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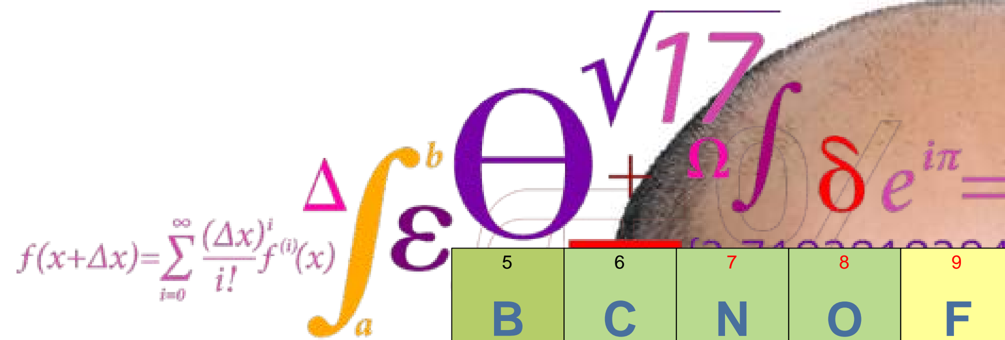
Danchip Techforum 1-2015



1 H											5 B	6 C	7 N	8 O	9 F
3 Li											13 Al	14 Si	15 P	16 S	17 Cl
11 Na	12 Mg	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As		35 Br
19 K	38 Sr	40 Zr	41 Nb	42 Mo		44 Ru	45 Rh	46 Pd	47 Ag		49 In	50 Sn	51 Sb	52 Te	53 I
		72 Hf	73 Ta	74 W	68 Er		77 Ir	78 Pt	79 Au	70 Yb		82 Pb			

AGENDA

payment model, customers, users, partners and Horizon 2020 Jørg

how our prices are calculated Anders

working out of the box Anders

Building 345C & facility Leif

samples in and out of the cleanroom Leif

equipment and technology Flemming

decommissioning of tools Flemming

wrap-up Jørg

Payment model

free access to Danchip for all DTU departments

External projects cover their cleanroom costs (part of the budget when submitting the application)

this part of the budget goes directly to 101

Danchip does not see this money and does not receive part of it in any form

Economy centers get the registration from Lab Manager and bill the respective projects accordingly

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CUSTOMERS, USERS, PARTNERS

costumer vs. service provider

not a suitable relationship for research projects

users of the cleanroom facility

with Danchip as a partner

WHY ?

We believe that the cleanroom facilities at DTU will be used more efficiently with a partner relationship where all parts take full responsibility

DANCHIP - A COMPETENT PARTNER

- Danchip has process experience
- Danchip has process development experience
- Danchip has equipment knowledge
- Danchip is present at selected fabrication conferences and trade shows
- Danchip has an extensive network: Nordic Countries, Europe, USA, Australia
- Danchip has ongoing research in selected fabrication topics not covered by Nanotech/Fotonik
- Danchip is partner in several research projects and project applications (Nanotech, Fotonik, Elektro, Fysik)

DANCHIP AS PROJECT PARTNER

Think Danchip as a project partner in the application phase:

- Danchip can be part of a process/technology development (co-supervision)
- Danchip can be of assistance in equipment procurement
- Danchip can take over processing tasks – only as a partner
- Danchip can allocate funds for co-financing

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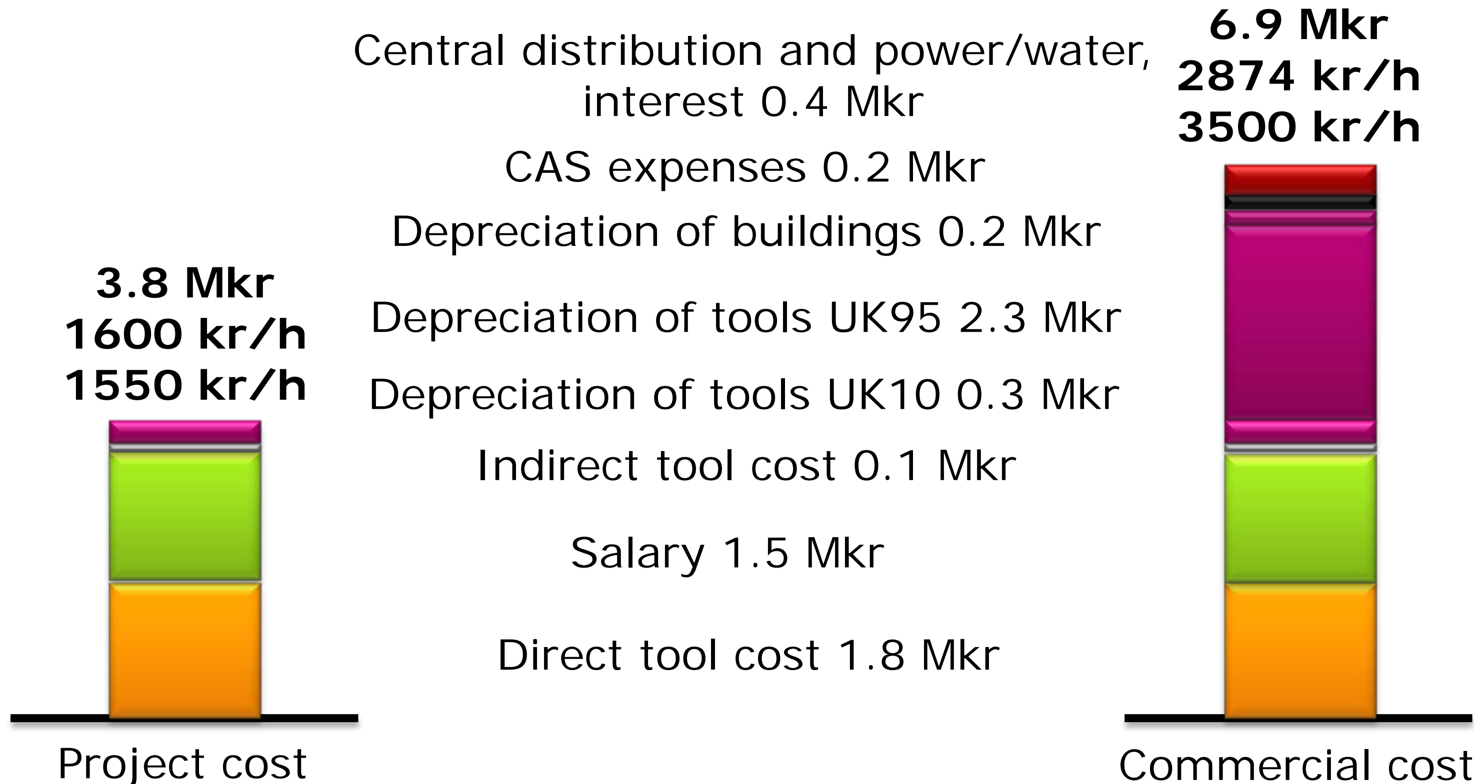
Horizon 2020 (as it looks now):

$$tool\ price = \frac{depreciation}{capacity}$$

PRICING/SHELVES

What is in a price? – Category C as example

Two tools, regular capacity of 1200 hours per tool: 2400 hours



Accounts from 2013

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2013 Accounts,
DTU, Danchip, Cen

Expectations

AØR Analysis group

2015 prices

AØR EC West

AØR EC

Innovation Fund Denmark
RESEARCH, TECHNOLOGY & GROWTH

AUDIT

2015 Accounts,
DTU, Danchip, Cen

Shelves in cleanroom – Academic usage - update

- Lot of feedback from last year!

- LabManager changes made to include supervisor and programmed to make labels
- Printer and cleanroom labels acquired
- Place for label printer not completely fixed

- We can all benefit when the cleanroom is rearranged
- Danchip need to use own boxes

Academic usage – Current approach

- One box per person active in cleanroom
- One box per project in the cleanroom (5 digit project number is in both economy system and in LabManager)

- Possibility for extra box for 200 hours of tool usage in a year (Cat A, B, C)

- Renewal of licence: twice per year

- Implementation not fixed
  - It is really hard to figure out who uses a given shelf!
  - Space is limited - remove samples you do not need
  - Rolling implementation ~1 rack per month

VARIOUS FACILITY THINGS

Construction work B345C

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- March 2015 WK11-WK15: Tar work on roof (tagpap) could lead to smells
- Very good information from CAS and the contractors

Importing Samples to the Cleanroom - An important message

- Too many users have been found brining samples from the outside directly into the cleanroom.
- No change of sample carrier
- No cleaning of samples
- **This behaviour damages a lot of other user's work!**
  - **Contamination of sensitive equipment (furnaces etc.)**
  - **Cross contamination of other people's wafers**
  - **Yield killer**
- **Nobody really want to destroy other people's work – do they?**

What does LabAdviser say?

Items that have been outside the cleanroom

Items that have been outside the cleanroom should always be ***cleaned in soap and ultra sound followed by a 7-up or Piranha clean*** *before entering the cleanroom.*

- All supervisors must inform their students about this basic rule.
- If in doubt, always ask. We can usually find a solution.

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New N2 purifier

- Present N2 purifier is 20 years+
- No spare parts
- No service
- New ordered December 2014
- Expected delivery June 2015
- 3 stops in Feb-Mar
  - All at 14:29
  - All lasted 10min
  - Gremlins??

- Under 24/7 video surveillance
- Heater installed in room

Cl_2 and BCl_3 update

Cl_2

- Leak in one fitting in gas cabinet
- Cl_2 etched the fitting – hole became larger
- Gas pipes vented through leak with atmospheric air (Cl_2 traces still in gas line)
- Etching of many valves and pipes
- Spare parts missing – in spite of 300 000 inventory
- May need to re-route entire piping.
- Earliest date back in service: 01 April 2015
- Damage amounts to > 200 000 DKK

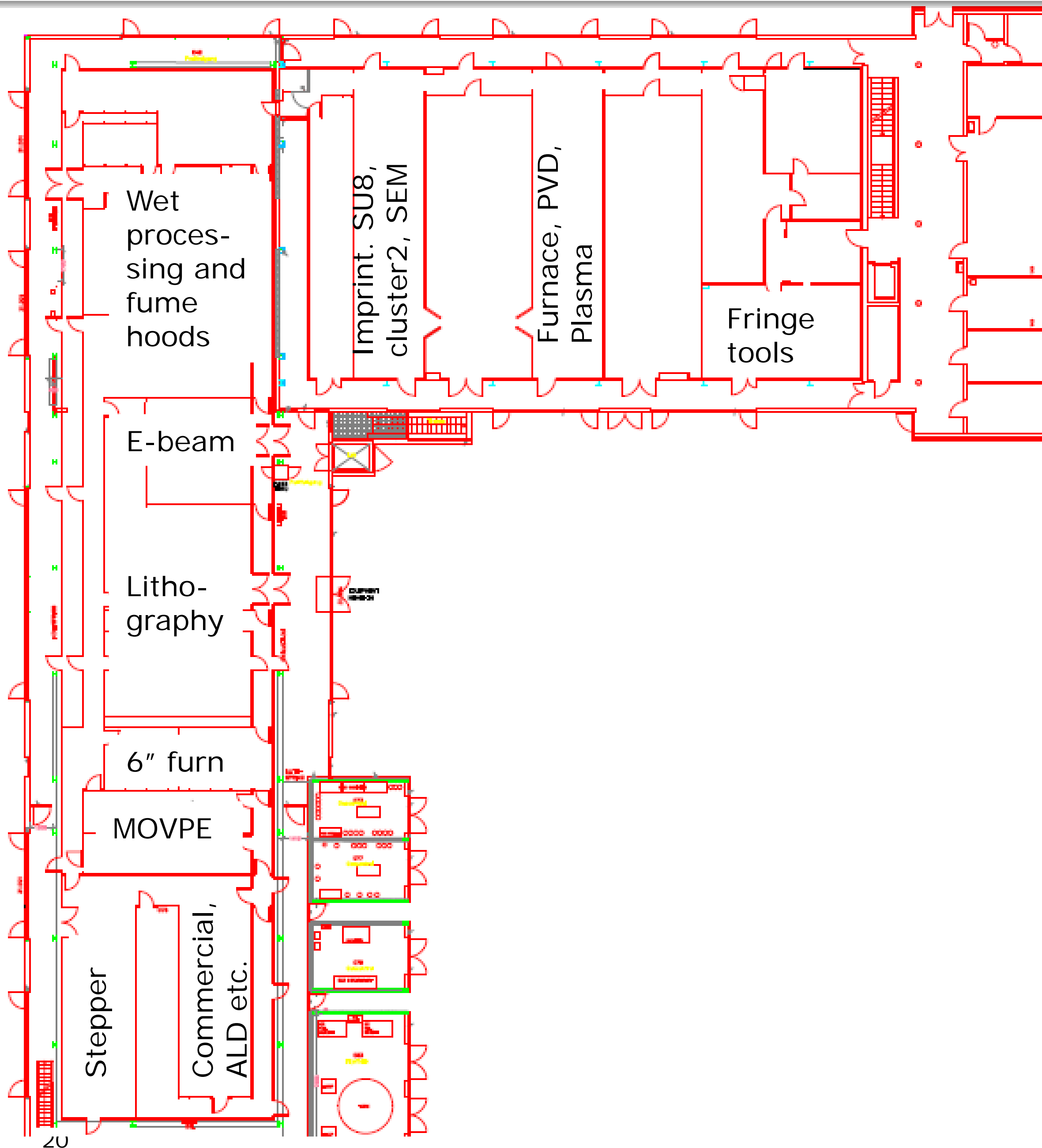
BCl_3 on Metal ICP

- Long processes (>15-20 min): BCl_3 flow drops
- Issue limited to Metal ICP
- Something wrong with either gas pipe, filter or MFC
- If not precisely temperature controlled, BCl_3 condensates
- Tests ongoing

H_2 update

- Hydrogen generator has had major overhaul
- New partss
- New motherboard
- New firmware
- Seems stable…

New cleanroom order



Upcoming cleanroom installation works

- Hole in wall for RCA SRD – this week
- Straightening of Cluster 1 wall – preparation for PECVD 4 installation – this and next week(s)

NEWS ON TOOLS AT DANCHIP

13 new fumehoods

- Flexible processing activities rise and decline
- New material groups are introduced with constantly increasing frequency
- Same applies for substrates
- No ghettos (sub cultures, local kingdoms)

New Litho rooms

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Phase 1 (C-1 or "Cleanroom 3"): Polymer and NIL lithography

- New "KS Spinner" with Gyrset and vacuum free chuck. Ships today.
- EVG 620 will move to Phase 1. Arm will be removed.
- EVG NIL will move to Phase1
- Old HMDS stays
- SU-8 developer stays

Phase 2, E-4 & E-5 (New room + "CR13"): Main UV lithography

- Two Karl Süss mask aligners (one old, one new)
- New Süss Gamma 2M developer robot ("The Ninja developer")
- New Nikon Eclipse L200 optical inspection microscope
- New HMDS oven: Yield Engineering YES310. Release in 2015Q2
- New Gamma 2M resist spinner cluster. SAT ongoing. Release in 2015Q3
- Two new fume hoods (FAT end of March 2015).
  - One for manual spin coating
  - One for manual development of odd samples
- Spin track (will be moved from Phase 1)
- 2 R2D2 developers: one TMAH + one e-beam (being installed9
- 6 Inch developer (has moved to E-4, being re-installed)

Metal deposition - news

Alcatel and Physimeca (E-Beam Evaporation)

- Need for increase of utility (Physimeca) and for internal backup (both)
- Open up for changing metal composition in Physimeca (as for Alcatel)
- Danchip makes weekly plan with user group (″wish list″ for metals)
- Check Status-log in LabManager for next 3 weeks plan

New capabilities: Thick metal layers?

- Investigate the need and possible solutions for depostion of > 1 µm metal layers (e.g. Cu and Al)

Plasma Enhanced ALD – new system?

Motivation

- High utilization, bottleneck tendency
- No in-house back-up
- Limited capacity for new precursors

Key features

- Highly flexible ALD system, thermal & PE-ALD
- Stacked substrates (pieces – 8″ wafers)
- ″Work horse″ as well as new capabilities
- New chemistries, e.g. for metals and metal nitrides
- Low temperature processes

Meeting with Picosun: March 11, 10-12

- Model R-200 Standard for basic ALD research
- Model R-200 Advanced for even more flexibility with more precursor sources and plasma-enhanced ALD
- Highly versatile, cost-efficient, modular, and customizable ALD tools for single or batch wafer processing, 3D objects, high aspect ratio (such as deep trench and via) structures, through-porous, and particle samples

Excellent film uniformities achieved in Picosun thermal and plasma (PEALD) processes. Wafer size 150 mm, 49 point measurement.

Material	Non-uniformity (1σ)	Single (S) / batch (B) process
Al_2O_3	0.13 %	B
SiO_2	0.77 %	B
TiO_2	0.28 %	S
ZnO	0.94 %	S
Ta_2O_5	1.0 %	S
HfO_2	1.83 %	S
Pt	3.41 %	S
TiN	1.10 %	S
PEALD Al_2O_3	0.50 %	S
PEALD AlN	0.62 %	S
PEALD SiO_2	1.10 %	S
PEALD TiN	2.16 %	S
PEALD TiAlN	2.87 %	S
PEALD In_2O_3	0.87 %	S
PEALD ZnO	2.64 %	S

ALD - Enabling the Future

Meeting with Oxford Instruments: March 23, 13-??

Materials Matrix

Material	Page	Metal precursor	Non metal precursors				
			O_2	H_2O	N_2	H_2	NH_3
Al_2O_3	on page 3	TMA	P	T			
AlN	on page 6	TMA			P1	P1	P2, T
GaN	on page 8	TEGa			P	P	
HfN	on page 12	TEMAH			P	P	T
HfO_2	on page 10	TEMAH	P	T			
La_2O_3	on page 13	$La(thd)_3$	P				
LaAlO	on page 13	$La(thd)_3$/TMA	P				
NbN	on page 14	TBTMEN			P	P	
Pt	on page 15	$Me_3Pt(MeCp)$	T, P				
Ru	on page 17	$Ru(EtCp)_2$	T, P1			P2	
SiN_x	on page 20	3DMAS			P1	P1	P2
SiO_2	on page 19	BTBAS	P				
STO	on page 18	StarTi, HyperSr	P				
Ta_2O_5	on page 22	TBTDMT	P	T			
Ta_3N_5	on page 23	TBTDMT			P	P	T
TaN	on page 23	TBTDMT				P	
TiN	on page 27	$TiCl_4$ Or TDMAT			P	P	
TiO_2	on page 25	TTIP	P				
WN	on page 29	WNBURE					P
ZnO	on page 30	DEZ		T			

P = plasma gases used (P1, P2, indicates alternative gases).
T = thermal gases or vapours used (T1, T2 indicates alternative chemistries)

Furnace with reducing atmosphere

PEO–604 (ATV)

- Multi-purpose process furnace with vacuum capability
- Capacity: 50 x 200 mm wafers
- Process temp: 1100 C, rate < 100 C/min
- Multi-purpose: Easy swap of quartz glass
- Reducing atmosphere: $\mathbf{H_2}$ **/** $\mathbf{N_2}$

Tool accepted in February

Major part of the investment is paid by the **pyrolysis project** (Stephan Keller)

Initial development will focus on pyrolysis before releasing for other purposes

PECVD-4 – replacement of PECVD-1/2

- SiO / SiN / SiON / BPSG / (~~Ge-doped~~)
- Including stress-tuning capability
- Refurbished SPTS system (2011)
- Installation in Q2 2015

Details

2 wafer carousel loadlock

Hinged lid for easy access to showerhead (quick to change)

High Power / High Frequency clean (C4F8)

New software

PLC control system

Large gasbox

Easy size change (2, 4, 6, 8″)

Option: TEOS LDS heated delivery line

Tools leaving – decommissioning 2015

Decommissioning of equipment

- Noble Furnace/old Resist Pyrolysis Furnace (replaced by ATV Furnace)
- PECVD-2 (replaced by PECVD-4)
- SSE Spinner (Maximus) (replaced by Süss Gamma 2M)
- Developer 1+2 (Alternatives: 6 Inch dev. + Gamma UV dev. + R2D2)
- KS Spinner (To be replaced by new KS spinner – RCD8)
- K&W aligner (replacement: KS Aligner 2)

wrap up

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