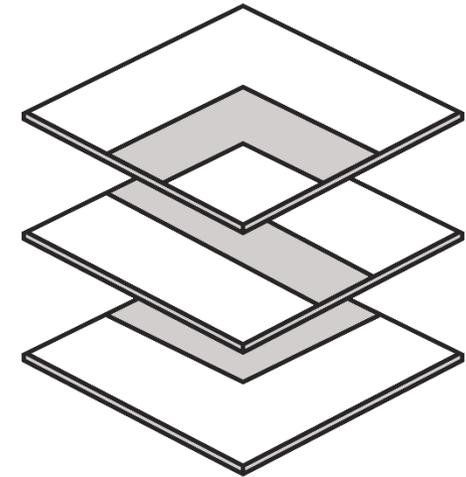


DTU



Agenda for TechForum 2022#3

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

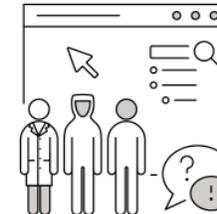
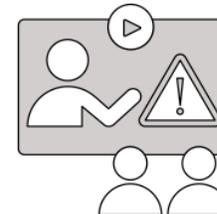
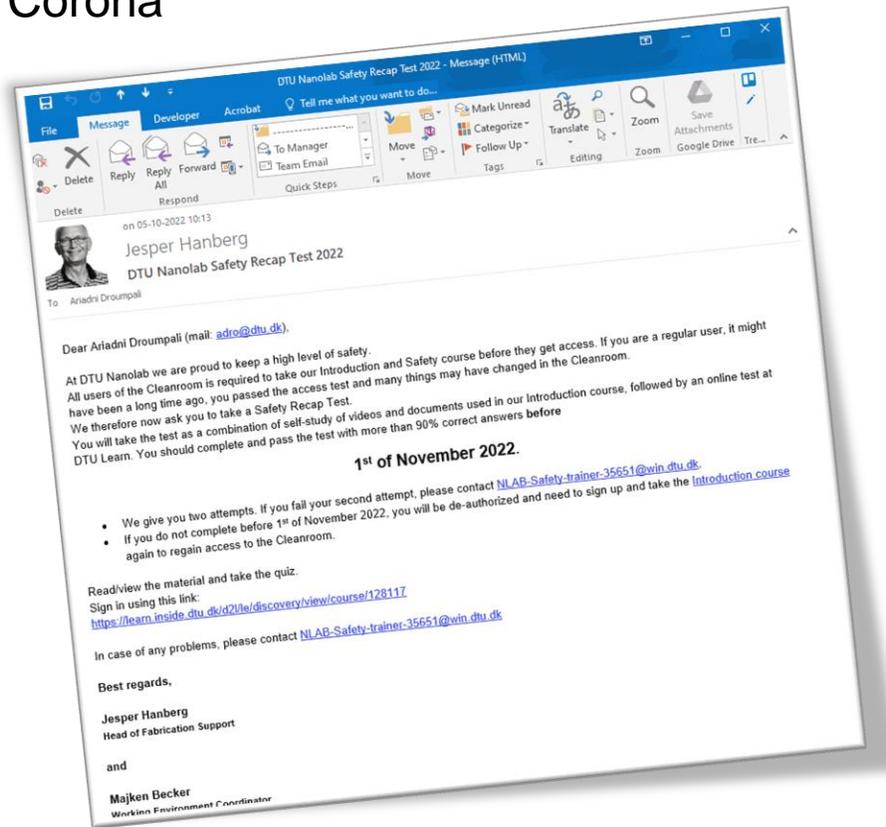


MISC. UPDATES

Annual safety update

- Safety recap was done two years ago
- Annual update in 2021 postponed due to Corona

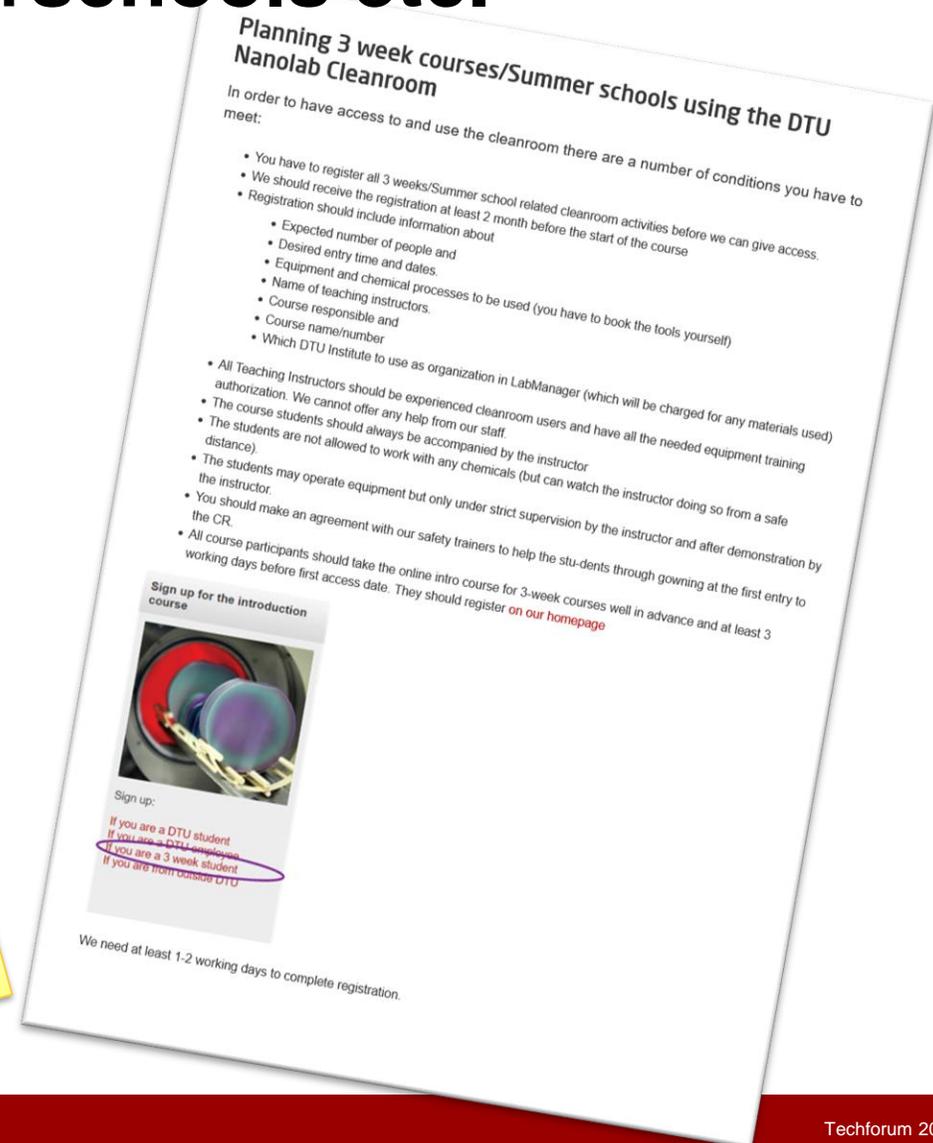
- Call for Safety recap training sent out beginning of October 2022
- The test is online in Learn
- Deadline is November 1st



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“
- 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
 - ...

No DTU Nanolab staff between Christmas and New Year eve.



Notice of increased Commercial prices

- Increased electricity prices is hitting us hard
- Current electricity consumption for the Cleanroom is more than 4 000 000 kWh/year
- We are not allowed to subsidise commercial companies

Service from Nanolab	Unit	Commercial activity 2022	Commercial activity 2023	Increase from 2022 to 2023
Cleanroom access (below cap)	Kr/hour	900	1260	360
Category A tools	Kr/hour	425	470	45
Category B tools	Kr/hour	775	930	155
Category C tools	Kr/hour	3700	4070	370
Category D tools	Kr/hour	1285	1540	255
Category E tools	Kr/hour	1800	2160	360
Category P tools	Kr/hour	425	470	45
Nanolab assistance	Kr/hour	1450	1850	400
Area rent	Kr/m ² /month	2175	Depends on "Nettoprisindeks" in November 2022	
Materials		At cost+20%	At cost+20%	None beyond price increases of individual materials
Electricity price will change to 6.62 kr/kWh for those with a contract charging directly for electricity				

ENERGY SAVINGS

Energy savings

- Increasing electricity prices: Urgent need to save energy
- LED light
 - Back to “original” light intensity
 - Switch off LED light when no one inside
 - Intelligent power-up
- Old cleanroom (sections A, B and C)
 - Improved pressure control
 - Floating humidity in “dead band” (ca. 35 to 60% RH)
 - Reduced air recirculation 18:00 to 06:00 + weekends
 - New HEPA filters with less pressure drop
- New cleanroom (sections D, E and F)
 - Ramp down FFUs from 40% to 30%
 - When no one inside
 - Always 18:00 to 06:00 + weekends
- Expected saving: ca. 310.000 kWk/yr (ca. 8%)
- Potential impact:
 - More particles outside normal hours
 - Less control over RH (sections A, B &C)



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:



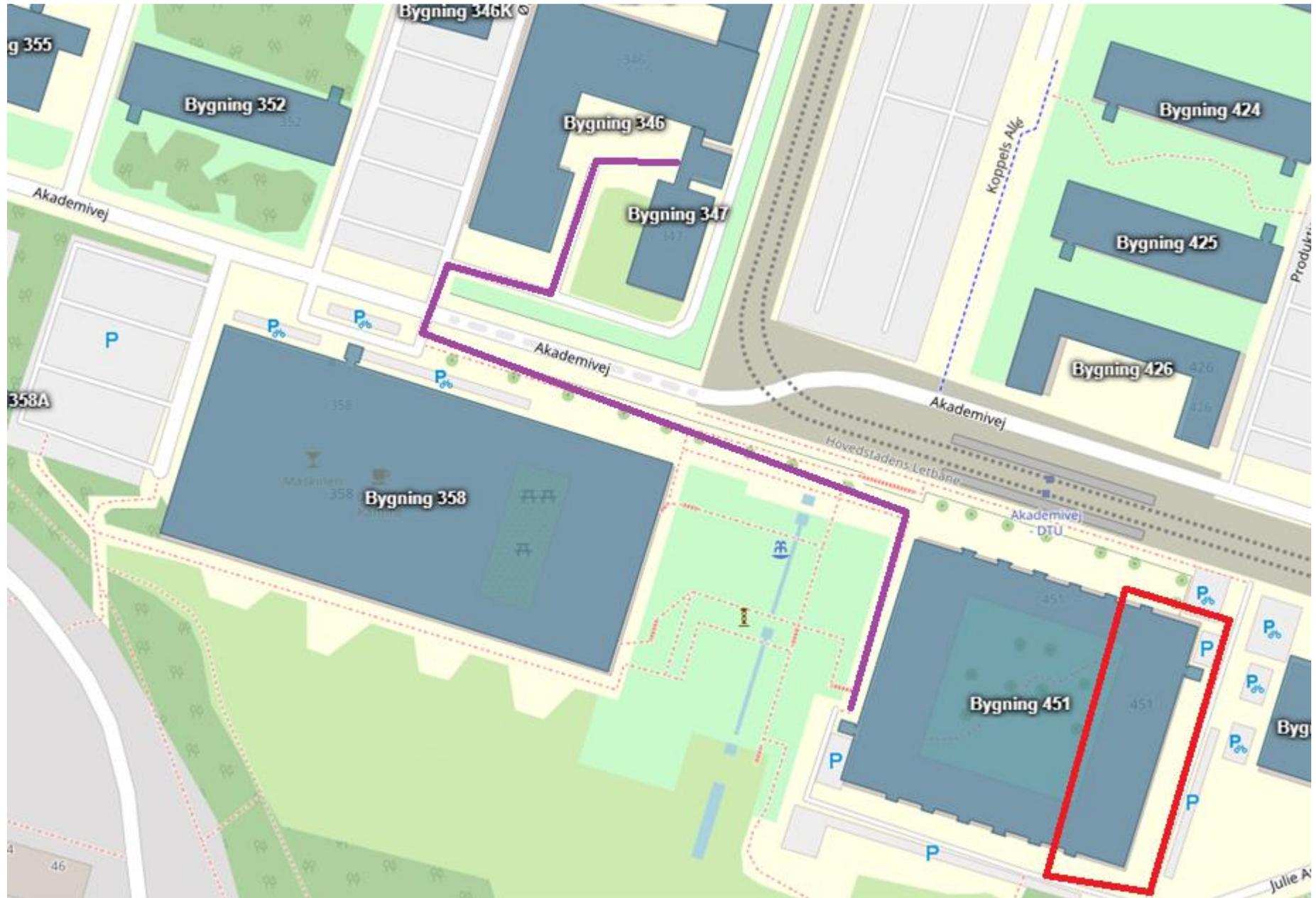
DTU – LLYN.347
Indretning af nyt PolyFabLab
samt kontor, møde- og køkkenfaciliteter

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

B451:

Temp. reception
In Seminar
room

Packlab closure –
relocation of activities



FACILITY CLOSURES AND PROJECT UPDATES

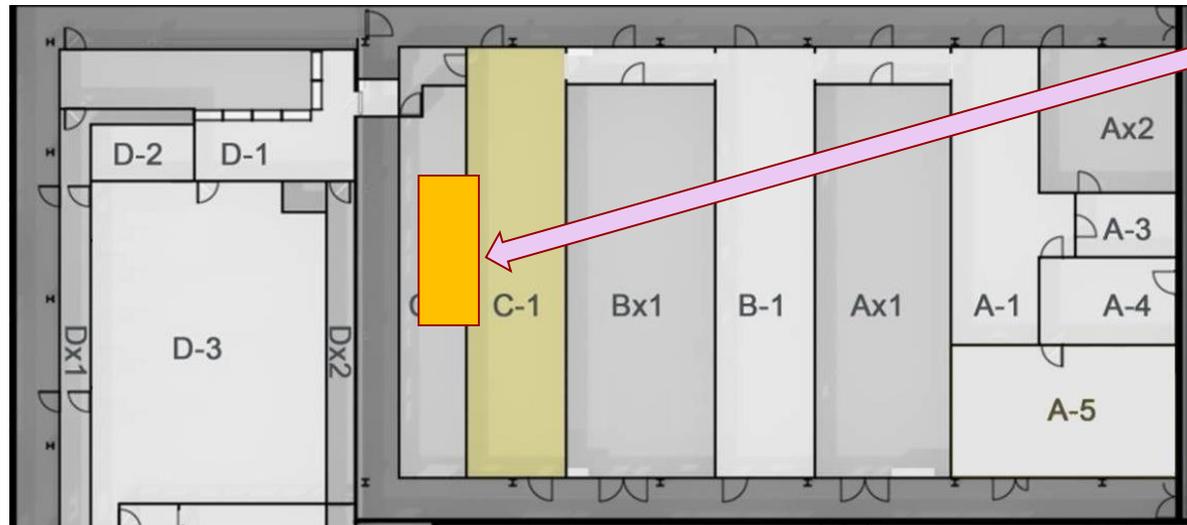
Process cooling water

- 3 incidents with leaking pipes in new part of cleanroom
- Typically in strained locations
- Alarms not transferred – fixed now
- Planning for prevention of further incidents
- New pipe system would require long shutdown



New NILT installation – Raith EBPG 5200

- NILT owned – not for public use
- Installation in C-1 and Cx1
- Move-in: ca. 2 November to 9 November
- Tools permanently moved:
 - IBSEN's inspection lamp (move to stepper room)
 - Sensofar (move to F-2)
 - Dektak (move to F-2)
 - Asher 1 – not decided (maybe move to E-5)
- Tools in Cx1 may out of use in this period



LED and FFU installation

- Almost complete
- Contractors finished in cleanroom
- Programming of on/off and ramp-down functions etc. remaining
- Future installations of more PIR sensors for more intelligent light control



B346 closure overview

- Re-route safety systems to new UPS:
 - Close B346 two days – date unknown
- Energy saving HEPA filters in old cleanroom (sections A, B and C)
 - Close cleanroom in ca. one week – date unknown
- Potentially more smaller closures to implement energy saving
 - Dates and duration presently unknown

NEW EQUIPMENT

Raith e-Line - smaller add on

- Filament change and adjustment
- Laser height sensor installation
 - Automatic focusing
- Chuck for 6" wafers
 - field of view 100x100mm

January 2023

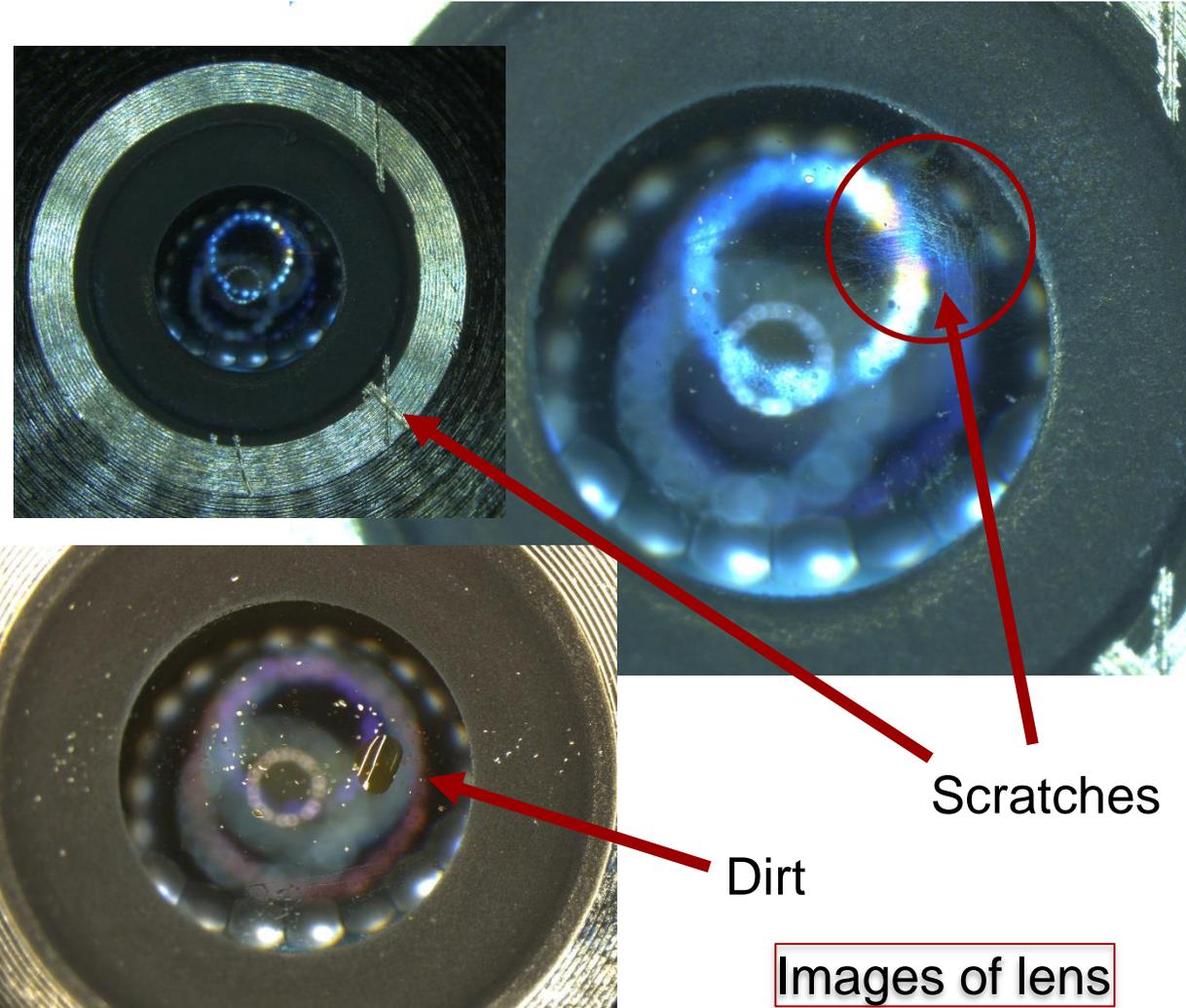


MLA2 – upgrade from Write Mode 1 to Write Mode 2

- MLA2 has been out of use for ½ year on and off due to scratches and dirt on the lens
- Now only usable for large structures (>5-10 μm) with pneumatic focus.

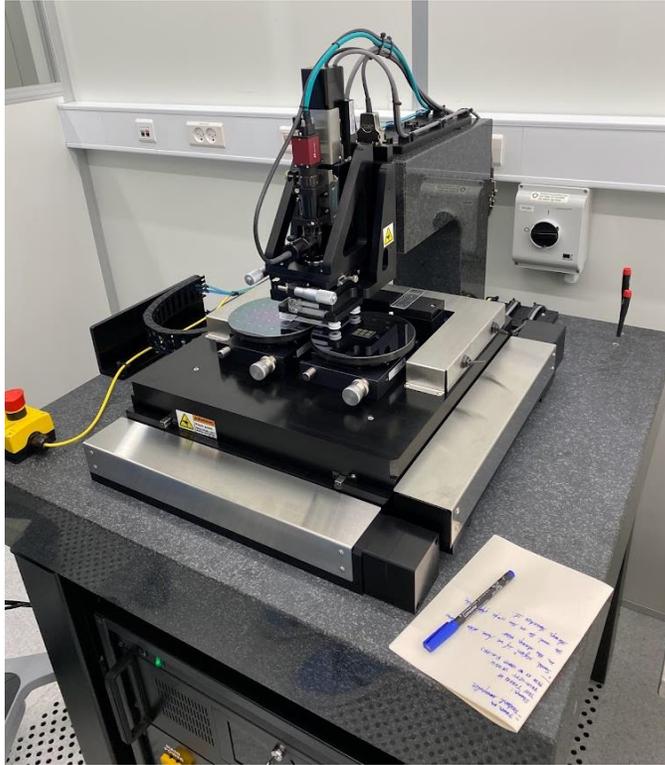
UPGRADE from WM1 to WM2:

- A new writehead will be mounted
- All optics will be changed
- The OAF adjusted to fit the new writehead.
- It is compatible with both wavelengths (375nm,405nm)
- It is compatible with both autofocus modes (optical/pneumatic).
- Loose high resolution option (>1 μm)
- Loose gray scale lithography option
- Faster writing speed ~ half the speed of MLA3

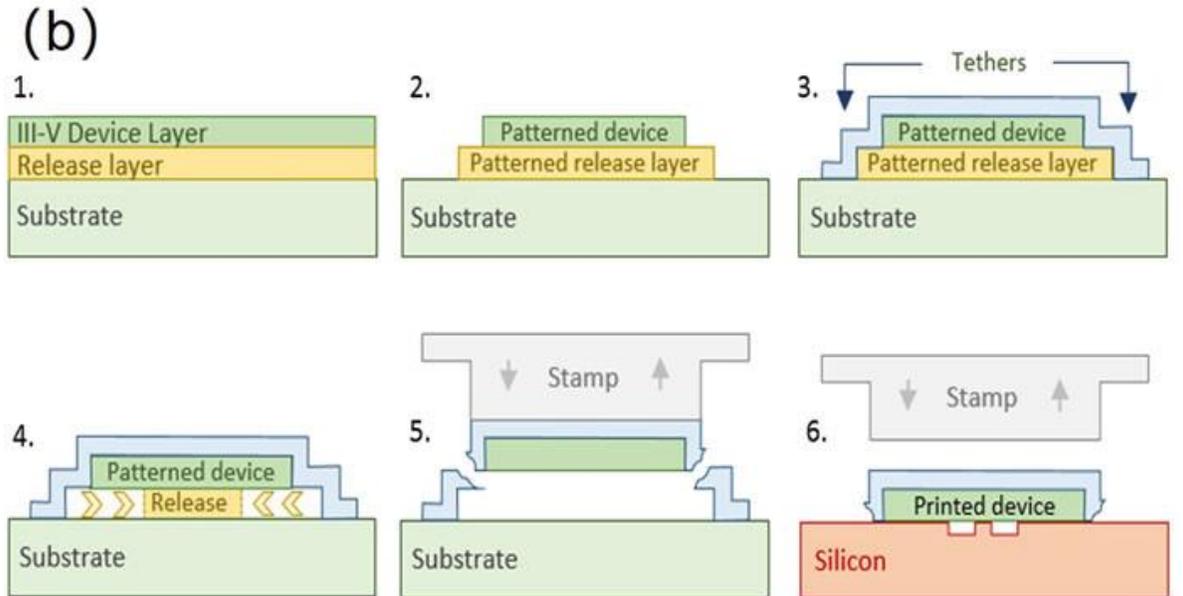
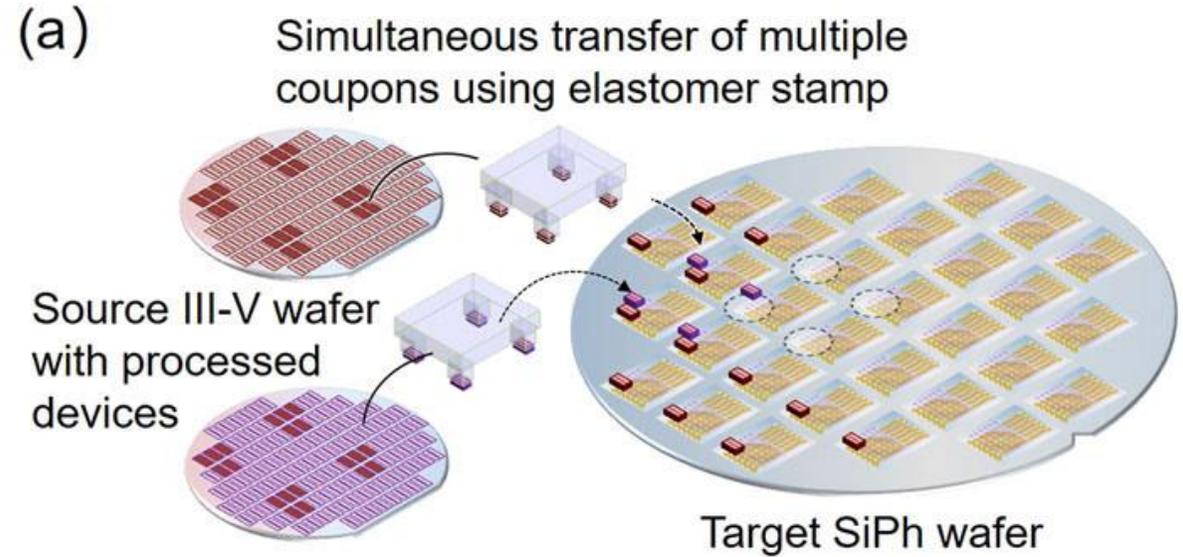


μTransfer printing

- Aligned transfer of devices from one wafer to another.
- Purchased in cooperation with DTU Electro.



- **Expected release February 2023**



Next SEM in 346? – and the winner is

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 May 2023

Next E-Beam Evaporation System? – and the winner is

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)

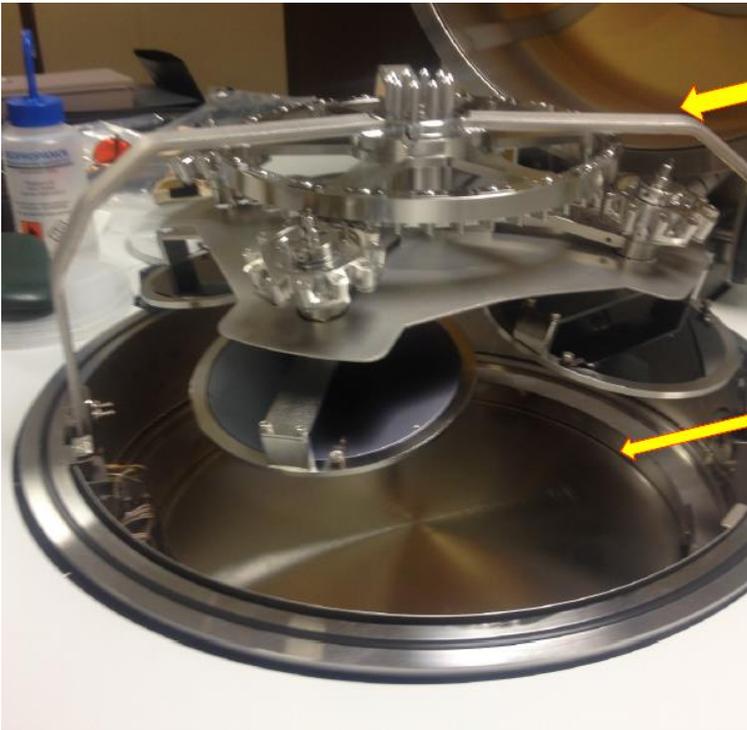
Expected delivery: Ultimo April 2023



Focus points

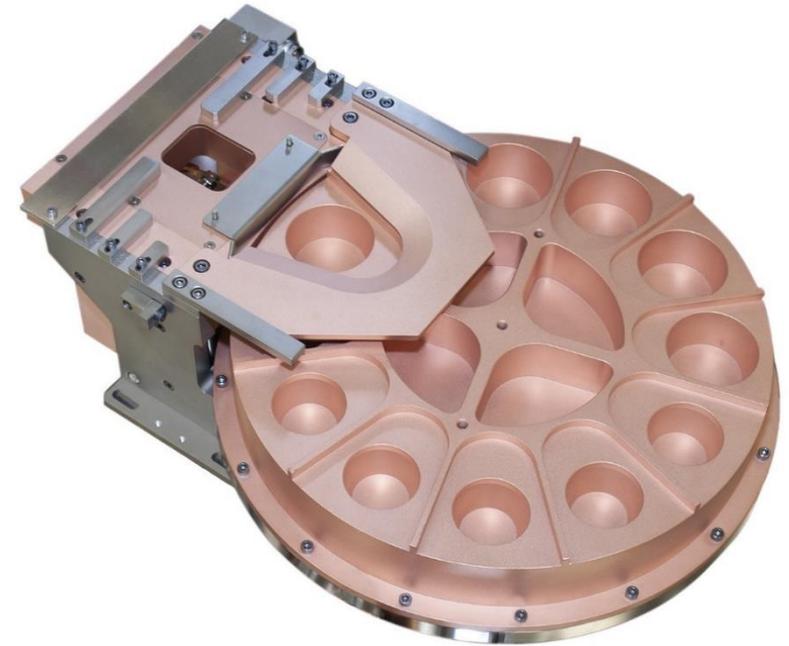
High-Uniformity Lift-off Assembly (HULA substrate holder)

- ensures that wafers spend equivalent periods in high- & low-density regions of the vapor cloud + low sidewall deposition



Many-Pocket system (10 x 25 cc pockets crucible)

- ensures high flexibility on material selection at any time



Issue: Booking / Usage of XRD - SmartLab

Month	Booked (Hrs)	Coverage (Usage of booked)
Jan	302	51%
Feb	462	56%
Mar	258	54%
Apr	289	83%
May	370	51%
Jun	430	59%
Jul	376	49%
Aug	490	61%
Sep	497	18%
Oct	616	19%





Coming up – 2023

X-Ray Diffractometer – outside the cleanroom

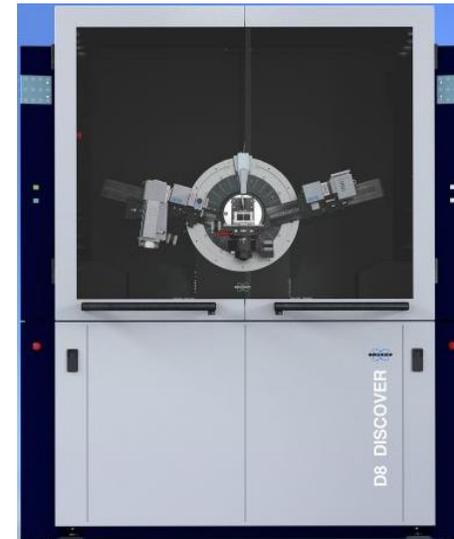
Material properties (crystalline/ poly/nano-crystalline):

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

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

Further investigation of user needs

Tender process to be started



End of Presentation

- New Cleanroom info page and Calendar
- Electricity price increase means
 - higher commercial prices from 1/1-23
 - focus on energy savings in Cleanroom to reduce future costs
- Energy savings may affect cleanroom operations
- Building 347 incl. Packlab activities relocation
- E-Line EBL and automatic SEM installed in CR and released for use
- New SEM and e-beam evaporator for delivery Q2 2023
- XRD usage and possible new instrument
- Slides will be available online at LabAdviser

