

CETAL - Research infrastructure for photonic based technologies

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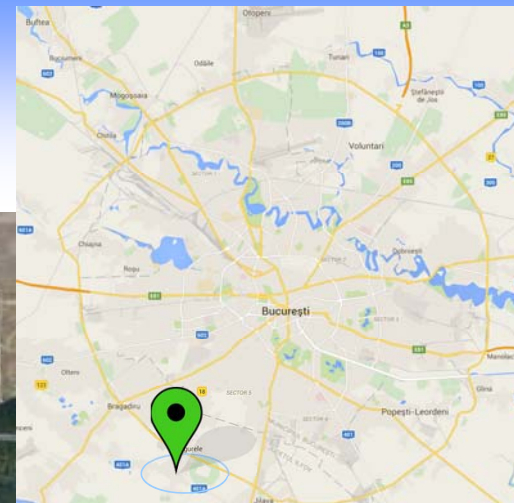
CENTER FOR ADVANCED LASER TECHNOLOGIES



The project CETAL

Project No: 8PM /I 26.11.2008
(IMPACT program financed by ANCS)

Project value: 17 MEuros
Building surface: 2700 m²
End of the Project: 30 Oct 2014



INFLPR
Center for Advanced Laser Technologies, CETAL
Atomistilor 409, 077125 Măgurele, Romania.



Center for Advanced Laser Technologies - CETAL

High-intensity laser fields Laboratory CETAL - PW



Particles Acceleration
electrons and protons acc.
Harmonics generation
Radiation Hardening, Matter
characterization and damage
assessment.

Laser Material Processing Laboratory LaMP



Laser macroprocessing:
cutting, drilling, welding.
**Laser micro and
nanoprocessing:** microfluidics,
micro-optics, metamaterials.
Processing of biomaterials:
tissue engineering, bio-nano-
material.

Photonic Investigations Laboratory PhIL



Spectroscopy (from 200 nm to
THz)
THz Spectroscopy, Raman, LIBS,
Absorption, Vibrometry.
Metrology
Laser beam characterization,
Optical frequencies synthesizer.

Follow-up development of ultra-intense lasers in Romania

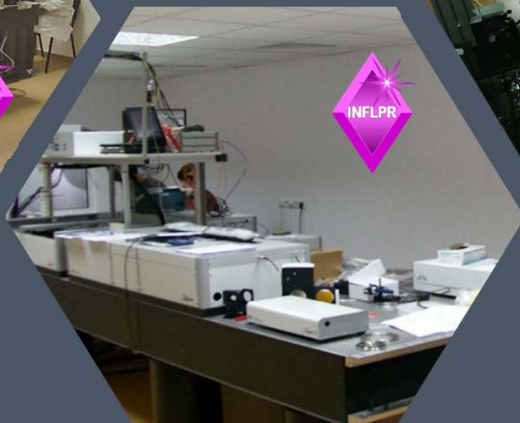
2006 - 3 GW
GIWALAS
(INFLPR)



2014 - 1 PW
CETAL-PW
(INFLPR)



2019 - 10 PW
ELI-NP



2009 - 20 TW
TEWALAS
(INFLPR)



CETAL-PW ultra-intens laser system



Ti:Sapphir laser

max. power: 1 PW @ 0.1 Hz

secondary output: 45 TW @ 10 Hz

ultrashort pulses: 25 fs (1fs = 10^{-15} sec)



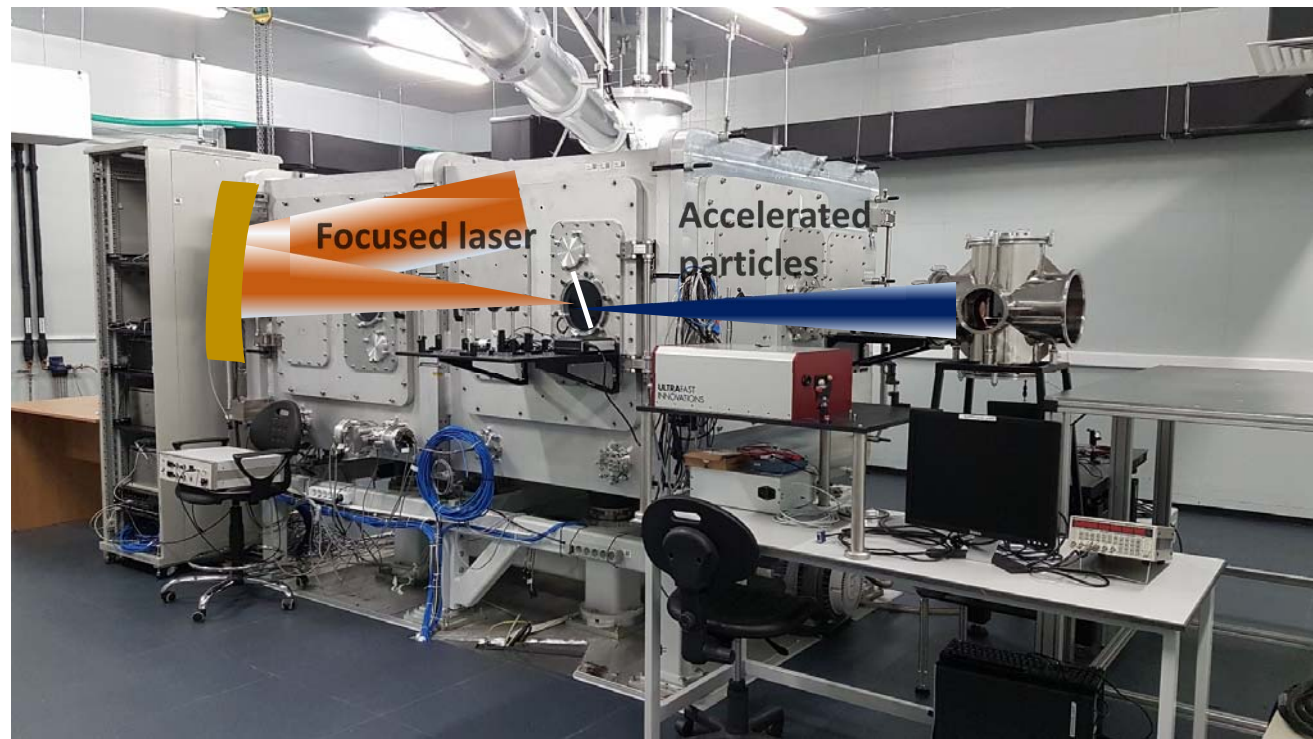
CETAL-PW ultra-intens laser system

interaction chamber

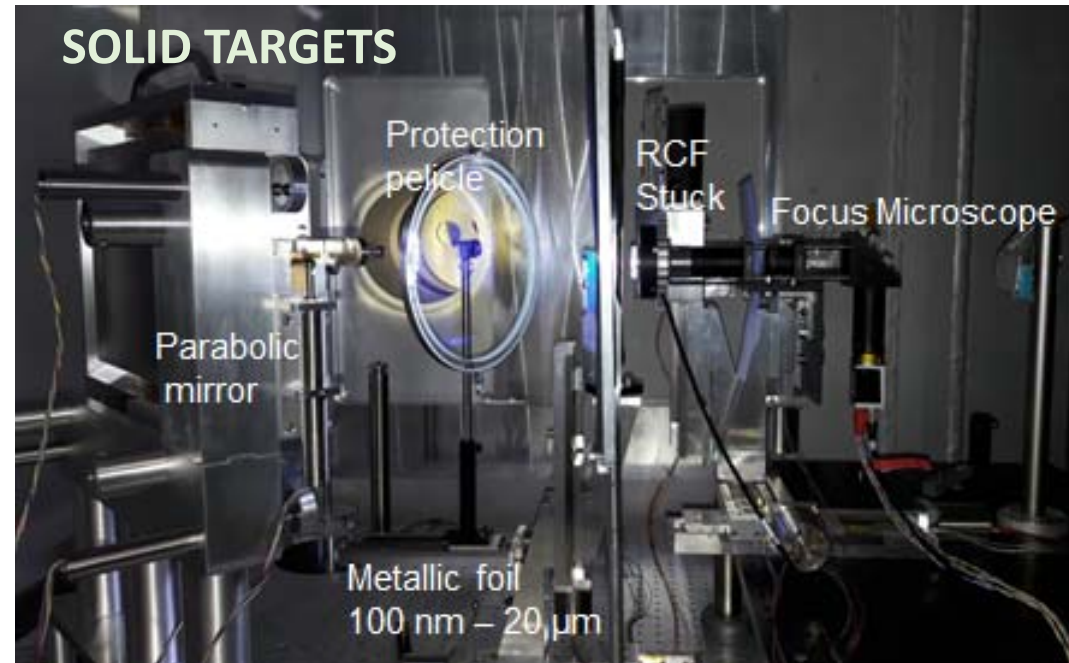
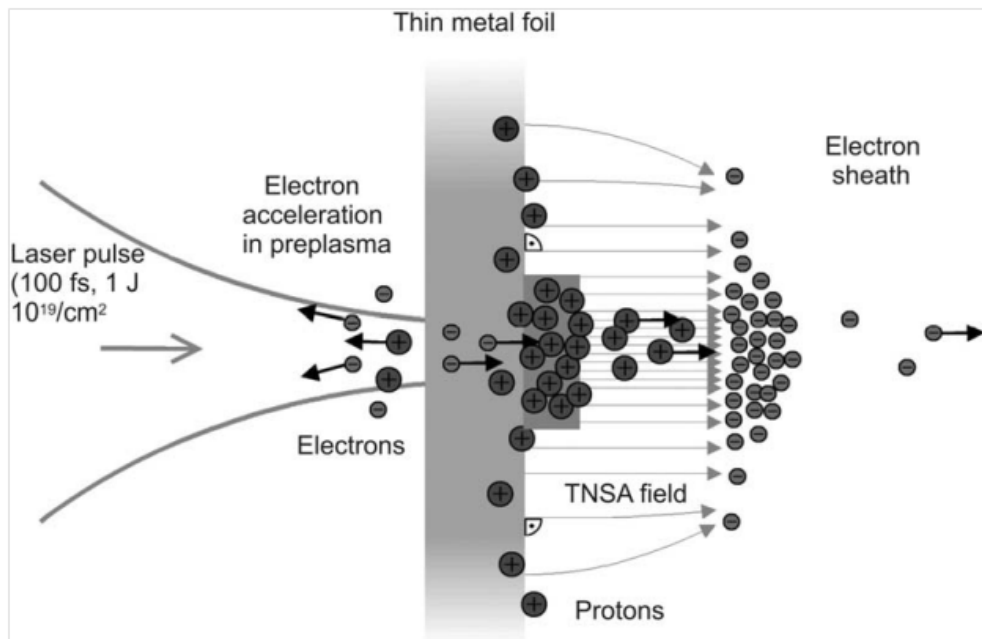
aluminium, volume: 6 m³,
UHV: 10⁻⁶ mbar

experiments

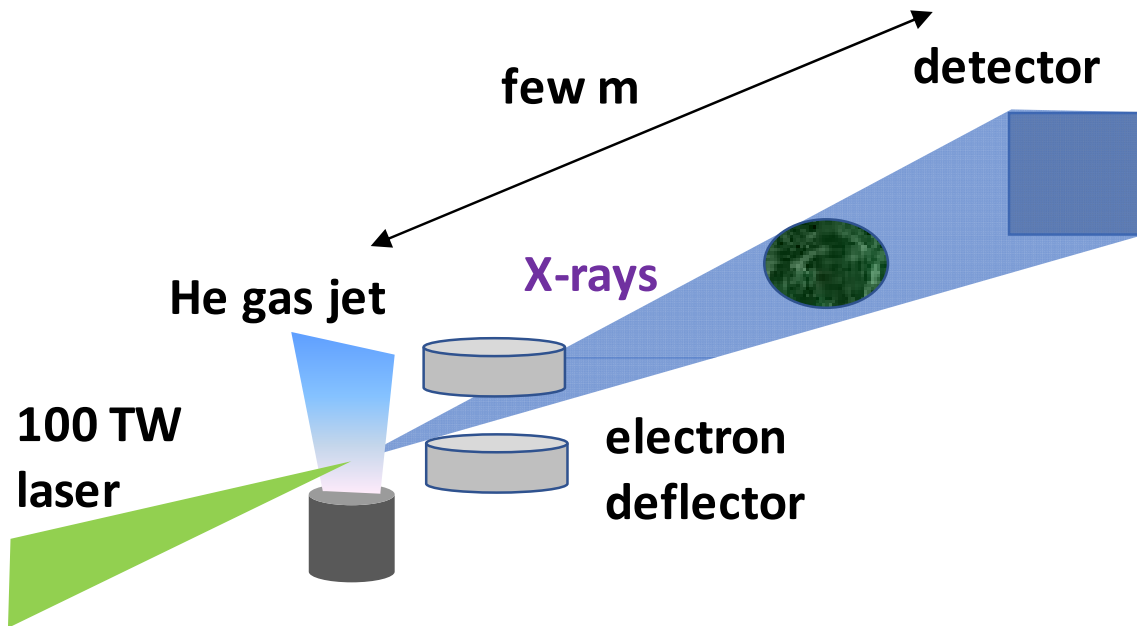
- Particles Acceleration
electrons and protons acc.
- X-rays generation



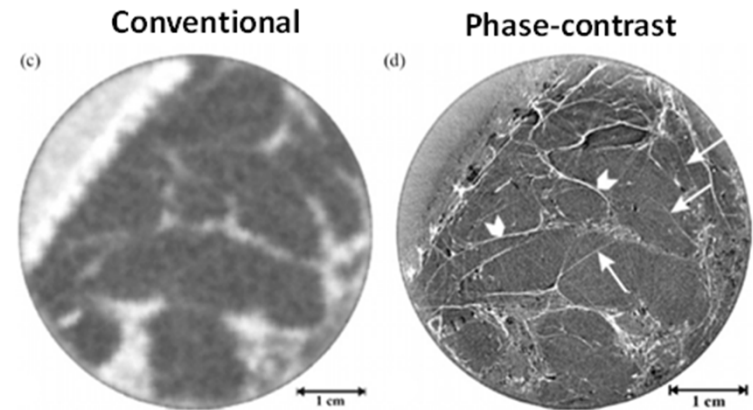
laser-driven particle acceleration



Laser betatron source (100 TW laser) for X-rays generation



X-ray phase-contrast imaging with μm resolution



CT of breast tumor
(Keyriläinen et al 2010)

ELI-NP European Research Infrastructure



**THE ELI - NUCLEAR PHYSICS
FACILITY**

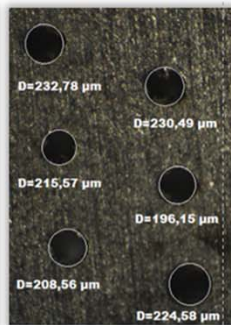
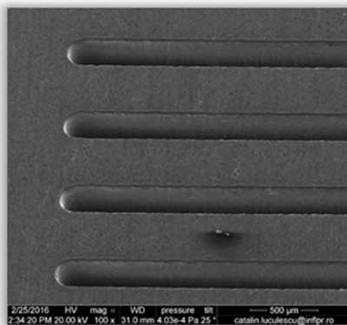
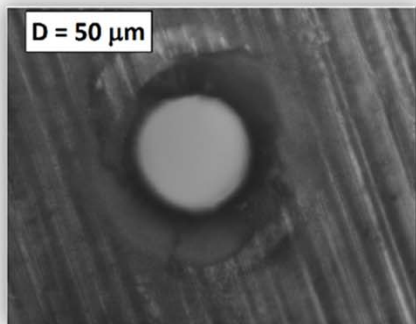




Laser Macro-Processing facility



- Laser cutting, drilling and marking ($\text{Ti}_6\text{Al}_4\text{V}$, Al, carbon-steel, stainless steel)
- Laser welding and laser welding of dissimilar materials (Al/Cu)
- **Additive manufacturing** of metallic 3D structures (Ti alloys and stainless steel)





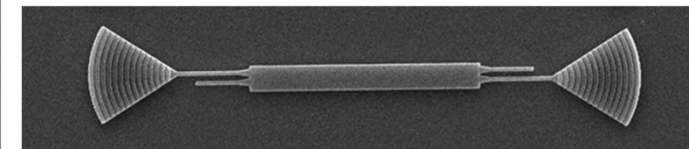
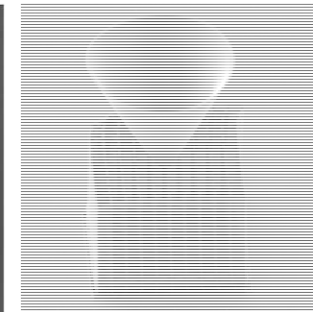
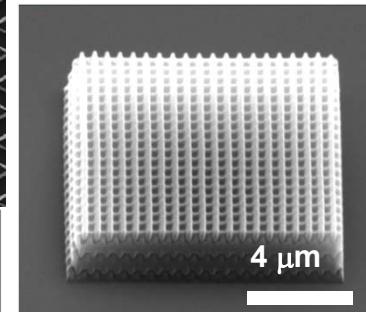
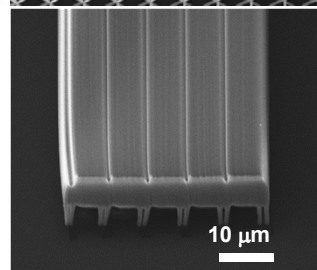
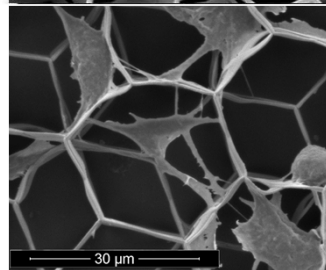
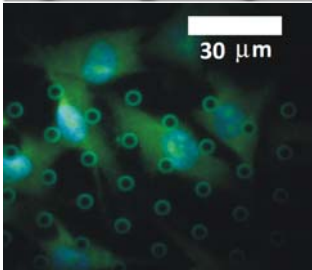
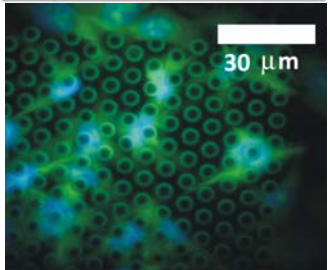
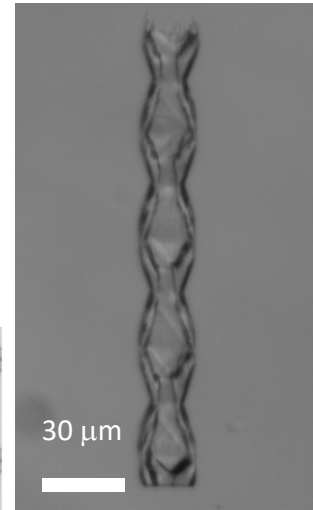
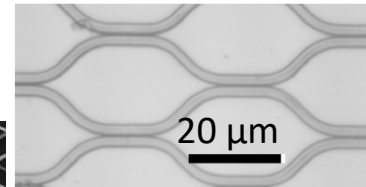
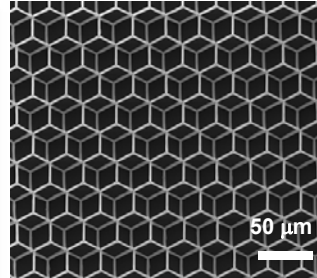
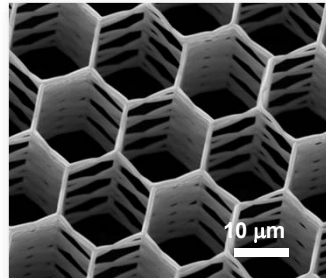
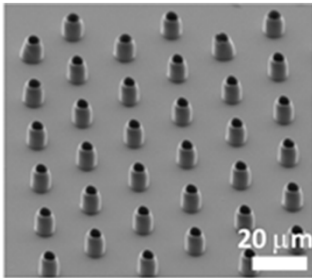
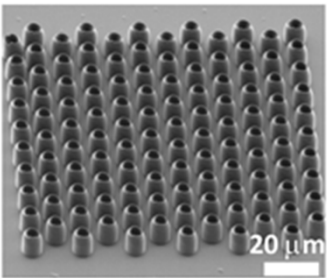
3D laser lithography with sub-micrometer resolution

“Photonic professional”
Nanoscribe GmbH



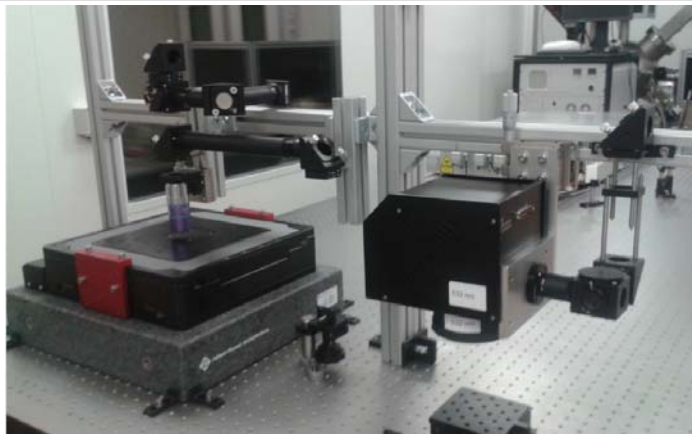
Applications

- micro-optics
- photonic crystals and metamaterials
- scaffolds for tissue engineering
- 3D targets for laser-matter interactions
- 2D masks
- micro-fluidics

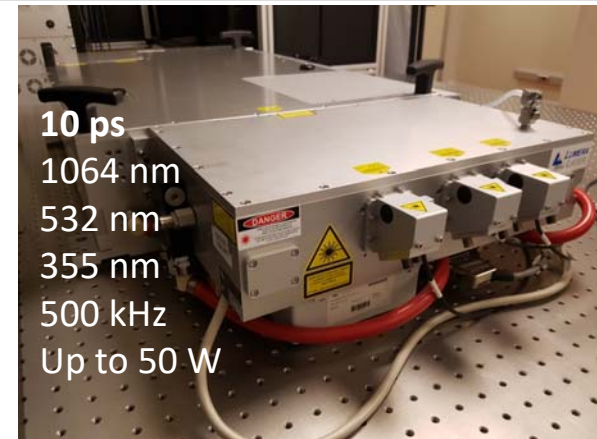




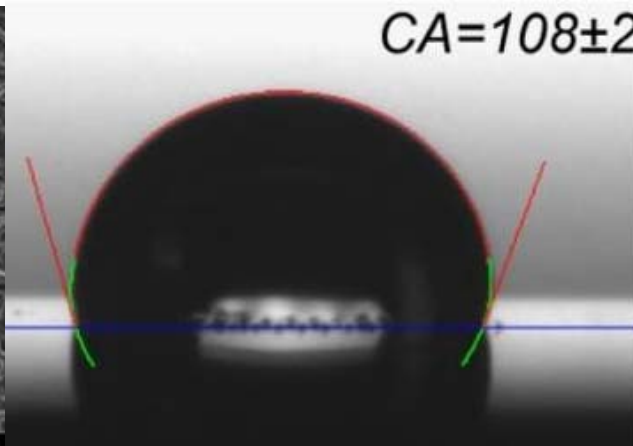
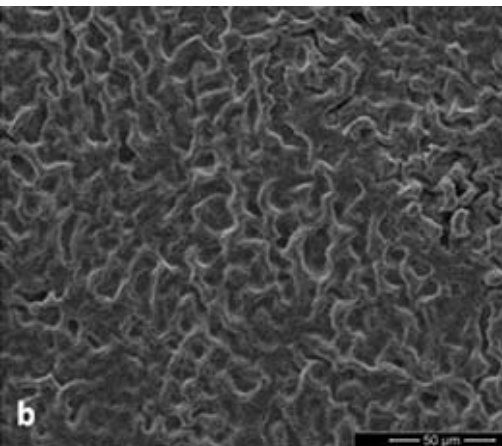
Direct laser writing by ultrafast laser ablation



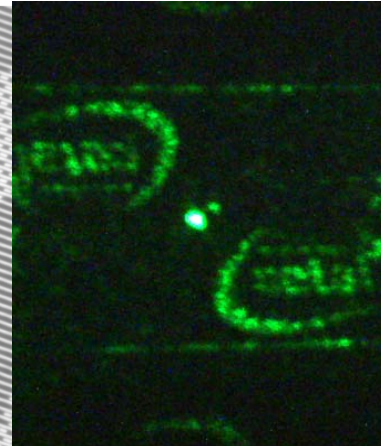
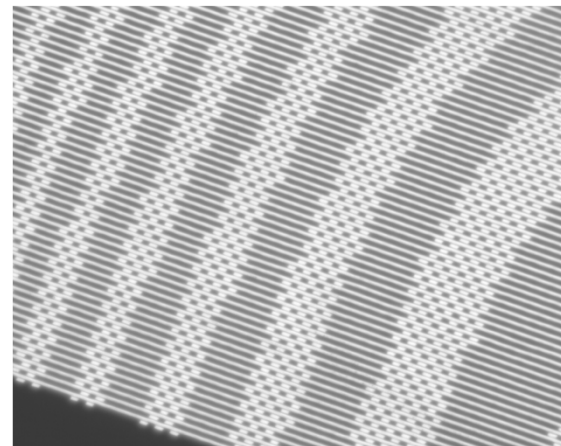
- Laser ablation with sub-micrometer resolution of metals, polymers and glasses



- Surfaces patterning for hydrophobic surfaces



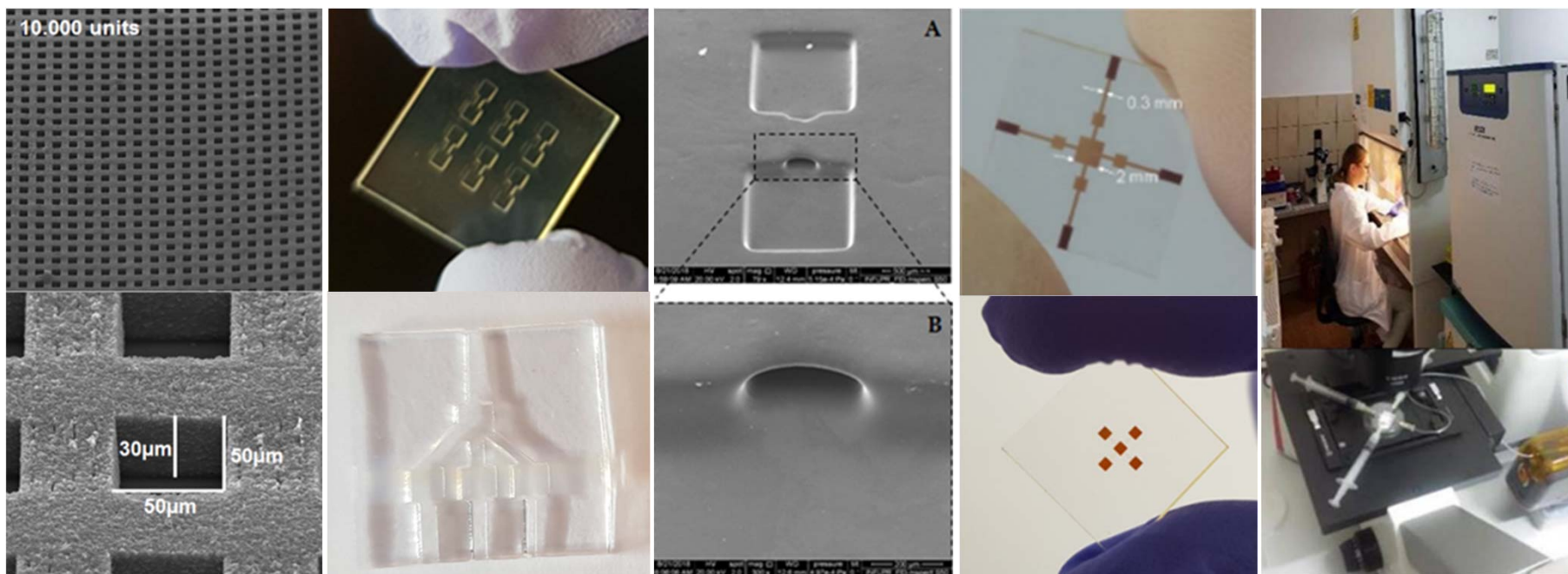
- Holograms and DOE





Lab-on-a-chip biosystems and cell culture testing facilities

- Microfluidic devices fabricated by picosecond laser irradiation of glasses



Nanomaterials 8 (8), 583, 2018.

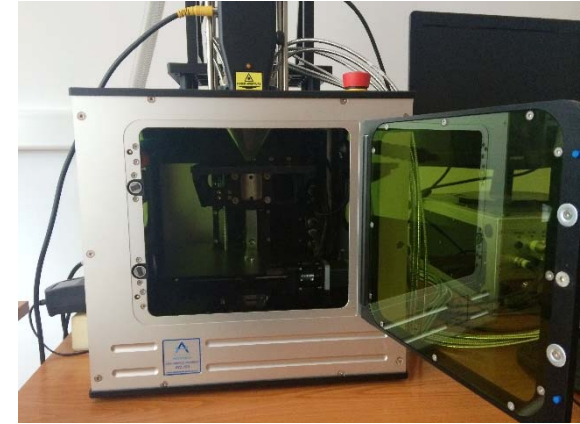


Photonic investigation laboratory - PhIL

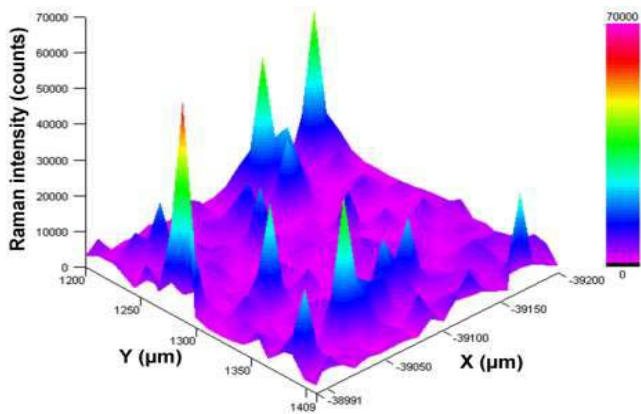
Sources and detectors from UV to THz



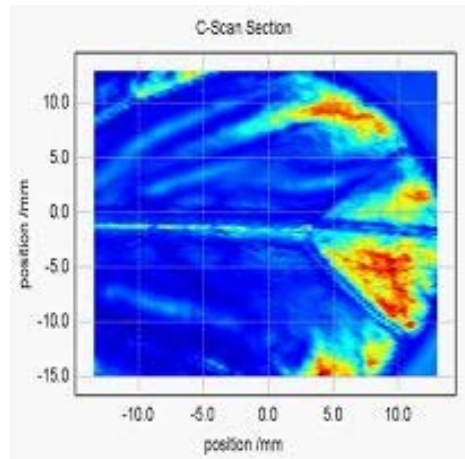
- Testing of optoelectronic components;
- Characterisation of new materials;
- Food and environment safety.



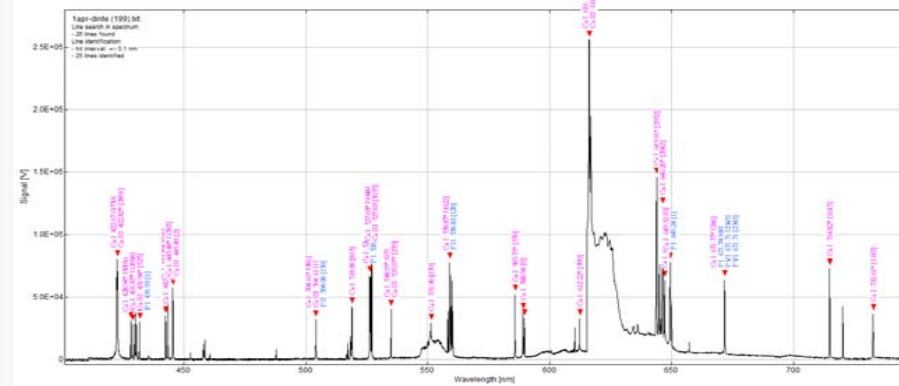
• Raman Spectroscopy



• THz Spectroscopy



• LIBS





Other facilities at CETAL

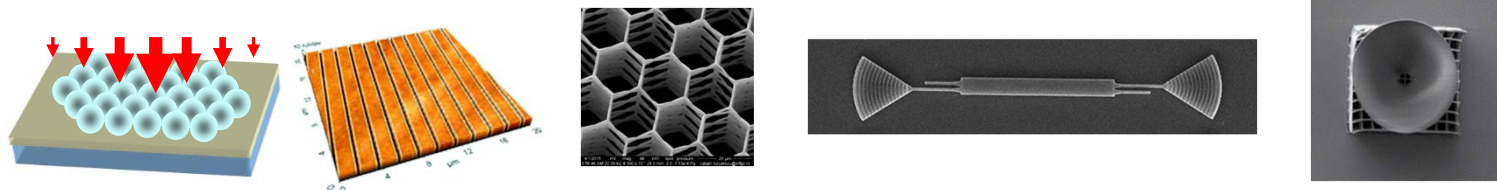
- Bunker for experiments with ionizing radiations (accelerated particles from interaction with PW laser).
- Cleanrooms ISO7 and ISO8.
- Anti-vibration platform and electromag. shielded rooms.
- Sound isolated laboratory for vibrations test.



Conclusions

CETAL - laser facility for:

- Laser-matter interaction in ultraintense regime
- Integrated optics using 3D laser lithography.
- 3D targets for laser particle acceleration (application to Radiation Hardening).
- Laser surface nanotexturing for ultrasensitive sensors.
- Fabrication of microfluidic devices.
- Lab-on-a-chip technology of glass portable devices for detection of chemical and biological substances.
- Laser Cutting and Welding of various materials.
- Additive manufacturing (laser cladding, 3D printing of metallic parts).
- Design and construction of laser custom systems for laser processing.
- Laser safety training and audit.





Thank you!



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