

5th RD51 Collaboration Meeting

# GEM Foils by laser MicroMachining: preliminary results

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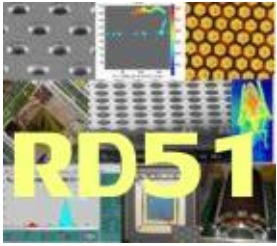
INFN - Bari (Italy)

A Ancona, T Sibillano

CNR-INFN Bari (Italy)

Special thanks are due to Rui de Oliveira  
for his active support

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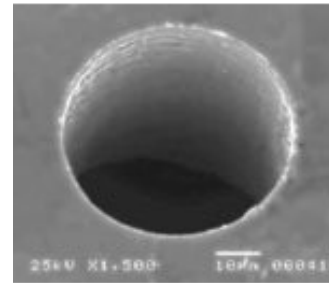
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# Why Laser Micromachining?

- Flexibility;
- Possibility of manufacturing very large arrays (2x2 m and more);
- Manufacturing is (rather) simple

### Trepanned Holes

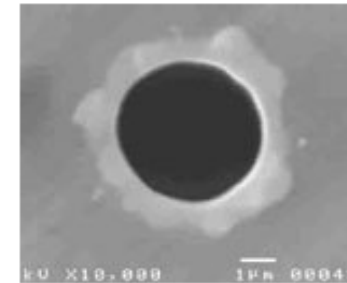
Diameter  $>0.020\text{mm}$   
All materials



50 micron diameter, steel

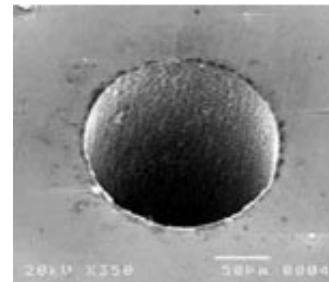
### Percussion Holes

Diameter  $>0.001\text{mm}$   
Metals, ceramics, polymers



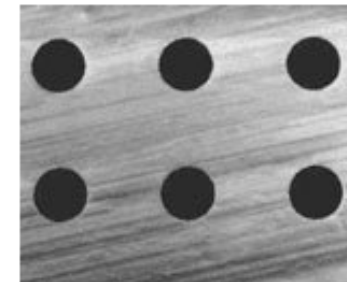
5 micron diameter, steel

### Metal & Semiconductor

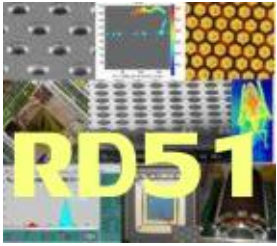


150 micron diameter, silicon

### Ceramic



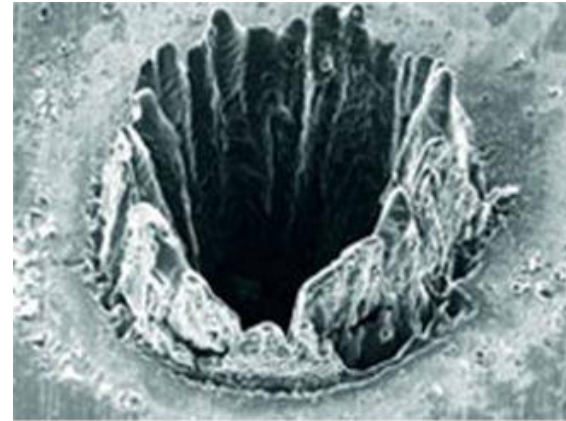
60 micron diameter, SiN



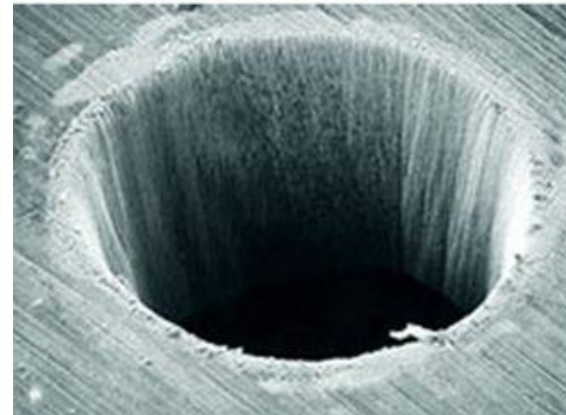
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## Laser ablation and micromachining

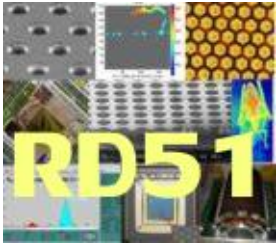
nanosecond



picosecond



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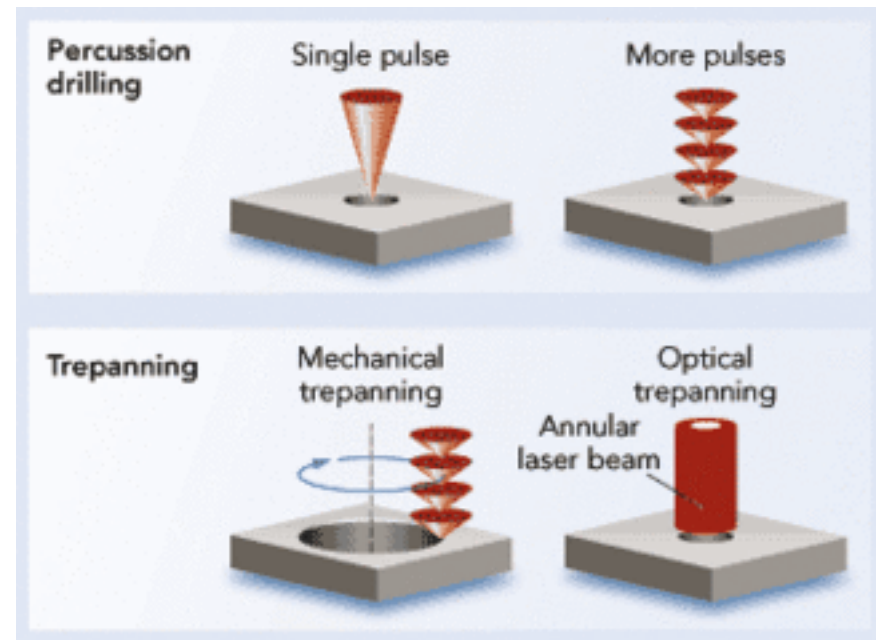
# The laser and the technique

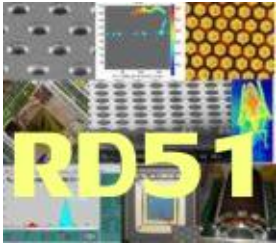
Fiber laser (experimental, non disclosure agreement);

Maximum power is 10W at a frequency of several 100kHz

Laser pulse = 100 ps;

The technique used is named “Mechanical trepanning”





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# Process parameters

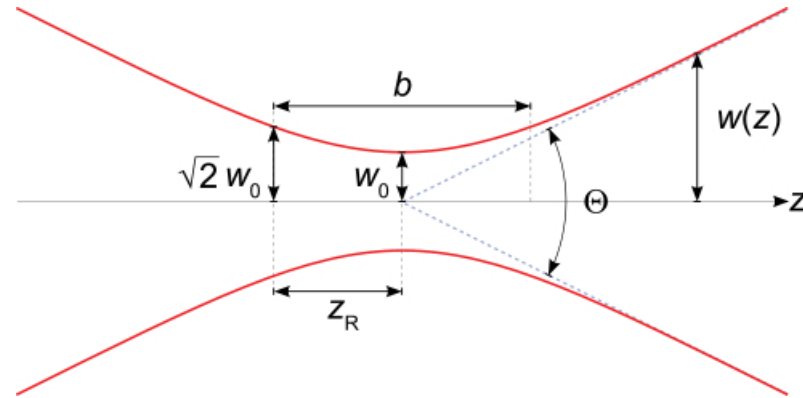
$$w_0 = \frac{4\lambda f M^2}{\pi D}$$

D = diameter on the lens

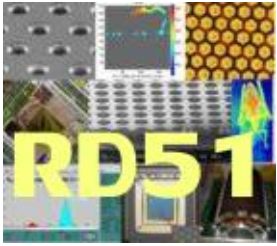
f = focal length

M = quality factor

b = Rayleigh length



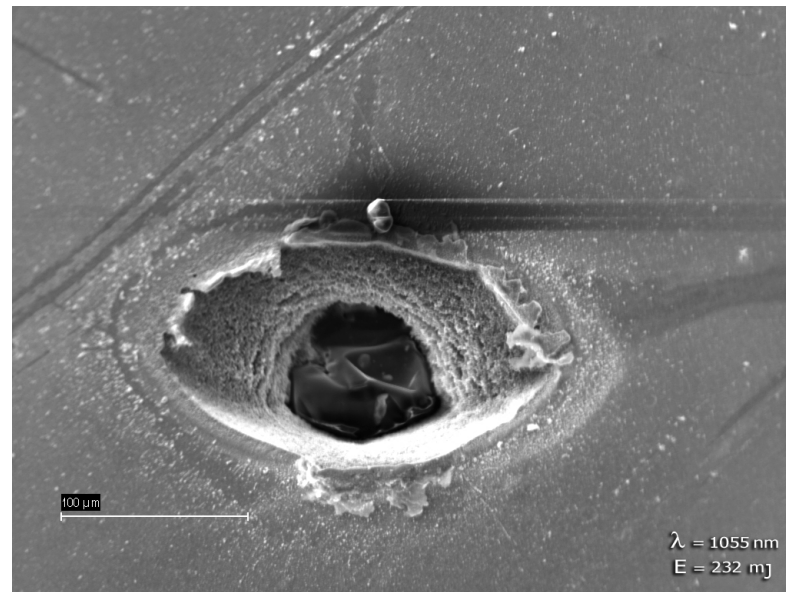
$$\begin{aligned} D' &= 4.0 \text{ mm}; & M^2 &\approx 1.3; \\ f &= 56 \text{ mm}; & \lambda &= 1064 \text{ nm}; \\ w_0 &\approx 20 \text{ }\mu\text{m}; & b &\approx 2 \text{ mm}. \end{aligned}$$



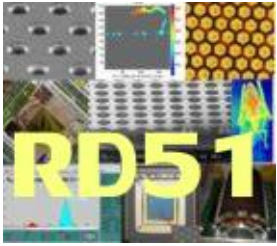
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## Very early test

(percussion drilling, ns laser, Nd:YAG)

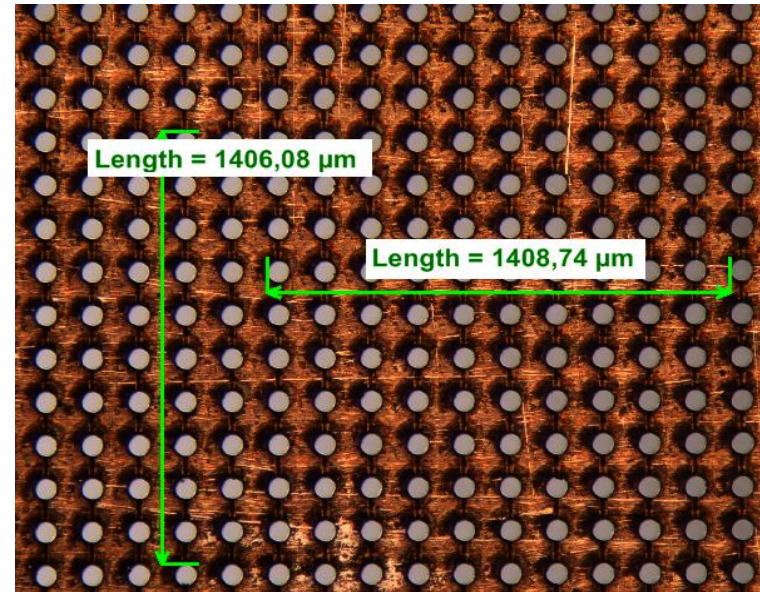
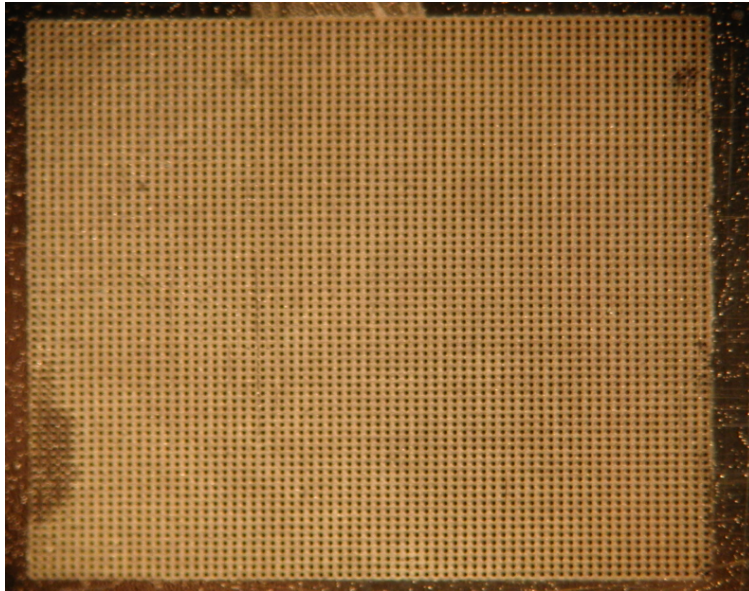


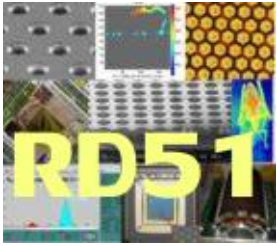
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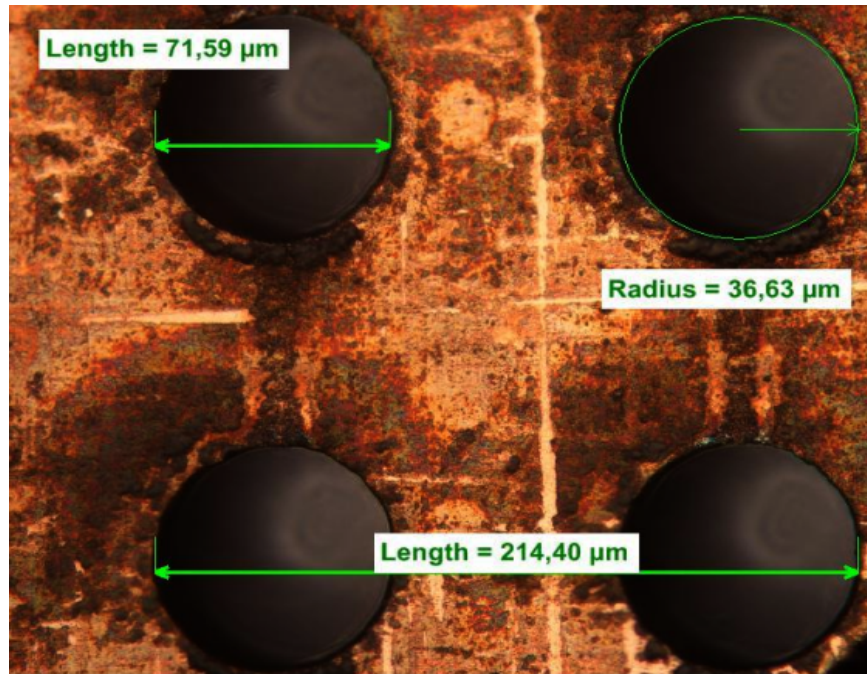
### Early tests





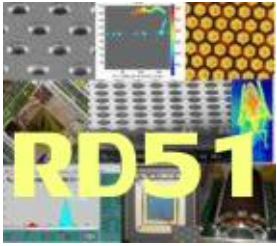
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### Early tests



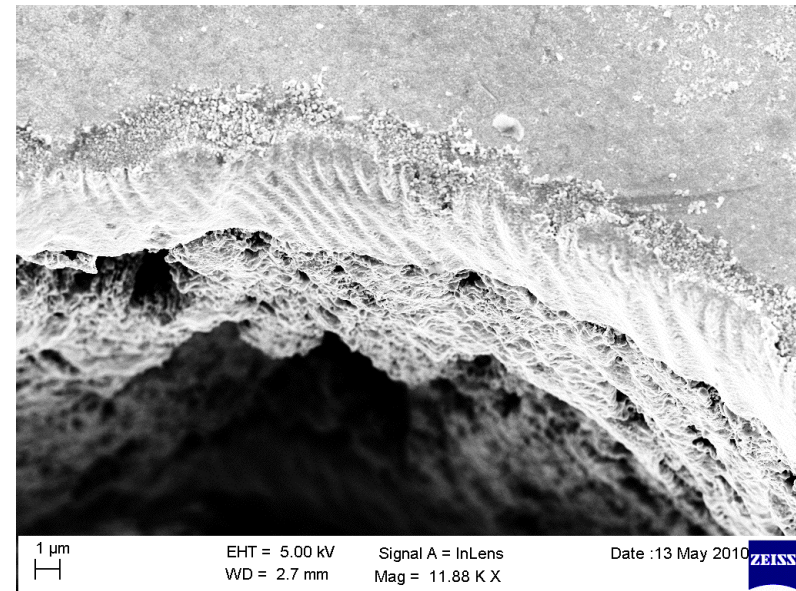
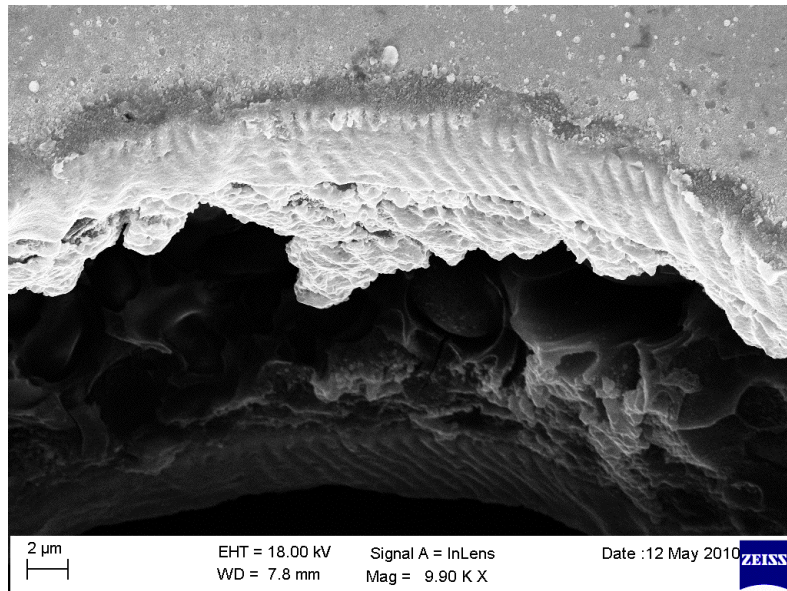
$$D = 69,49 (0.75) \mu\text{m}$$



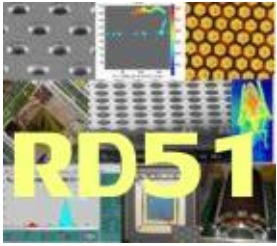


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## 1.4W (left) 0.7W (right)

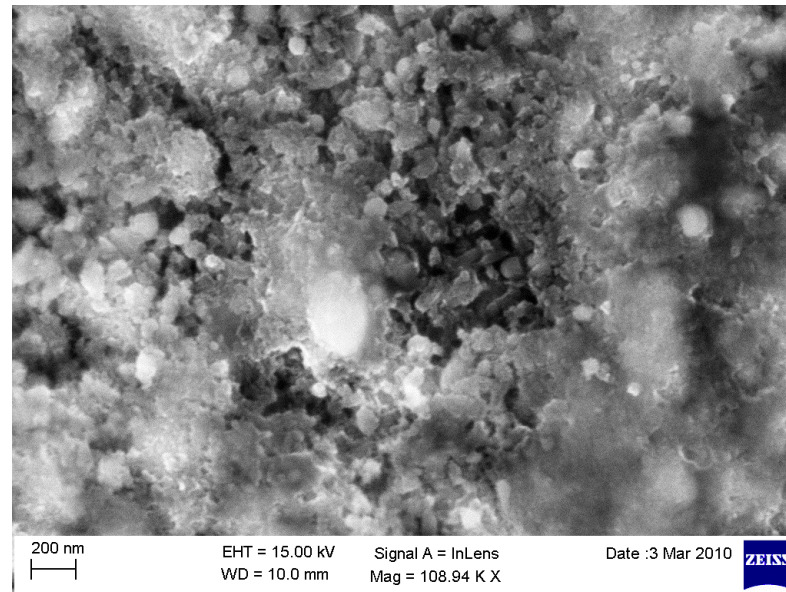


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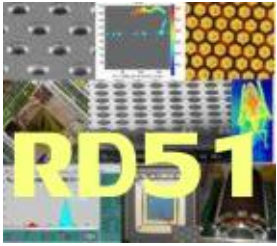


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## Details of the Cu inclusion in KAPTON

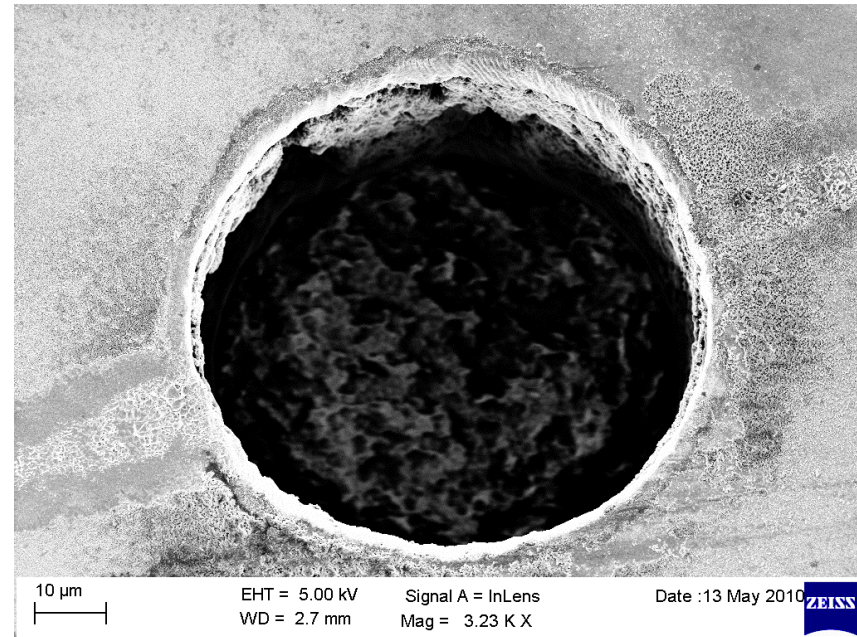
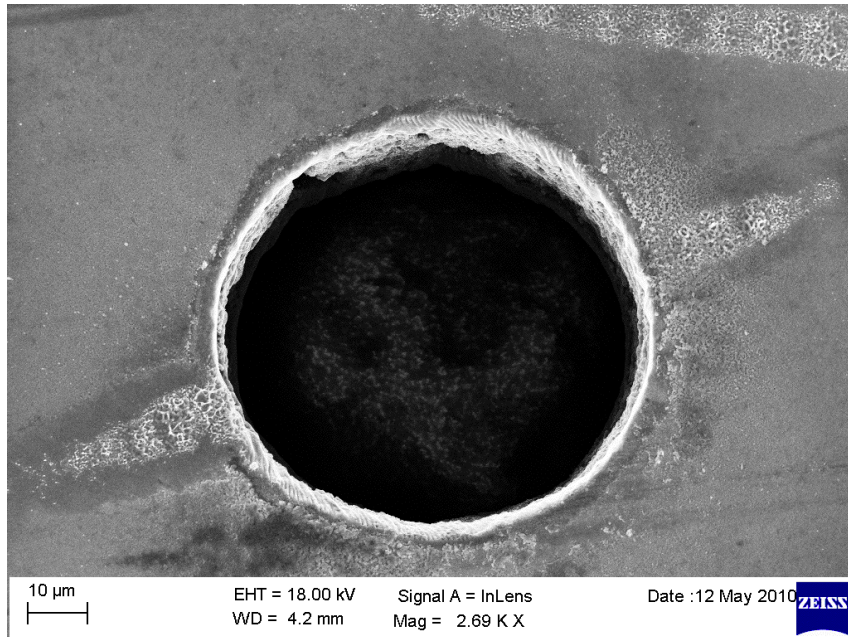


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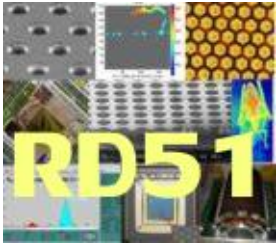


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## New samples and comparison (0.7 W)

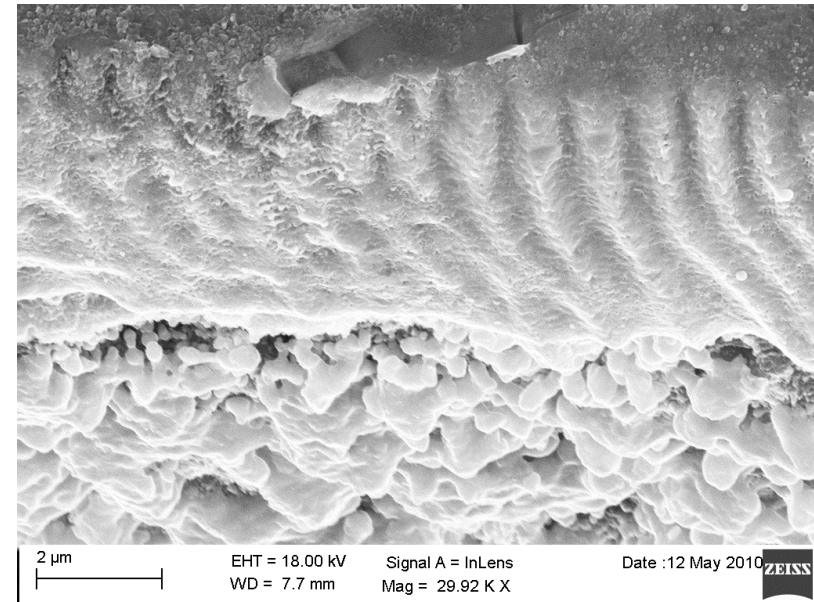
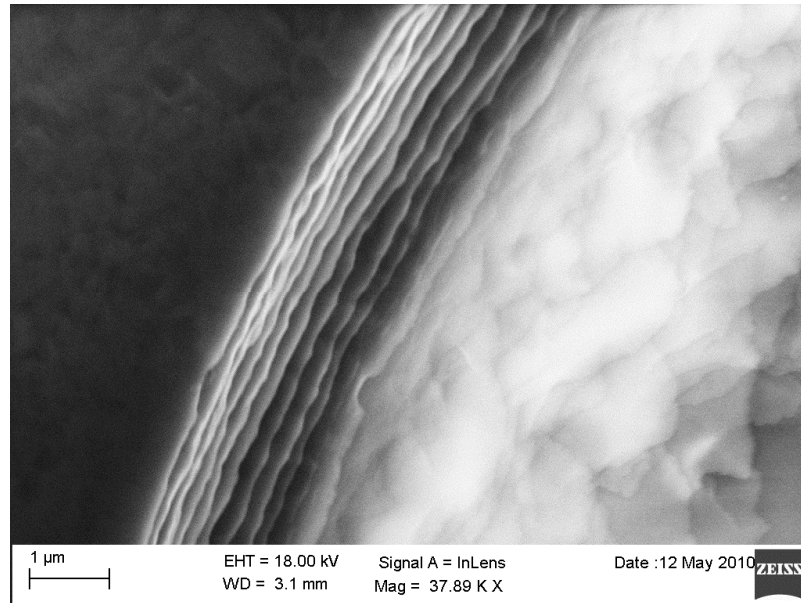


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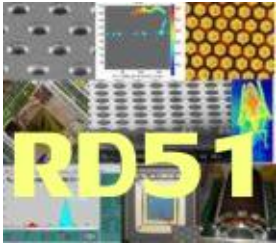


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# Cu-Kapton edge (0.7 W)

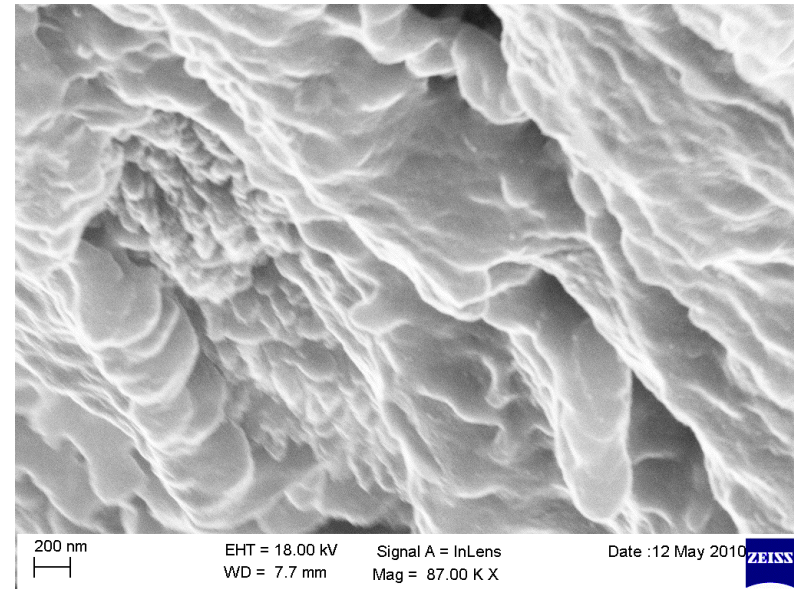
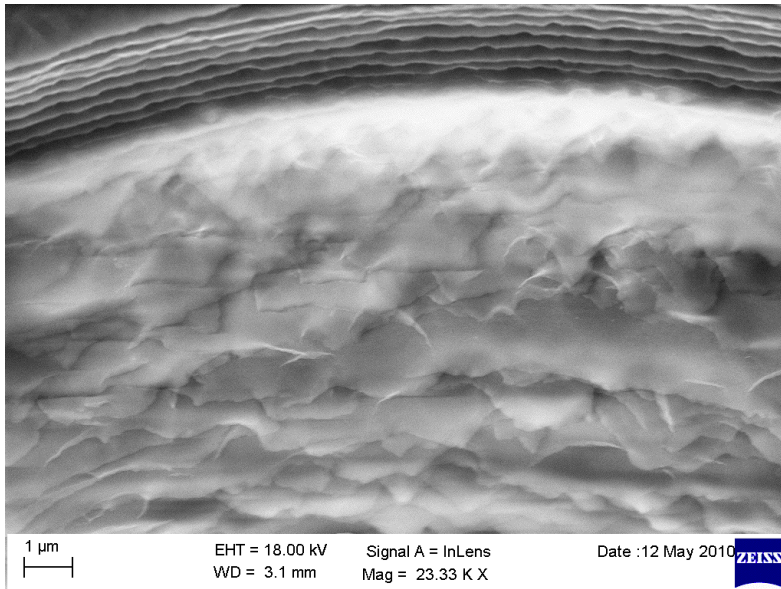


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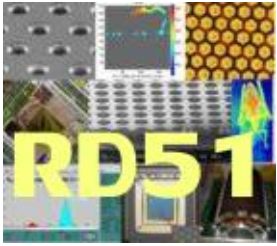


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# Kapton structure (0.7 W)

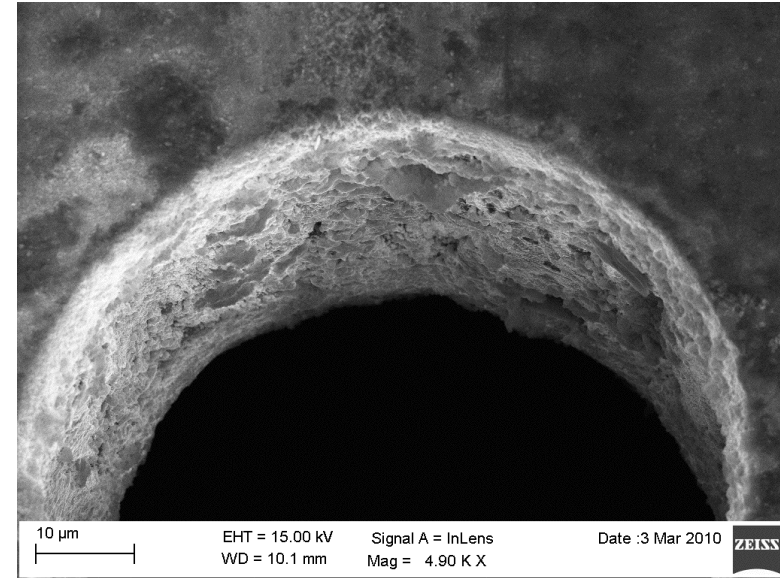
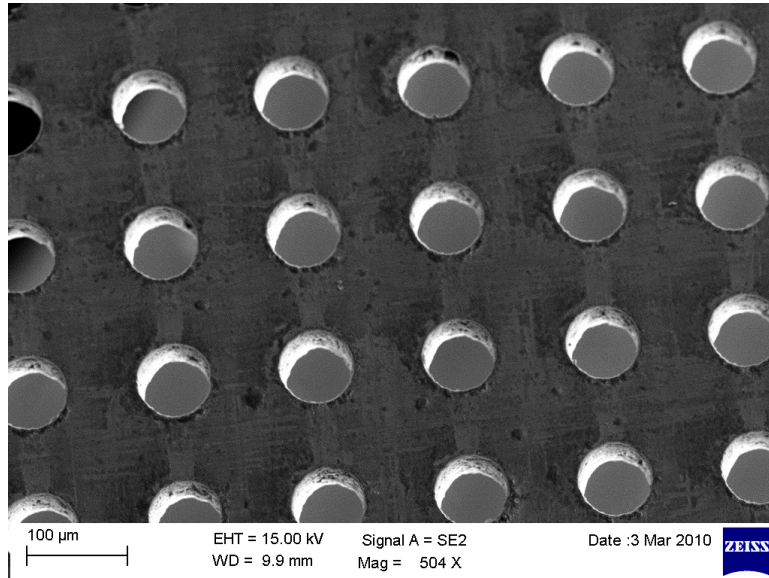


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# Conclusions



To be fixed:

Laser stability, possible capton burning, etching needed?

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