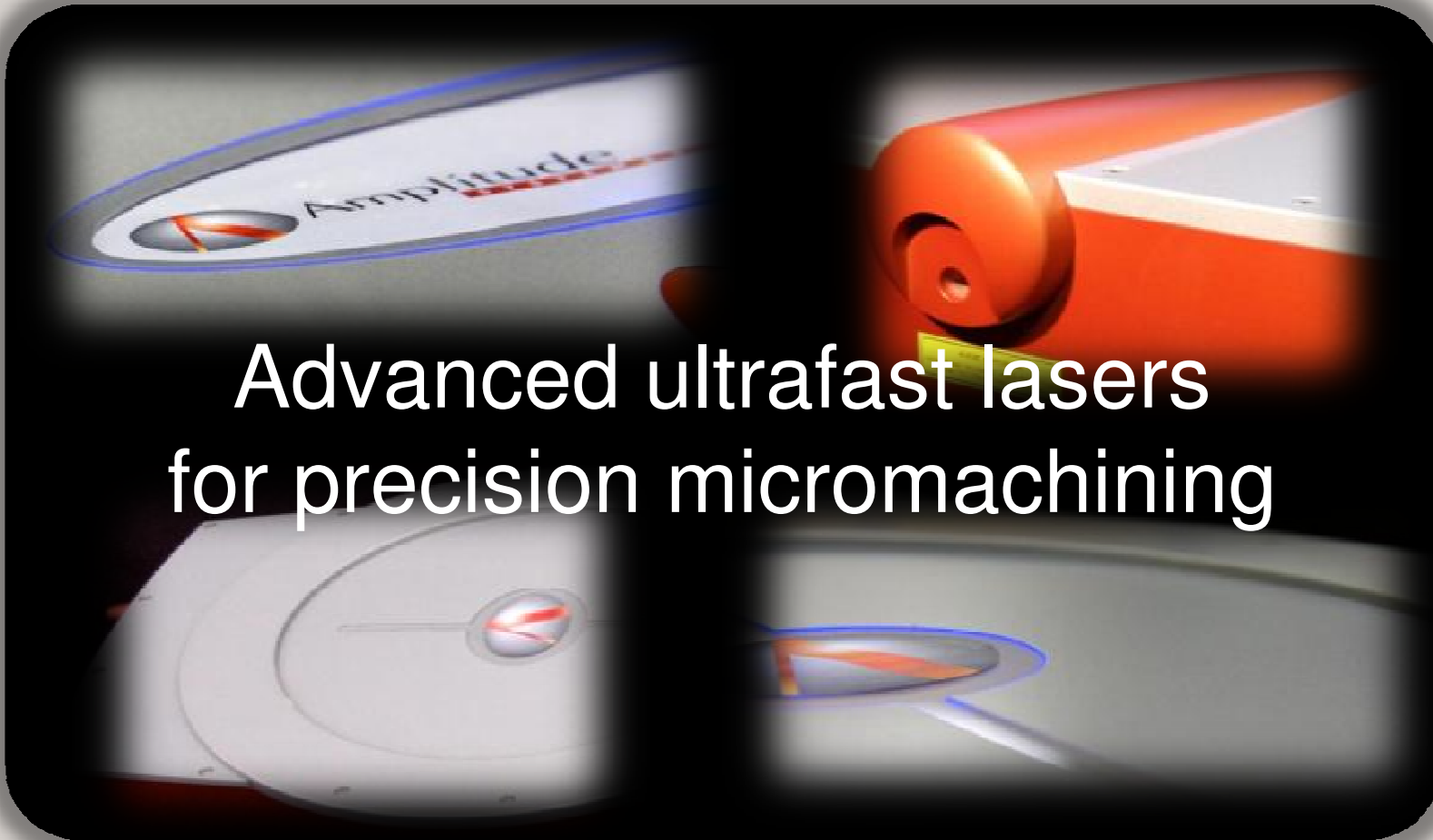
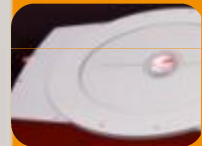


Amplitude

S Y S T E M E S



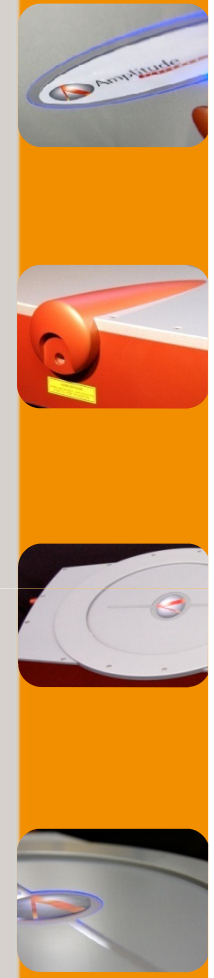
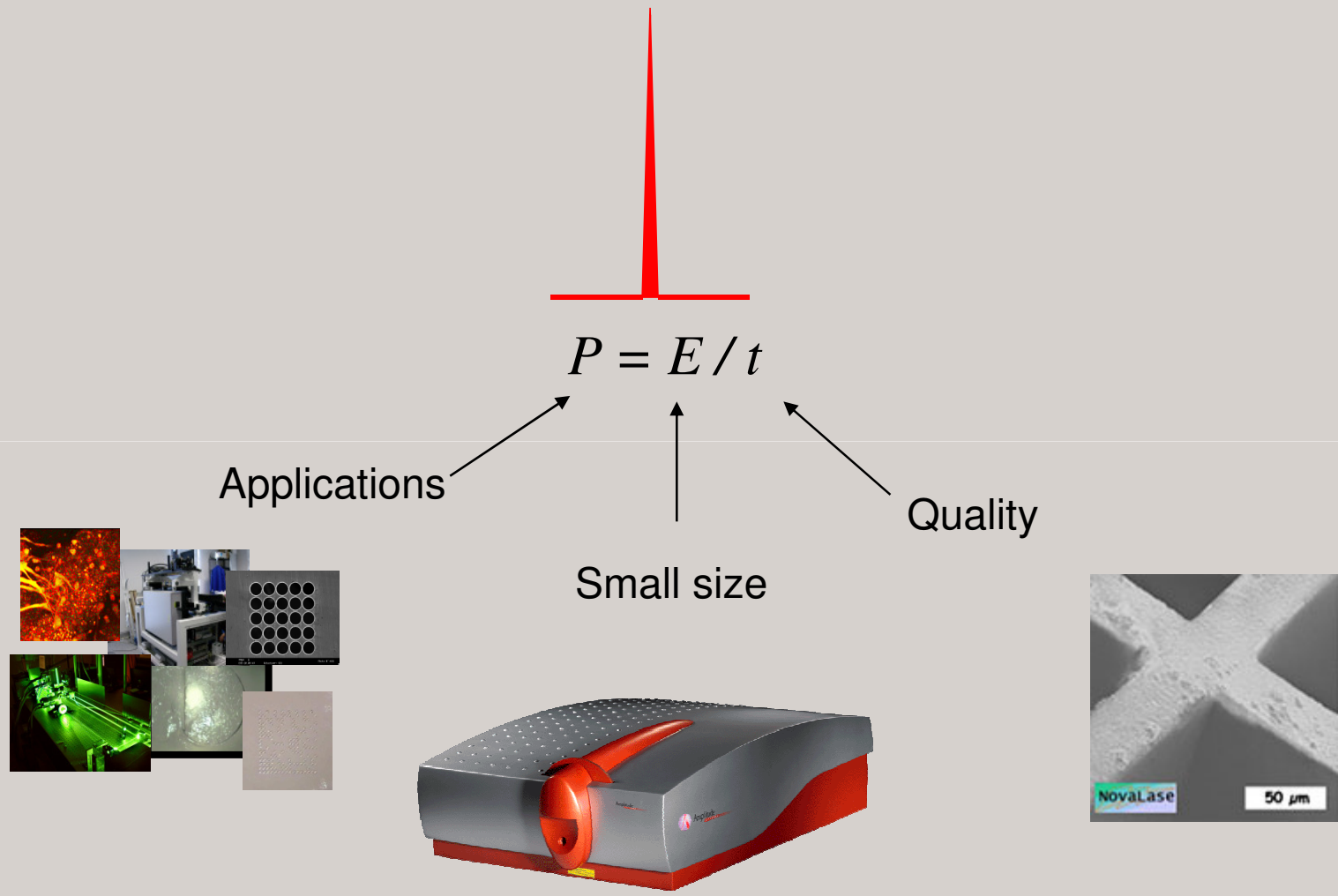
Advanced ultrafast lasers
for precision micromachining

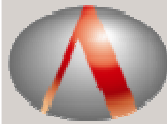


ultra **FAST**

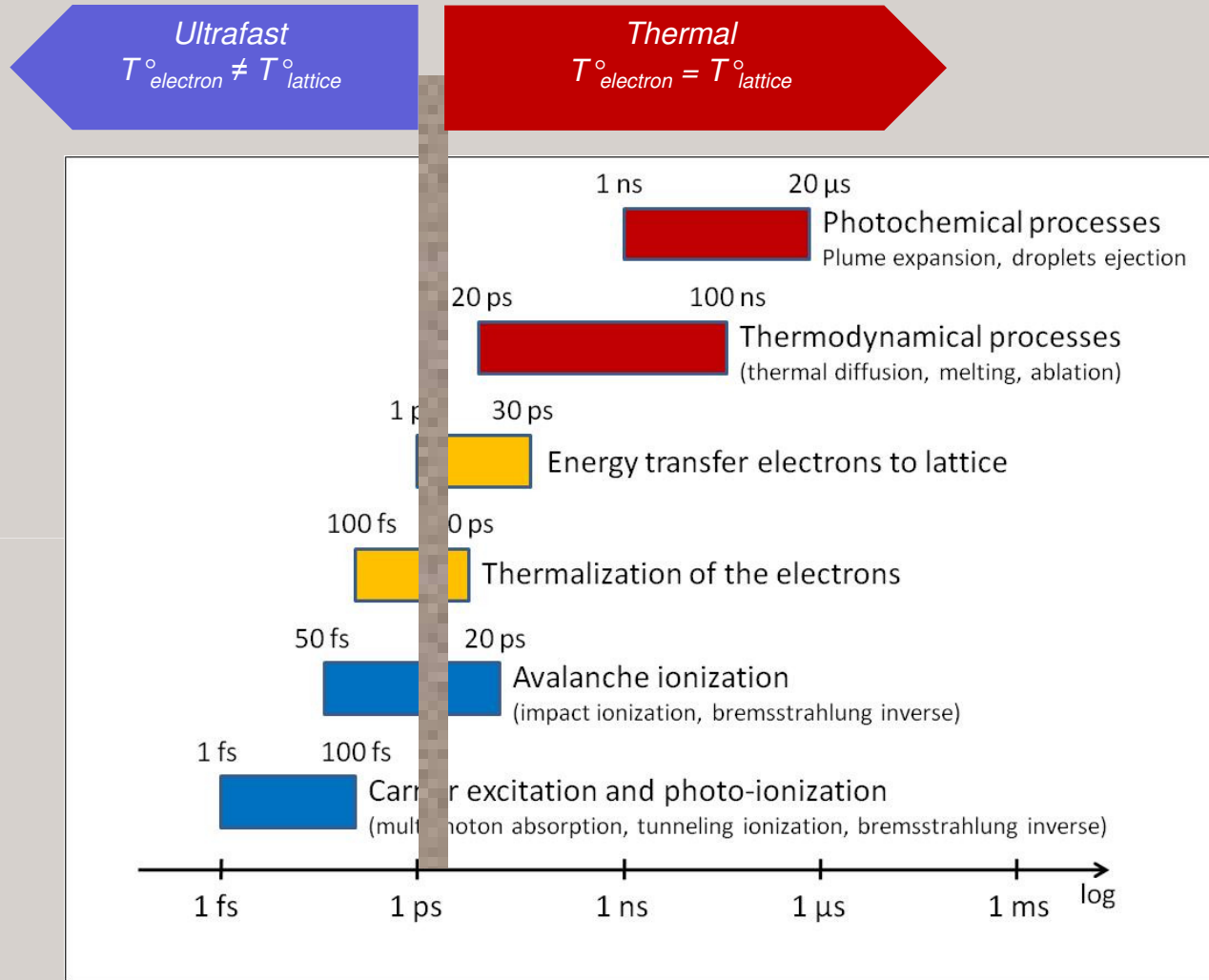
www.amplitude-systemes.com

Why ultrafast lasers?





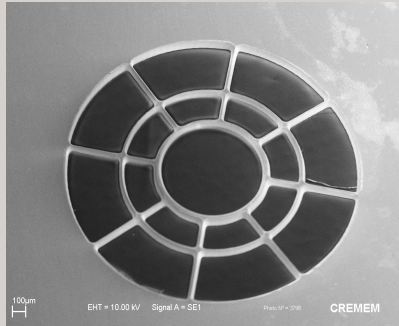
Laser ablation process



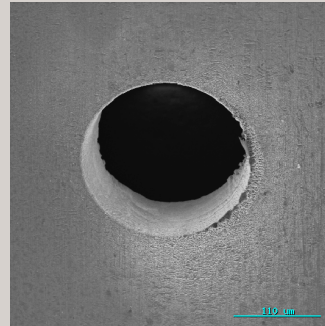
Electron cooling time 1-10ps

Lattice heating time : 100ps – 1ns

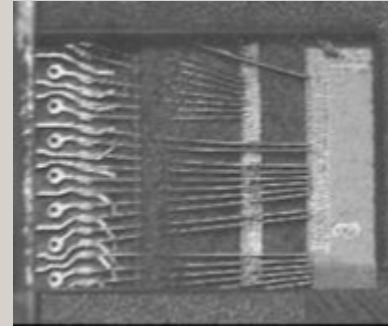
A variety of processes



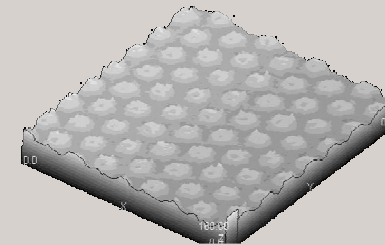
Cutting
(Tungsten)



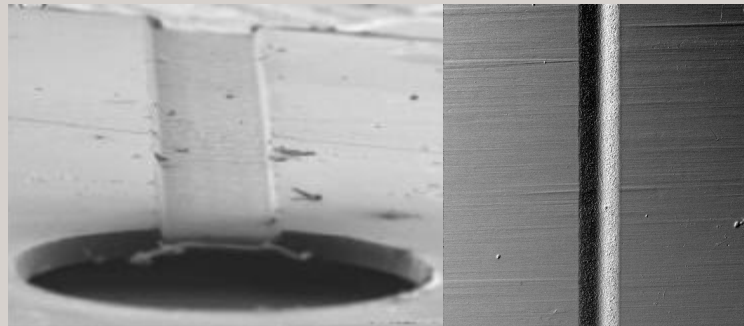
Drilling
(steel)



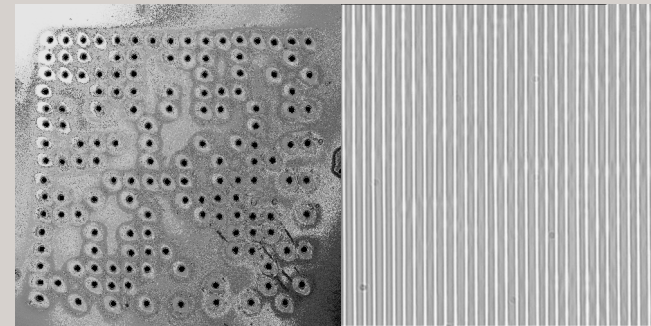
Selective
ablation



Texturing
(Platinum)



Engraving
(Polyimide, Molybdenum)



Surface & Internal
Marking (Silicon, glass)

	Ablation efficiency mm³/min per Watt		
Pulse duration	500 fs	900 fs	34 ps
Molybdenum	0.19 @ 12W	0.1 @ 2W	0.02 @ 1W
Silicon	0.38 @ 5.9W	0.19 @ 7.4W	0.04 @ 6W
Copper	0.26 @ 2W	0.21 @ 2W	0.07 @ 12W
Nickel	0.25 @ 3.5W	0.28 @ 1W	0.03 @ 3W
Stainless St.	0.19 @ 2W	0.2 @ 1W	-
Brass	0.45 @ 5.9W	0.26 @ 2W	0.08 @ 3W
Alumina	0.6 @ 3.5W	-	0.05 @ 1W

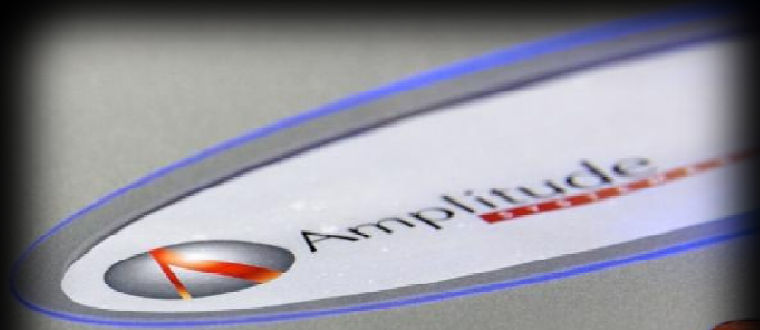
J. Lopez et al. Laser in Manufacturing, CLEO Europe, Munich, 2011

Femtosecond laser requires less average power than picosecond laser for the same ablation rate.

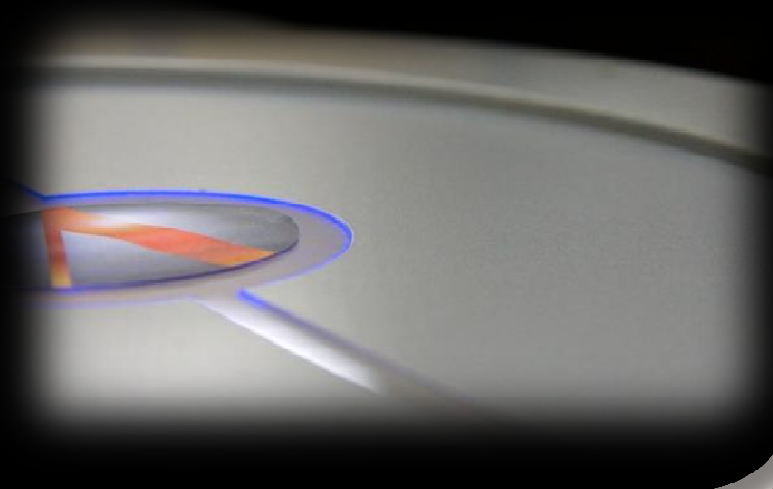


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Technology



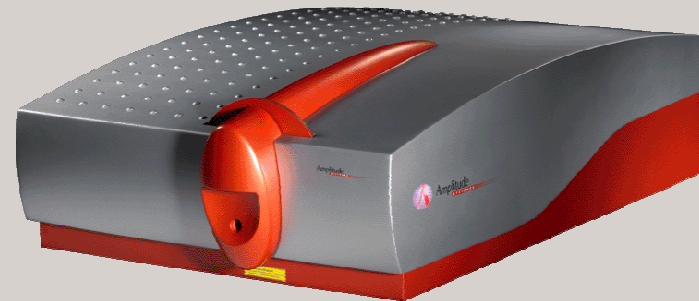
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Industrial ultrafast lasers



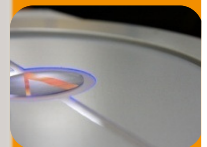
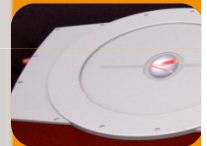
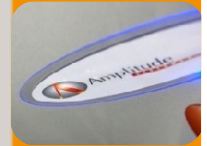
Oscillators

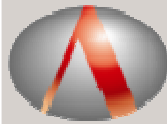


Amplifiers



Fiber lasers





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Industrial manufacturing



Clean room production

ISO 9001

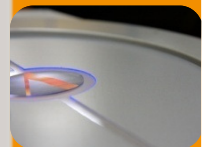
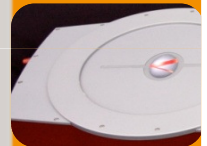
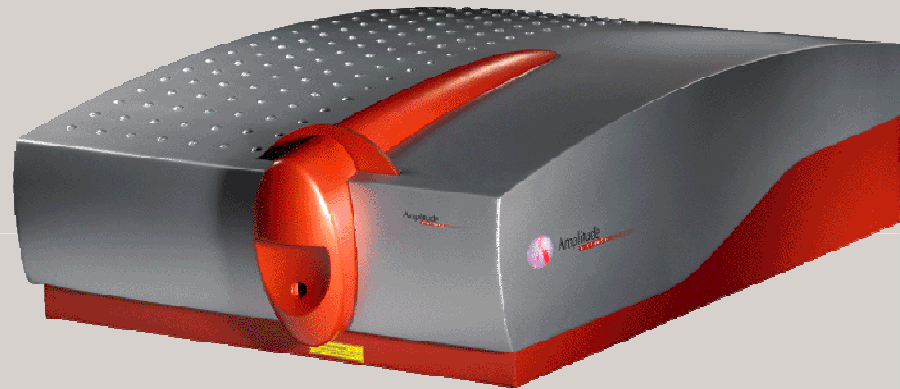
BUREAU VERITAS
Certification



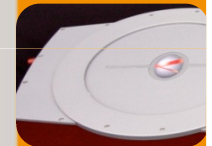
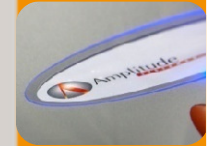
Vibration tests

A flexible laser for process development

- High performance
 - High speed: ~0-300 kHz
 - High pulse energy: 1 mJ
 - Short pulse duration: 500 fs
 - Small footprint 50x75 cm
- User control of key parameters
 - Full computer control
 - Pulse duration from femtosecond to picosecond
 - Repetition rate from 0 to 300 kHz
 - Pulse energy from 0 to 1 mJ
 - Internal or external trigger



Product	Satsuma	Tangerine fs
Pulse energy	1-10 μJ	> 100 μJ
Repetition rate	5 MHz	2 MHz
Power	5W	20W
Footprint (cm)	60x40	120x40
Refroidissement	Air	Chiller





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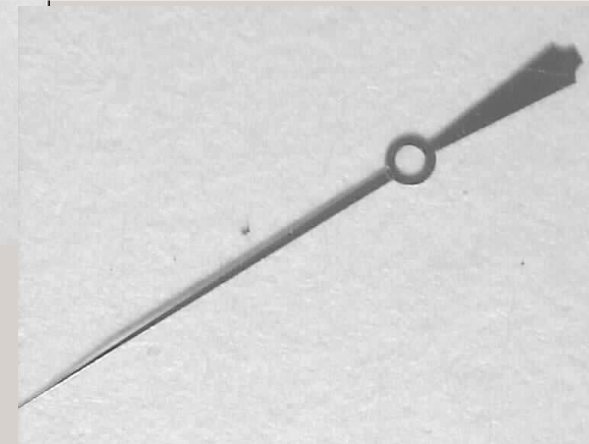
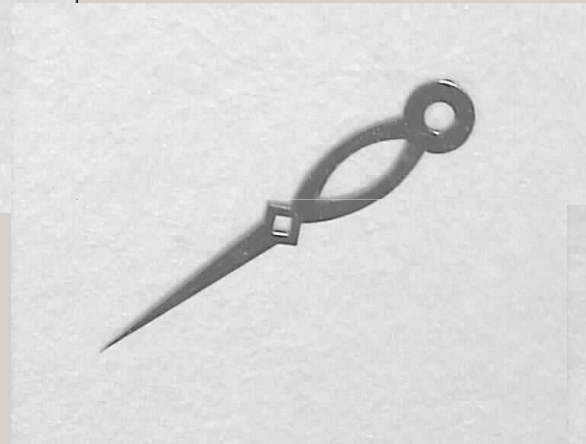
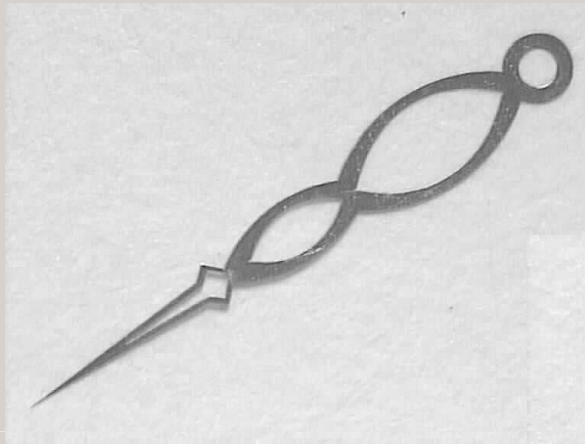


Example of applications



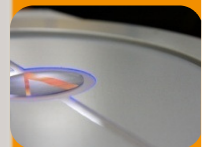
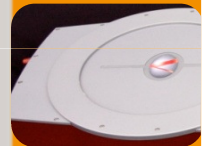
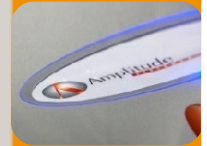
nothing but
ultraFAST

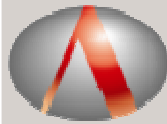
www.amplitude-systemes.com



Material : Gold
Thickness : 25 μ m

Courtesy Alphanov

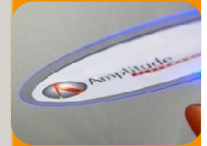




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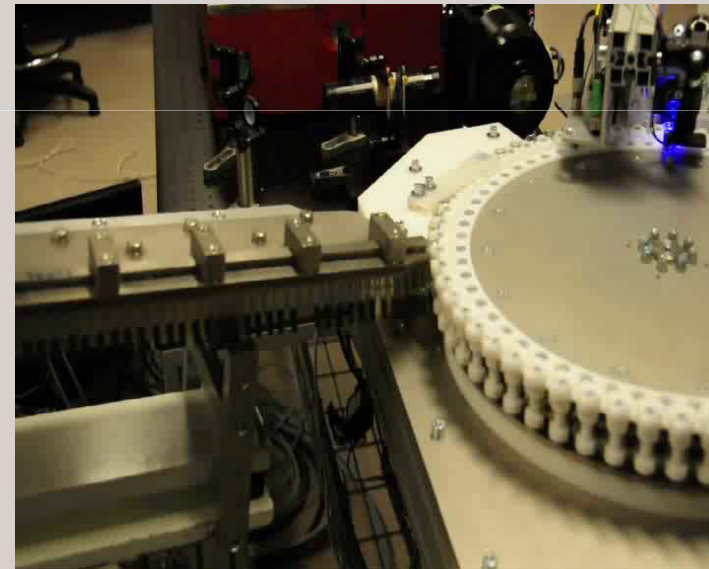
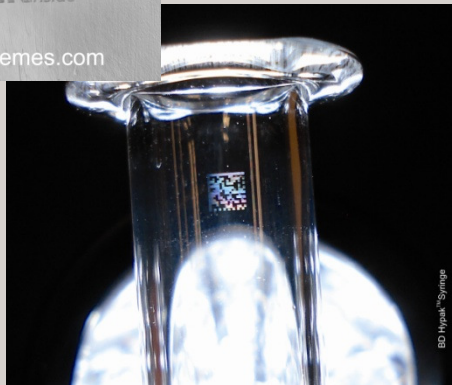
Precision cutting and engraving



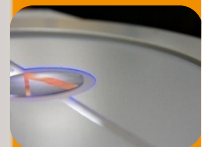
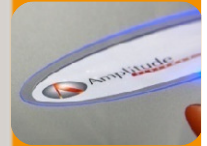
Courtesy Lasea

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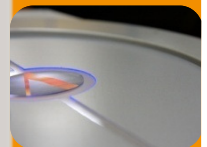
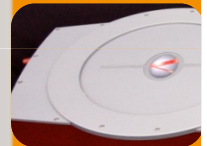
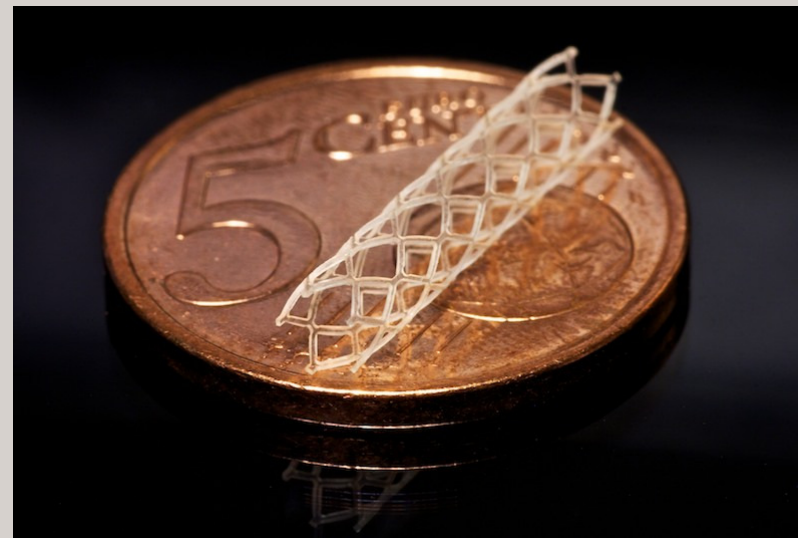
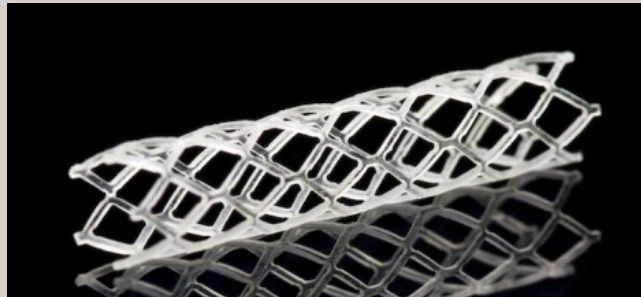
- Invisible, tamperproof, unerasable mark
- Internal engraving of glass
- Datamatrix, logo...
- Perfume and beverage, pharmaceutical industry

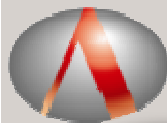


Marking and reading, 10 syringes /sec



- Stent manufacturing
- Cochlear implants
- Catheters
- High added value components





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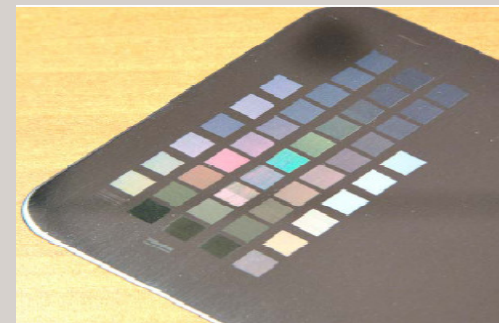
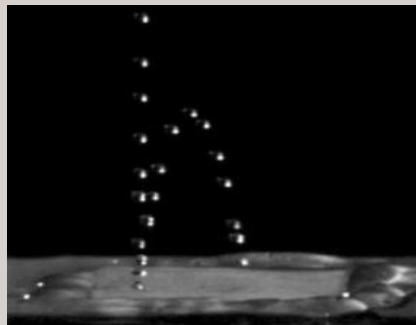
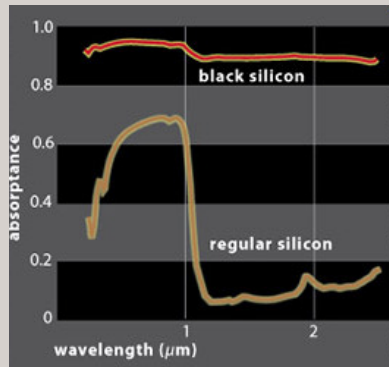
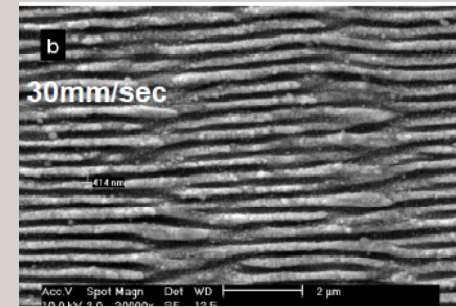
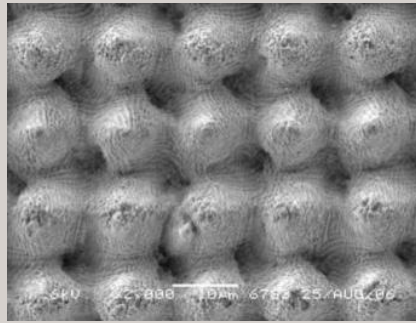
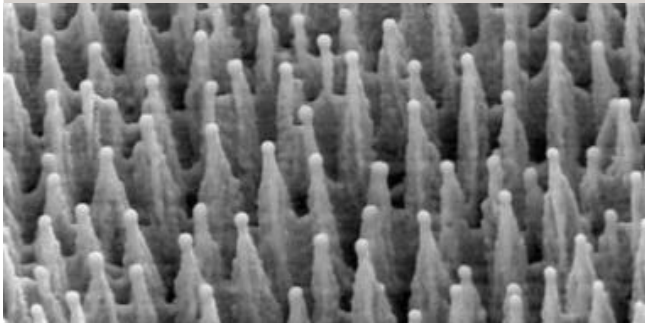
From micro- to nano-machining



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Surface texturing

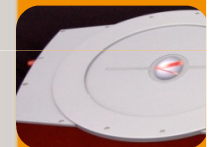
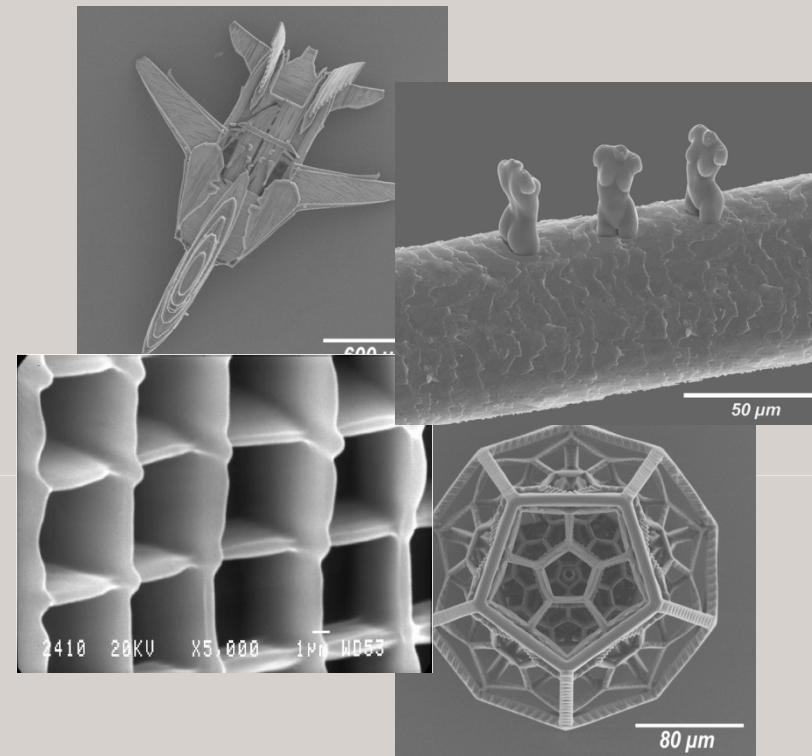


Nano-texturing
(black Silicon)

Hydrophobic coating

nano-ripples
(surface coloring)





3D nanoprinter: FemtoPrint project

www.femtoprint.eu

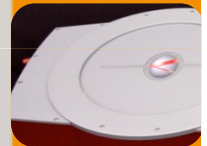
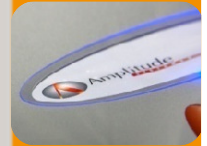
Nano-particles generation



Particular
customized material



Courtesy Laser Zentrum Hannover



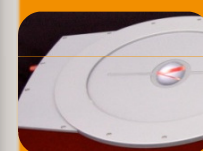
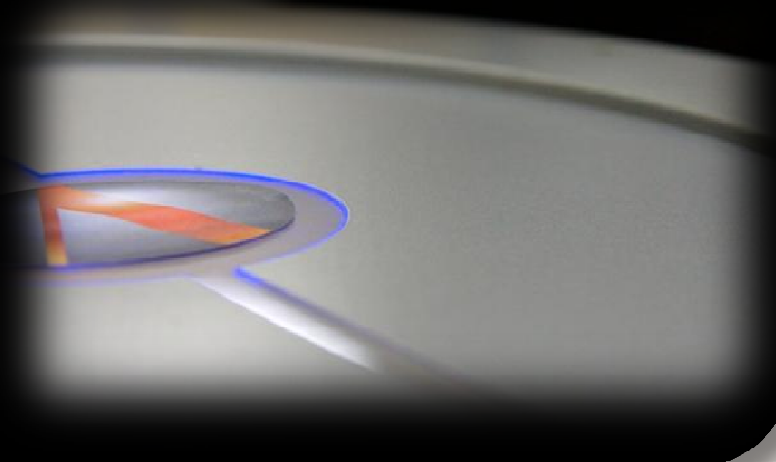


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Thank you for your attention



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