Agenda

- Short news and updates
- Laser micromaching tool
- Light rail
- CEN development
- New cleanroom equipment
- DUV Stepper II
AM Technology company presentation – September 18th

Here in the Seminarroom 347
September 18th at 10:00-11:00

Industrial scale:
- Dicing
- Grinding
- Polishing
- Cutting,
- Wax mounting
PhD course 33651, Methods in Micro and Nanofabrication

- Accelerate your research at Danchip!
- 3 weeks crash course and earn 5 ECTS points!
- 5 TPTs (Safety, Litho, Mask design, Dry etch, SEM). Drivers license to tools!
- Original literature in micro and nanofabrication!
- Design masks and make process flow recipes for your own project

Launched May 2018
So far 7 students participated
Very positive feedback
DTU Danchip will grow by January 1st 2019

- January 1st 2019: DTU Department of Health Technology
- Reorganization of research groups within DTU
- Significant strengthening Danchip’s technology research staff
- Better outreach to rest of DTU with “ambassadors”
- Continue focus on accessibility and state-of-the-art equipment
Energy saving

- CAS, MOE and Transition have been working with DTU Danchip to identify potential for energy saving
- Replace old FFUs with new ones
- Replace fluorescent lamps with LED
- Stop using cleanroom air for makeup air to new basement
- Requires cleanroom shutdown for > 2 weeks. Planned for 2019.
- Looking for qualified consultant and contractor
Mild evacuations

- Problem located to US013 – acid/bases exhaust section D
- Exhaust fan reboots – always at power cuts, but also “spontaneously”
- One day this summer: 3 evacuations in 26 hours!
- 1 August: Completely new control electronics
- In August: Many minor power cuts, but no mild evacuations (Yay! 😊)
- Problem solved?
Tools leaving the cleanroom

- Alcatel
- EVG 620
- Noble furnace
- Old ATV Pyrolysis furnace
- SVG Track
- III-V Asher* (alternative Asher 1)
- III-V Oven* (alternative dedicated VCSEL tool)

*We need to make sure backup is available - please let us know of issues
3DMM Laser Micromachining Tool

• Several air conditioner fallouts in summer

• Room temperature > 25° C

• Alignment has drifted due to CTE. Need realignment.

• Laser output power now 50% of original value. Need refurbishment.

• Do both operations at once: Only one downtime period

• The laser micromachining tool will be out of service 9 October to 14 December 2018! <- a long time
The light rail is coming
Light rail alignment on DTU Lyngby campus

- Expected operational in 2024
- Tracks: Per Aarsleff A/S
- Trains: Siemens Avenio
- Boundary conditions
  - Alignment fixed
  - Tram type fixed
  - Wires might be locally modified (segmentation)
  - Tracks might be locally modified (damping)
THE ALIGNMENT AT DTU, ENTERING FROM LYNGBY

- Sharp corner
- Tram stop
- Danchip Tram stop

Substation
### Vibrations

Need for vibration damping:

**DANCHIP (B345, B346) 12 dBV**

**NANOTECH (B347) 6 dBV**

**ENERGI (B301) 12 dBV**

**MEKANIK (B425) 12 dBV**

**KEMI (B206) 6 dBV**

**FOTONIK (B340) 6 dBV**

---

No vibration damping needed:

**CEN (B314)**

**ENERGI (B310)**

**ELEKTRO (B349)**

**KEMI (B204, B212)**

**KEMITEKNIK (B227)**

**FYSIK (B307, B309, B310)**

**SPACE (B327)**
Elecromagnetic fields

- Time varying electromagnetic fields 6000 nT (60 m away) to 22000 nT (10 m away)
  Earth’s magnetic field: 25000 to 65000 nT

- Spark generation when pantograph jumps: RF noise

- Tram CB radio: RF noise
Recommendations of Force/Rambøll/CAS

- **Vibrations**
  - Damping on light rail recommended (rubber under tracks)

- **EMI**
  - EMI damping on light rail (wire segmentation) “only reduces field 50%” at DCH (60 m away)
  - Damping on individual equipment recommend instead (Helmholz coils)
  - 95% damping of 6000 nT still gives 300 nT (limit is 50 nT!)
  - Practical test of field cancellation efficiency is being planned for October on e-beam
  - Talking to other universities with similar experiences

- **RF (jumping pantograph and tram CB radio)**
  - Some equipment on campus will have a problem with this (Potentiostats)
  - DTU Danchip equipment “should not be affected”

E-beam

| No field applied | 150 nT p-p white noise |

15 14.11.2018

E-beam

No field applied

14.11.2018
CEN DEVELOPMENT
Associate Professor in Soft Matter EM

- Starting date June 18, 2018

- Mériem Er-Rafik
  - Building up group / expertise at Cen for imaging of soft matter (polymer, biomaterials, etc) which requires special sample preparation
Cryo-Ultramicrotome (April 2018)

Ultramicrotome for Perfect Sectioning at Room Temperature and Cryo Leica EM UC7

The Ultramicrotome Leica EM UC7 provides easy preparation of semi- and ultrathin sections as well as perfect, smooth surfaces of biological and industrial samples for TEM, SEM, AFM and LM examination.

New Standard in Ultramicrotomy

Combining ergonomic design and innovative technology the Ultramicrotome Leica EM UC7 sets new standards in Ultramicrotomy. It offers a range of outstanding features and benefits of use for the ultramicrotomist, whether highly skilled or absolute beginners.

For research use only
High-Pressure Freezer

• We are aiming at purchasing a high-pressure freezer this year

• Mériem and Adam at IMC19 in Sydney to identify
SEM replacement (Q4 2018)

- OUT: FEI Inspect
- IN: FEI Quanta FEG

Previously enjoyed

ALL PICTURES SHOWN ARE FOR ILLUSTRATION PURPOSE ONLY. ACTUAL PRODUCT MAY VARY DUE TO PRODUCT ENHANCEMENT.
NEW EQUIPMENT
High Vacuum RTP-system for sidewall smoothening

Direct award: *(expected delivery October 2018)*

ANNEALSYS: AS-Premium

**Purpose/specs:**

Sidewall smoothening after DRIE nano etching
- high vacuum \((10^{-6} \text{ mbar base press})\)
- 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)
Coming up: Twin-Pegasus (version 2010)
Twin-Pegasus: The Plan

Pegasus 3
DRIE (Si) – 6”
High-throughput
Cassette-Cassette
“Workhorse”

Pegasus 4
DRIE (Dielectrics) – 6”
Reconfigure (Dielectrics)
High-throughput
Cassette-Cassette
“Workhorse”

CPX Platform
twin vacuum cassette cluster
(Brooks handler)

Twins brought home
Installation on-going
PVD multi-chamber tool: Dual-Sputter system
Candidate from Lesker

OCTOS robotic cluster tool including new functionalities:
- 2 x PVD75 sputter systems
- Separation: Metal oxides / Metal nitrides
- Module A: 6 x 2” magnetrons, DC/RF/pulsed DC/HiPIMS
- Module B: 1 x 4” + 2 x 2” magnetrons: DC/RF/pulsed DC/HiPIMS
- Distribution chamber (Genmark robot)
- Cassette station (10 wafer cassette)

Tender timeline:
In preparation – planned to be published ca. Sept. 17
Contract signed: Primo December
AFM Outside cleanroom

Dimension Icon from Bruker

- Capacity
- No sample go into cleanroom just for AFM
- Backup possibility
- Compatible scanner head with current cleanroom AFM
- Location in characterization lab in basement 346 (xps, tabletop SEM)
Logitech Orbis CMP system

- Purchased in co-operation with DTU Fotonik
- Polishing of 2, 4 and 6 inch wafers
- Polishing of 20x20mm Pieces
- Highly smooth initial surfaces, no lapping
- SF1 polish fluid and Chemcloth
- No acids or bases
- Si + SiO₂ polishing only with SF1
- Released in limited mode
  - Waste water system still under development
  - Can only be used in co-operation with Danchip staff (Rune or Claus)
Nano-Master SWC-4000

- For cleaning of polished wafers
- Cleaning of 2, 4 and 6 inch wafers
- Cleaning of 20x20mm Pieces
- Megasonic (water) and brush cleaning
- No acids and bases
- Ionizer
- Seems to be doing a good job
- Talk to Rune for more information
New DUV stepper

- DTU Danchip requirements
  - Easy to maintain
  - Fast, easy conversion between 6” and 8” mm
  - Acceptable process window to obtain resolution required by users

- User feedback
  - Prefer new machine – stability is a key factor
  - Resolution below 200 nm not required (now)

<table>
<thead>
<tr>
<th>New?</th>
<th>Ca. price in DKK</th>
<th>Light source</th>
<th>Type</th>
<th>Exp. Area</th>
<th>NA</th>
<th>Res. Limit</th>
<th>Ovl. Accuracy</th>
<th>Foot print</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>40-48 mill.</td>
<td>KrF 248 nm</td>
<td>5X stepper</td>
<td>22 x 22 m² or 17 x 26 mm²</td>
<td>0.5-0.65</td>
<td>150-180 nm</td>
<td>25 nm</td>
<td>2x4 m²</td>
</tr>
<tr>
<td>No</td>
<td>30 mill.</td>
<td>KrF 248 nm</td>
<td>4 X scanner</td>
<td>26 x 33 mm²</td>
<td>0.68</td>
<td>150-180 nm</td>
<td>30 nm</td>
<td>4x5 m²</td>
</tr>
<tr>
<td>No</td>
<td>??</td>
<td>KrF 248 nm</td>
<td>4 X scanner</td>
<td>26 x 33 mm²</td>
<td>0.55-0.82</td>
<td>110 nm</td>
<td>15 nm</td>
<td>?</td>
</tr>
<tr>
<td>Yes</td>
<td>30 mill.</td>
<td>KrF 248 nm</td>
<td>4 X stepper</td>
<td>22 x 22 m² or 27.4 x 14.7 mm²</td>
<td>0.40–0.63</td>
<td>150 nm</td>
<td>28 nm</td>
<td>?</td>
</tr>
</tbody>
</table>
Steppers vs. scanners

- **Stepper**
  - Entire image field exposed at once
  - Reticle fixed, stage steps from die to die
  - Limited optical performance
  - Less moving parts – lower operating cost
  - Limited footprint
  - Only Canon sells new steppers

- **Scanner**
  - Slit of light moves across the image field
  - Reticle and stage move in opposite directions (synchronized to nm precision)
  - Optical process window much larger
  - Lower resolution possible – especially for difficult wafers/resists
  - Higher footprint
  - Higher tool cost (ca. x2)
  - Higher operating cost
  - More difficult to maintain
  - ASML and Nikon market leaders
DUV stepper/scanner demos

- Canon, Japan
  - FPA3030-EX6 248 nm stepper
  - New machine
  - Very similar to existing tool
  - Footprint: 2x4 m²
  - 6” to 8” change in 10 min
  - 48 mill DKK

- ASML, The Netherlands
  - PAS 5500/350 248 nm stepper
  - Refurbished – Over 20 years old
  - Very rugged and modular tool
  - 6” to 8” change in 1 day
  - 30 mill. DKK

- University of Southampton
  - Nikon S203B 248 scanner (newer models available)
  - Refurbished – Ca. 10-15 years old
  - Really easy to obtain >200 nm in ≈ 1 µm resist
  - Footprint 4x5 m²
  - 6” to 8” change might be possible
  - Ca. 30 mill DKK

- Seems the new Canon 3030EX6 is the best choice
  - Only new machine
  - Most flexible wafer change
  - But: Marginal improvement over existing tool
  - Price negotiations ongoing