

Laser material processing: USP @ Philips Drachten?

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F. Vrijburg (**Philips**)

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Laserforum en Kring voor Materiaalbewerking 2014

Martijn de Keijzer (ECN-MTA, dekeijzer@ecn.nl) en
Folkert Vrijburg (Philips CL-RPD, folkert.vrijburg@philips.com)

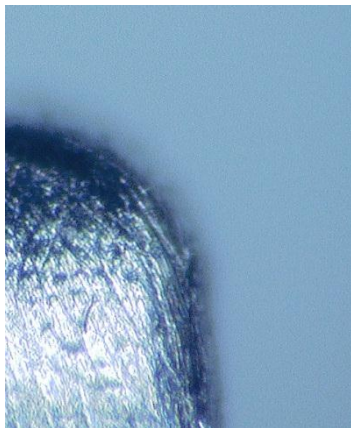
6 November, 2014

Opzet

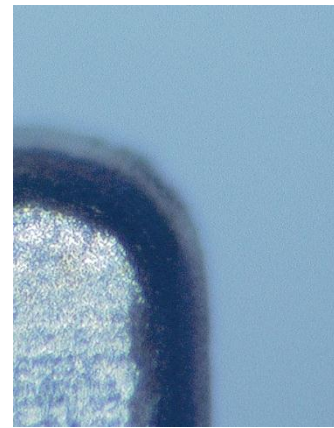
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- Intro Philips: DTN, RPD, LMM (7 slides) Folkert
- Intro ECN: locaties en lasers (3 slides) Martijn
- Setup voor USP experimenten: ADEM (4 slides) Martijn
- ECN USP laser: Resultaten: fs-ps bewerking onder de loep (4 slides) Martijn

- Ns(mechanisch nabewerkt)



- sub ps(zonder enige vorm van nabewerking)



Who are we

- Founded in **1891**
- Headquarters: **Amsterdam**, NL
- Sales: **€ 23,3 billion** (2013)
- Employees: **116,000** (2013)
- Operating in **>100 countries**
- **8% of sales** invested in R&D



Philips is a **global company** which delivers **meaningful innovations** that improve people's **health and well-being**

One Philips: Our Sectors

Healthcare



Imaging Systems • Clinical Care Systems •
Healthcare Informatics and Patient Monitoring •
Home Healthcare Solutions • Customer Services

Consumer Lifestyle



Television • Shaving & Beauty • Audio & Video
Multimedia • Domestic Appliances •
Health & Wellness • Peripherals & Accessories

Lighting



Lamps • Professional Luminaires • Consumer
Luminaires • Lighting Electronics • Automotive •
Special Lighting Applications • Solid-State Lighting
Components & Modules

Annual R&D spending ~€ 100 M

2000 employees of which 600 R&D

8 M Shavers/year



Drachten is Philips CL's largest development and manufacturing site

Philips Drachten

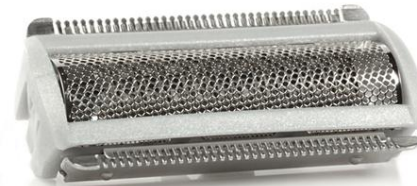
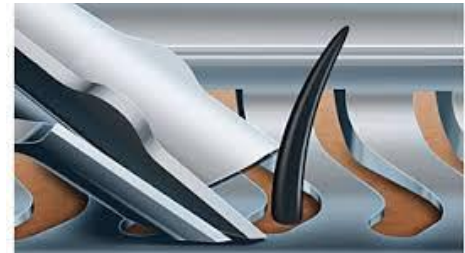
Prototyping department(45fte 1000m2):

Laser micro machining group(7fte 200 m2)



Development of LMM(+/- 2000-present):

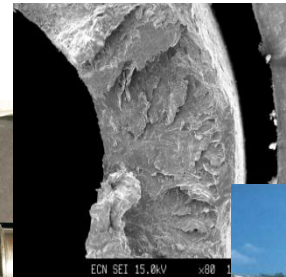
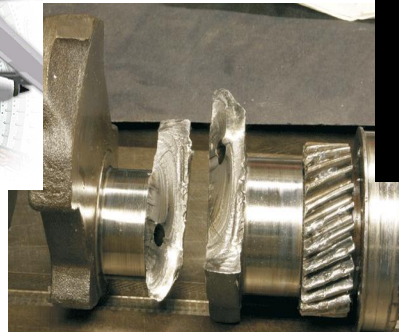
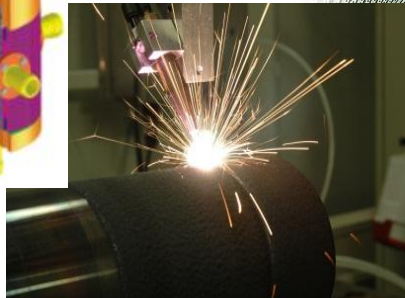
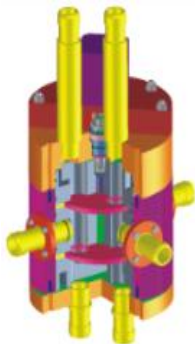
- 5 axis machine platform (Okuma).
- 3D laser micro machining software platform.
- High speed scanning laser ablation.
- Day to day capacity for two full time programmers/process specialists.



Environment & Energy Engineering: Expanding the envelope

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- Engineering & Realisation
 - Engineering
 - Realisation
 - Commissioning
 - HAZOP
- Materials
 - Characterisation
 - Failure analysis
 - Product optimisation
 - Production technology development
- Testing & Analysis
 - Corrosion testing
 - Lifetime prediction
 - Materials & Gas analysis
 - Pilot plant operation
- Environmental Assessment
 - Air quality measurements (PM, NO_x, CO, NH₃, BTX, C_xH_y, ...)
 - Emissions modelling
 - Leaching
 - Instrument development



Locations

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 **ECN
Petten**
(Head Office)

 **ECN
Wieringerwerf**

 **ECN
Amsterdam**

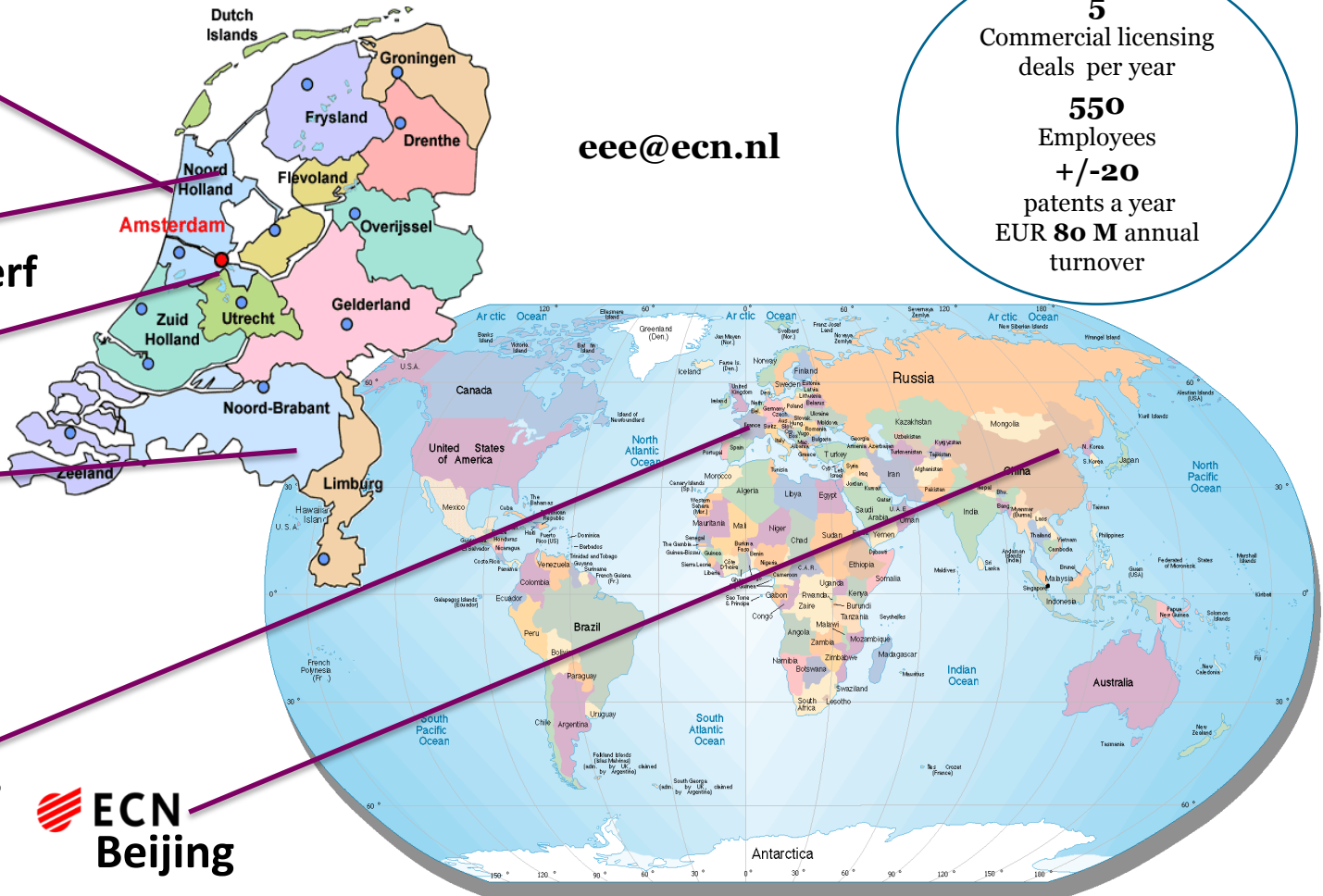
 **ECN
Eindhoven**

 **ECN
Brussels**

 **ECN
Beijing**

eee@ecn.nl

5
Commercial licensing
deals per year
550
Employees
+/-20
patents a year
EUR 80 M annual
turnover



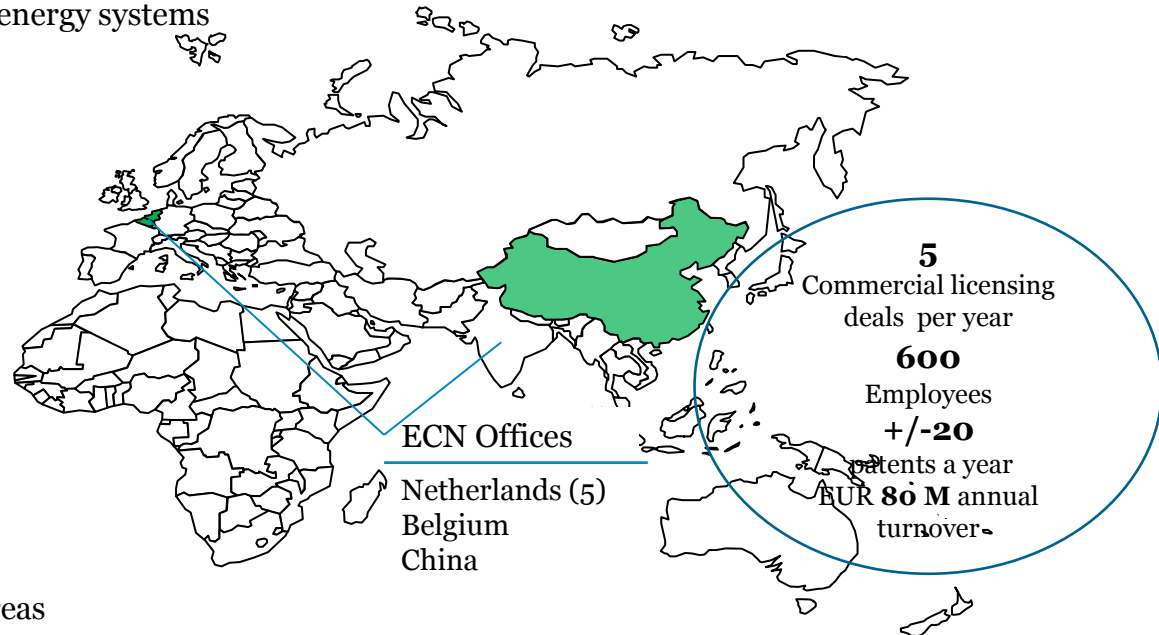
ECN at a glance

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Mission

Mission

To develop knowledge and technologies that enable a transition to more sustainable energy systems



ECN Focus Areas



- Solar energy



- Biomass



- Policy studies



- Energy efficiency



- Wind energy



- Environment & energy engineering

Lasers @ ECN: general overview



	10.6 μm	2 μm	1565 nm	1064 nm	800 nm	532 nm	355 nm	265 nm
Femtosecond				☑		☑	☑	
Picosecond								
Nanosecond				☑		☑	☑	
Microsecond	☑			☑				
Millisecond				☑				
Continuous	☑		☑	☑	☑	☑		

Legenda:



: Laser systems @ ECN



: Systems @ suppliers

Onderzoek ps-LMM

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- Overzicht industriële laser(systemen)
 - Rofin-Baasel
 - Jenoptik
 - Light Conversion
- Onderzoek @ ECN:
Het aantonen van:
 - Verschil 0.25 en 10 ps
 - Invloed golflengte
 - Verbeterde product geometrie
(ECN machine accepteert door open bouw ook LM3 aansturing)

Experimental system

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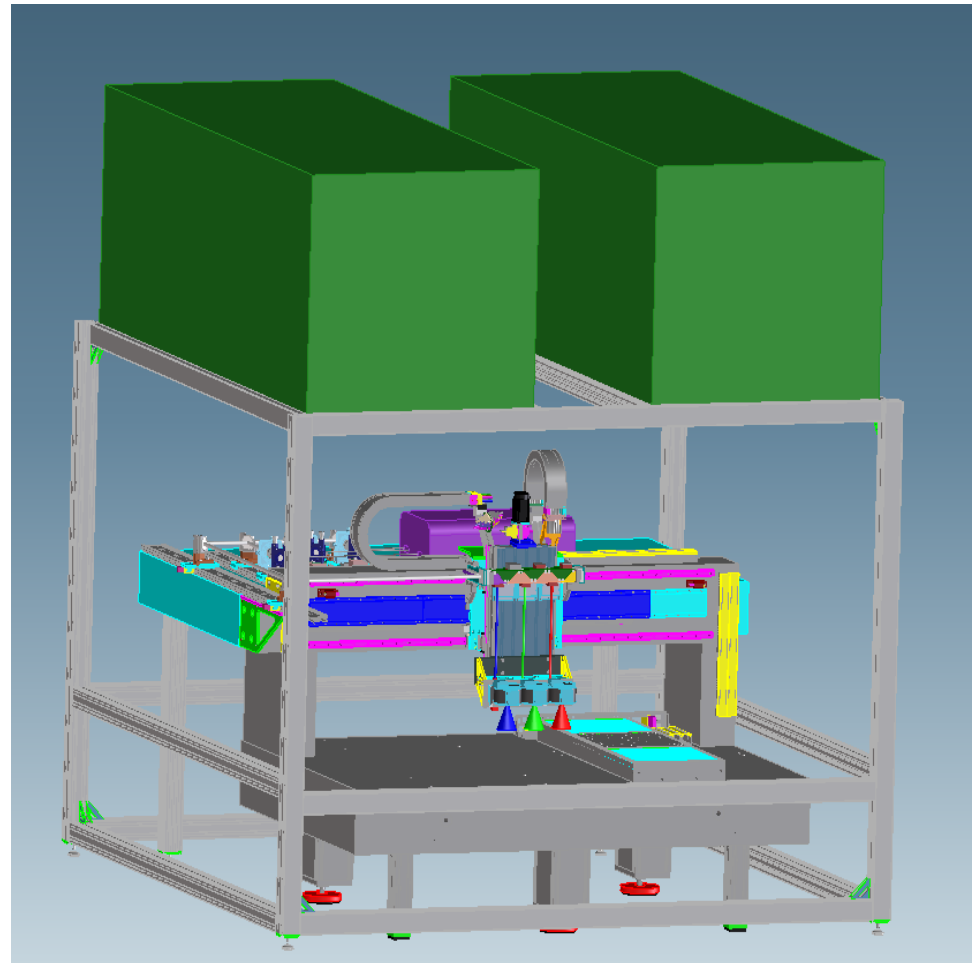
Project Adem

Platform with focus on

Pulse width range ,
three wavelength solution.
Pico second / femto second
Roll to roll and
sheet to sheet.
TCP/IP communication
(camera, power, scanners,
users)

One beam path approach

compact
allignment
optics



Specs. Adem system

Wavelength 1030 nm & 515 nm & 343 nm,

Pulse width : adjustable from 250 fs to 10 ps

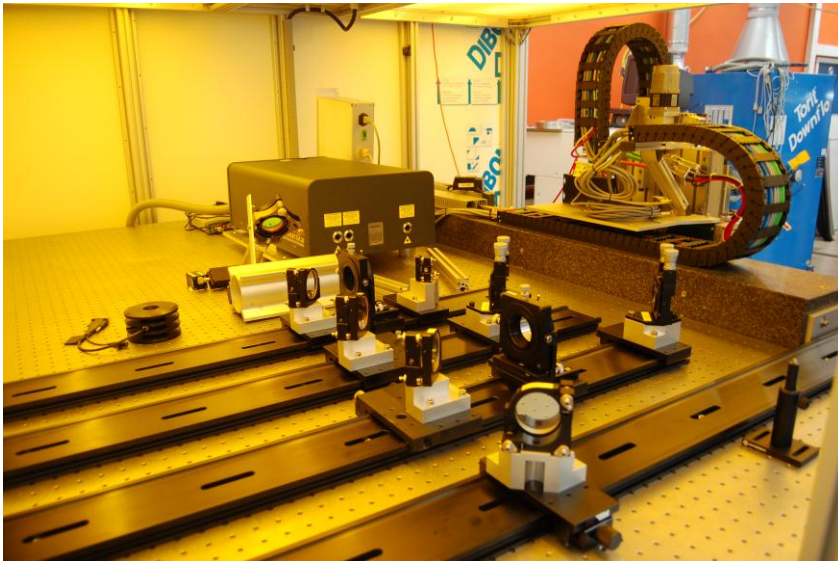
Power levels: 10 W @ 1030 nm, 5 W @ 515 nm, 2 W @ 343 nm

XYZ (1300 mm x 600 mm x 200 mm)

accuracy. X $5\mu\text{m}$, Y $5\mu\text{m}$, Z $3\mu\text{m}$

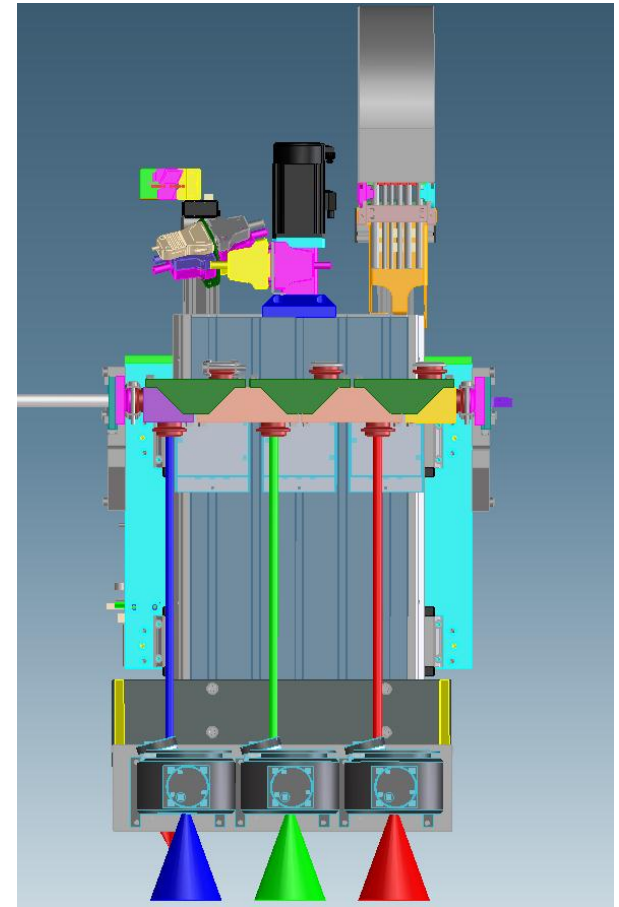
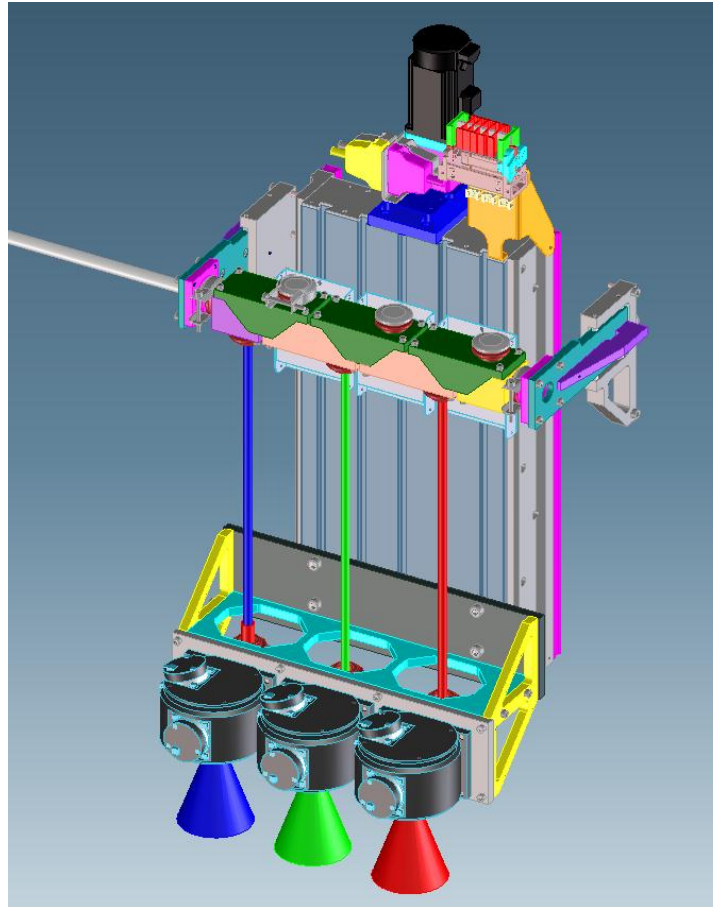
high speed Y axis, 2.5 m/s

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Z axis

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Opzet experiment

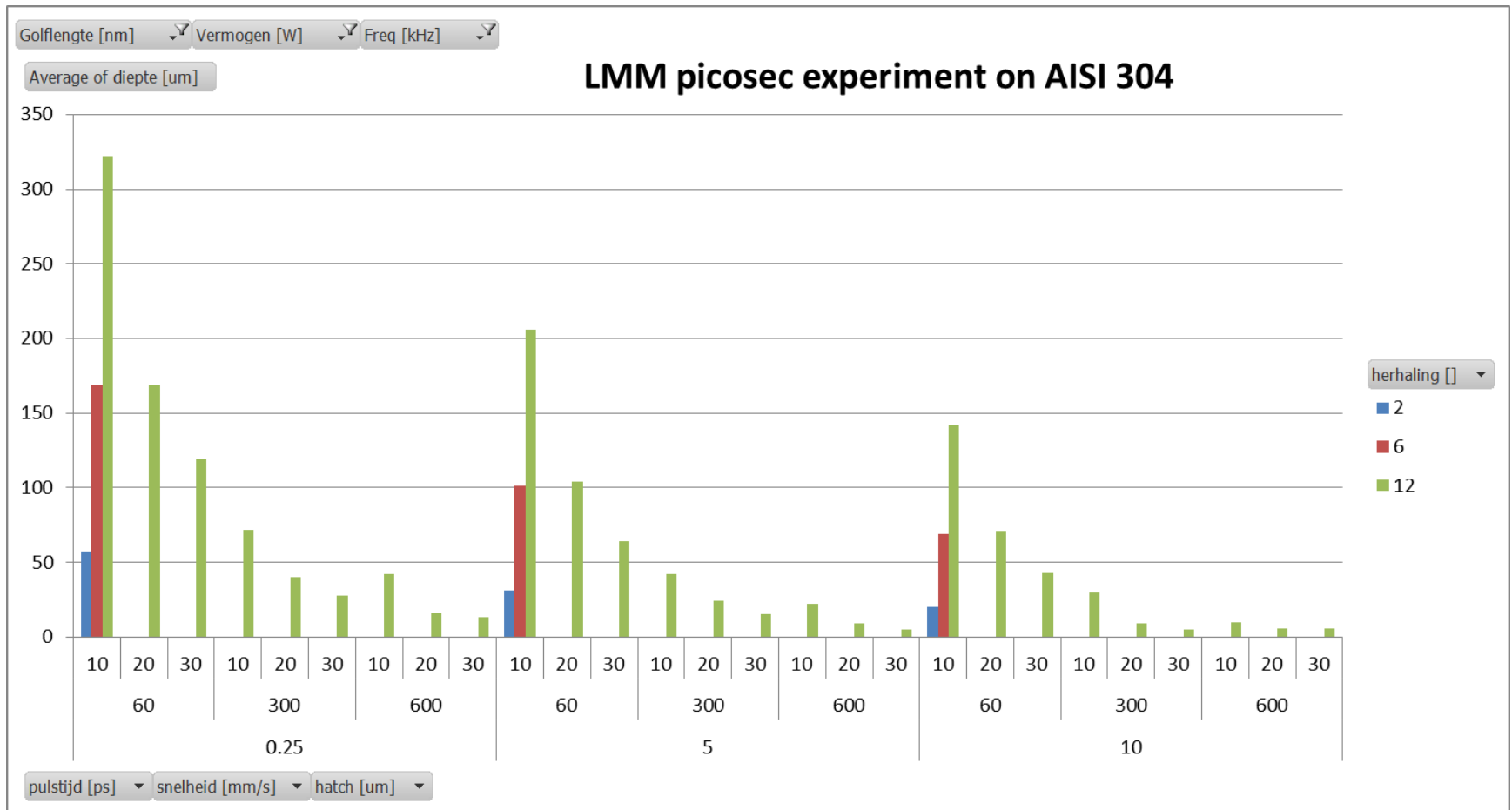
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- Drie golflengtes: 1030, 515 en 343nm
 - 1 frequentie: 100 kHz
 - Een vermogen: 1.2 W
 - Drie pulstijden (IR) : 0.25, 5 en 10 ps
 - Drie snelheden: 60, 300 en 600 mm/s
 - Drie vulafstanden: 10, 20 en 30 μm
 - Drie herhalingen: 2, 6 en 12x
-
- Schrijf vierkanten van 1x1mm
 - Meet de bereikte diepte

NB: spotgroottes niet helemaal gelijk: 1030 en 515nm ca 40 μm , 343nm ca 25 μm

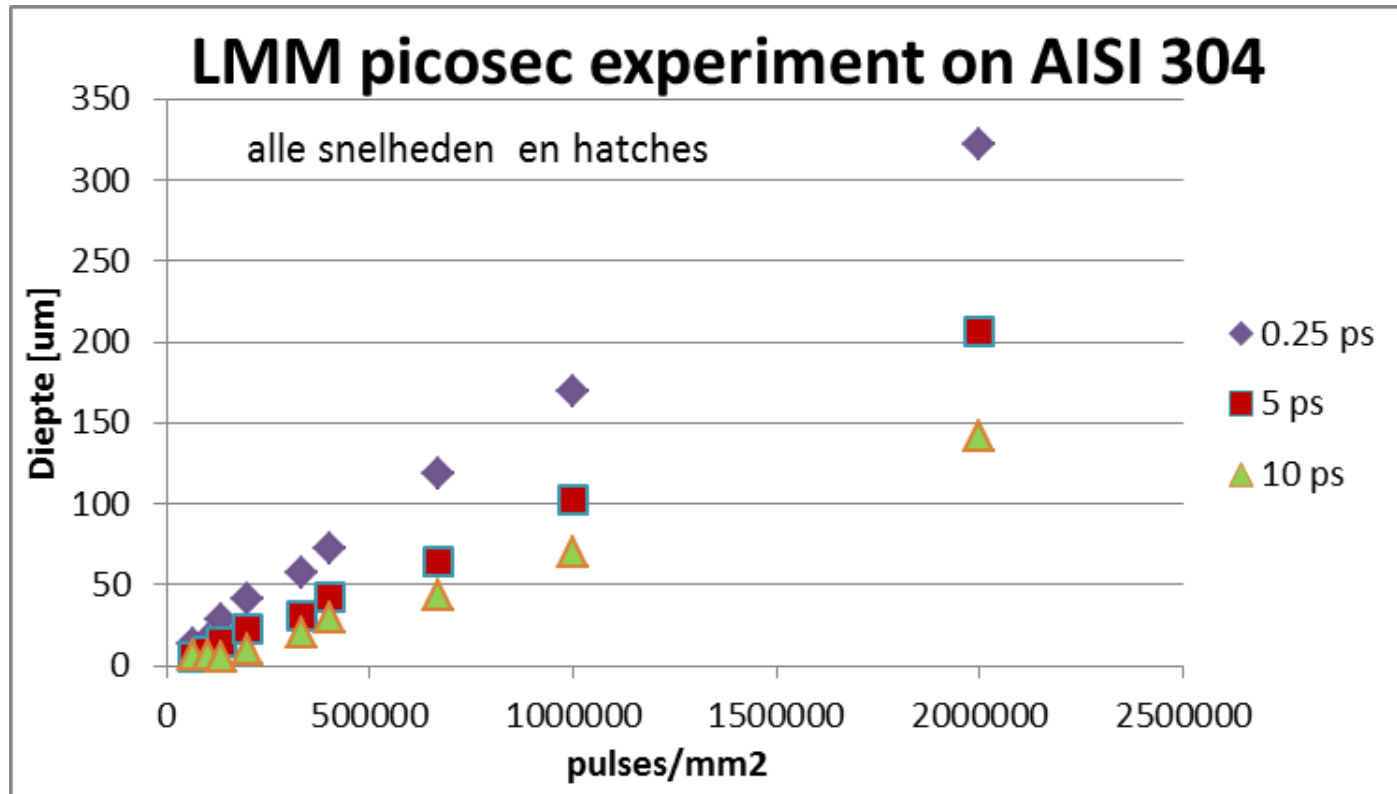
Dieptes @ 1030nm

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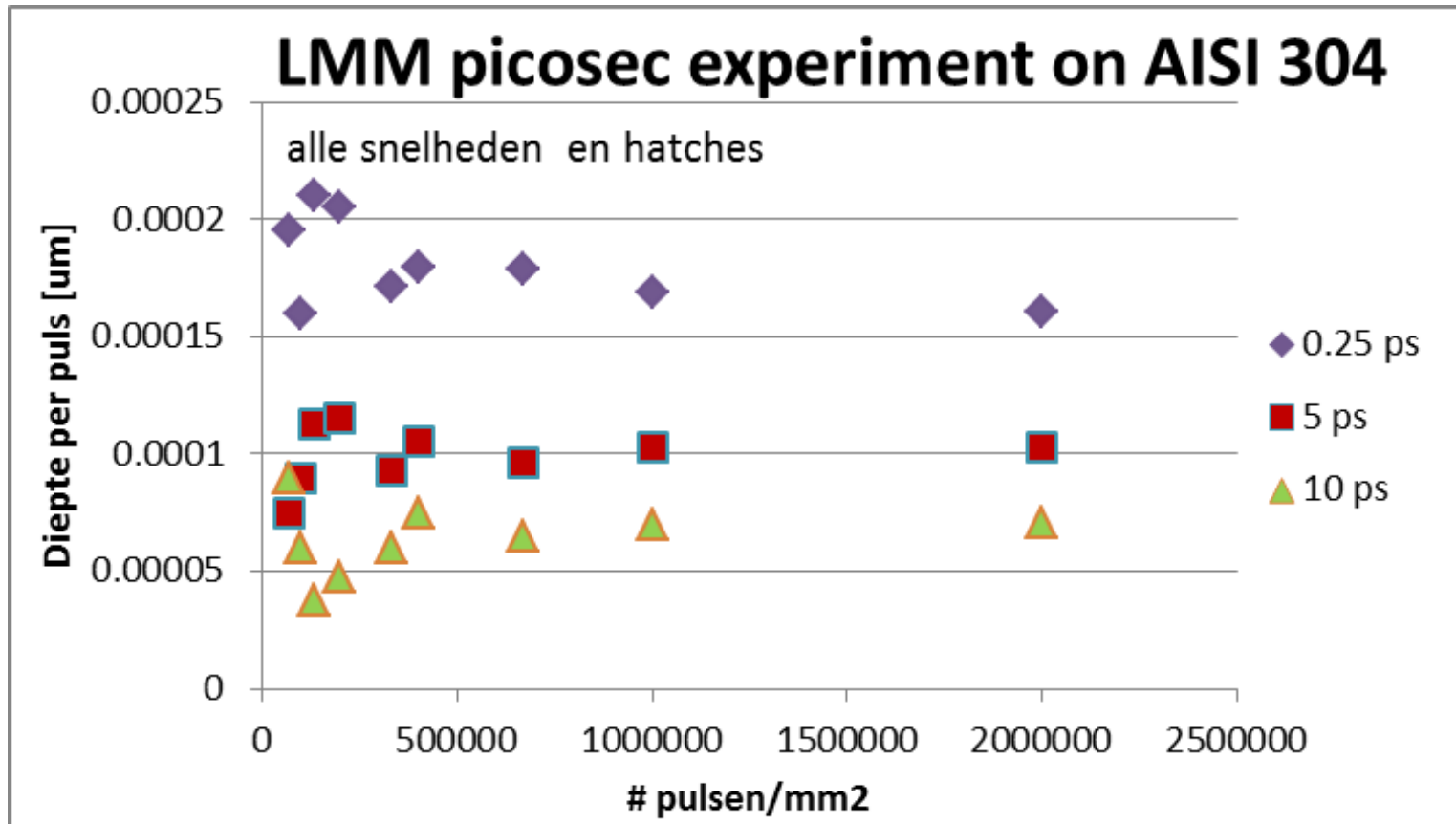
Afname genormaliseerd op pulsen/mm2

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Afname genormaliseerd per puls

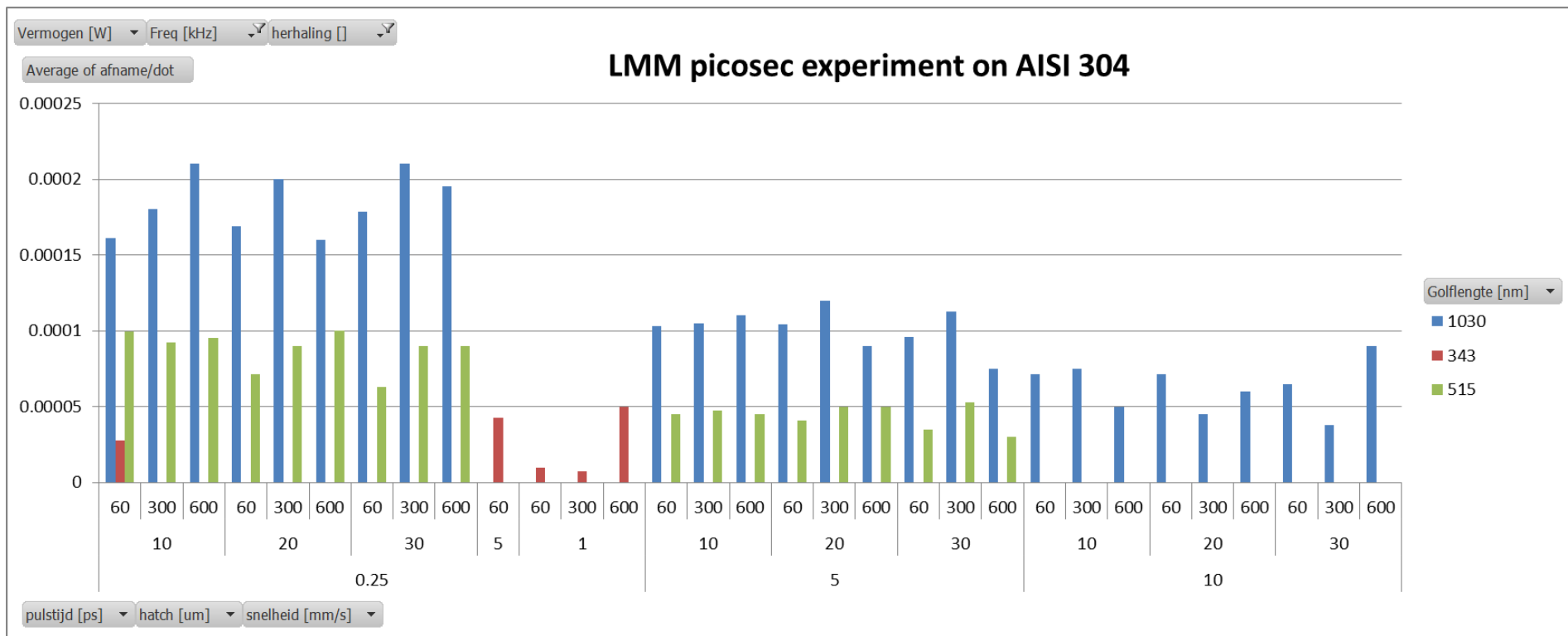
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- Hoe korter de puls hoe efficiënter de afname, geen lineair verloop....

Genormaliseerde afname per puls

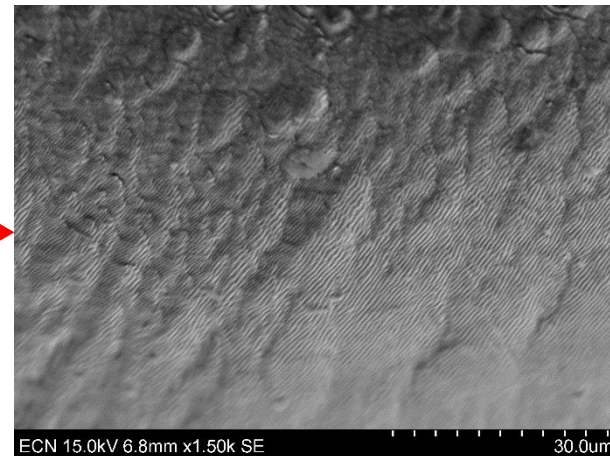
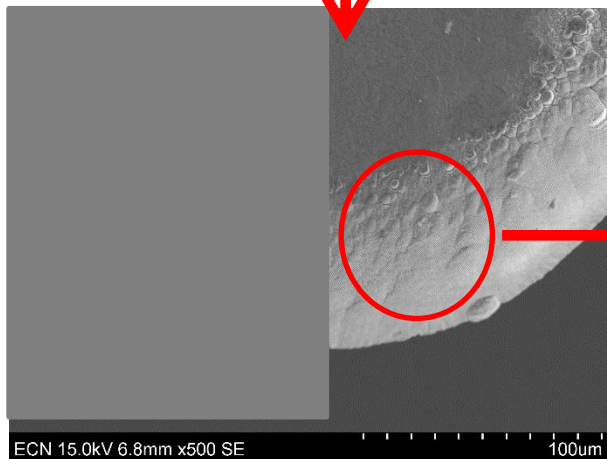
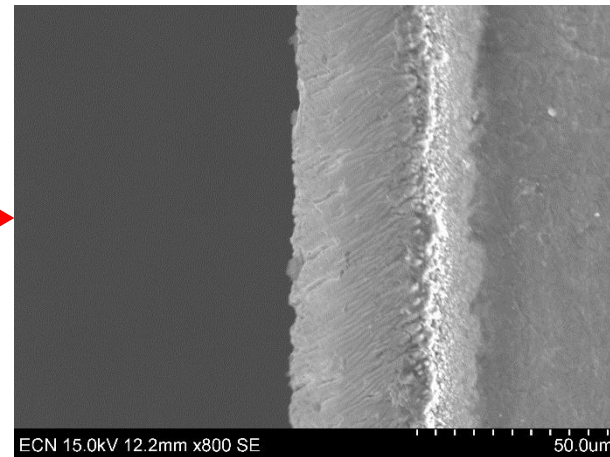
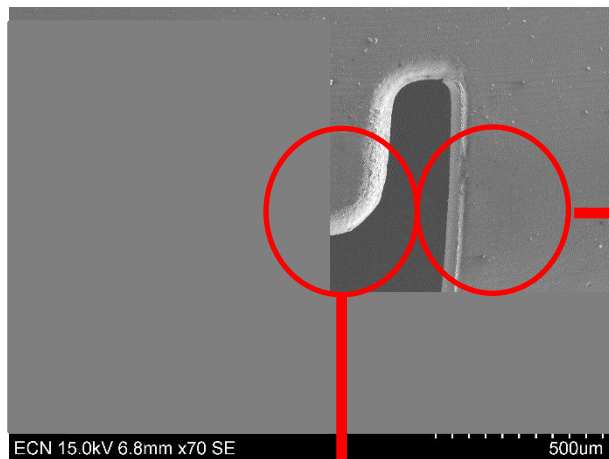
Overzicht hele experiment (n=12x)



Resultaat op typische geometrie

(AISI 304)

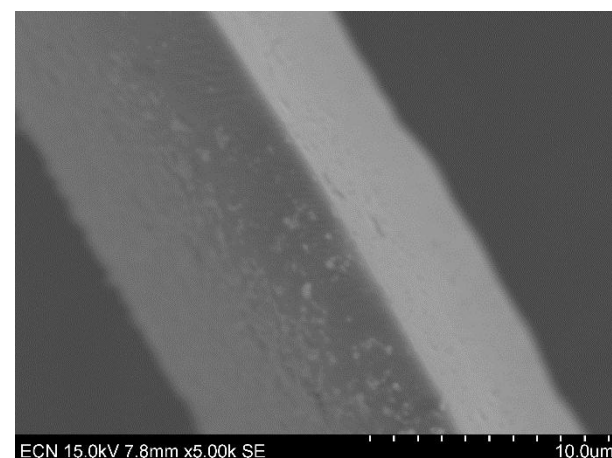
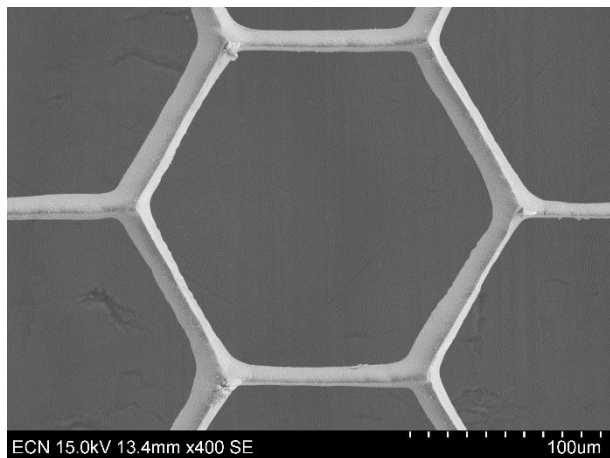
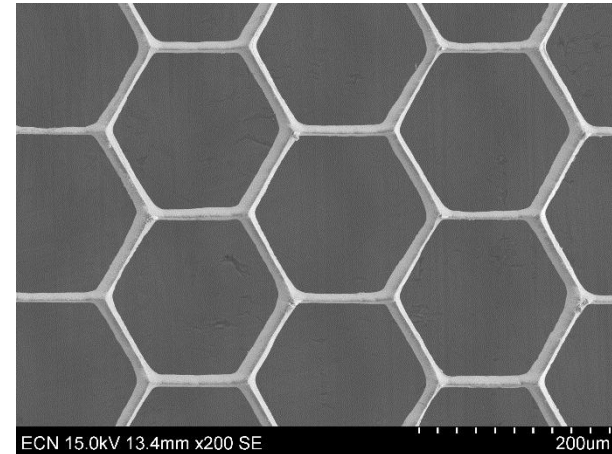
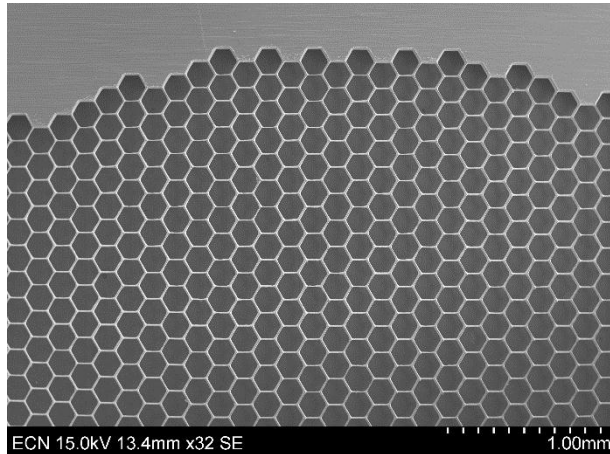
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- Strak en nagenoeg braam-vrij: geen nabehandeling meer nodig

Resultaat op typische geometrie (Molybdeen)

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Eerste resultaten

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Vragen ?



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