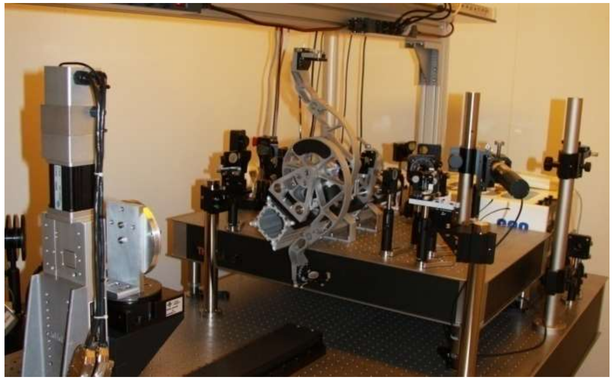
Laser processing of materials

NOVIEMBRE 2015



Laser interference system
- 1J/pulse Nd:YAG laser
- Wafer positioning system
- Beam postioning system
- Computer controlled

Femtosecond laser microfabrication station
- Coherent Libra HE laser
- 400 and 800nm
- Beam delivery system

EQUIPMENT - Fabrication

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- Thin film coating systems
  - ✓2 PVD
  - ✓PECVD , LPCVD
- Lithography
  - ✓Doubled side/NIL
  - ✓RIE
  - ✓NIL
- Packaging
  - ✓Dicing saw
  - ✓Ultrasonic bonding
- ✓Furnaces
  - ✓Oxidations
  - ✓Thermal treatments

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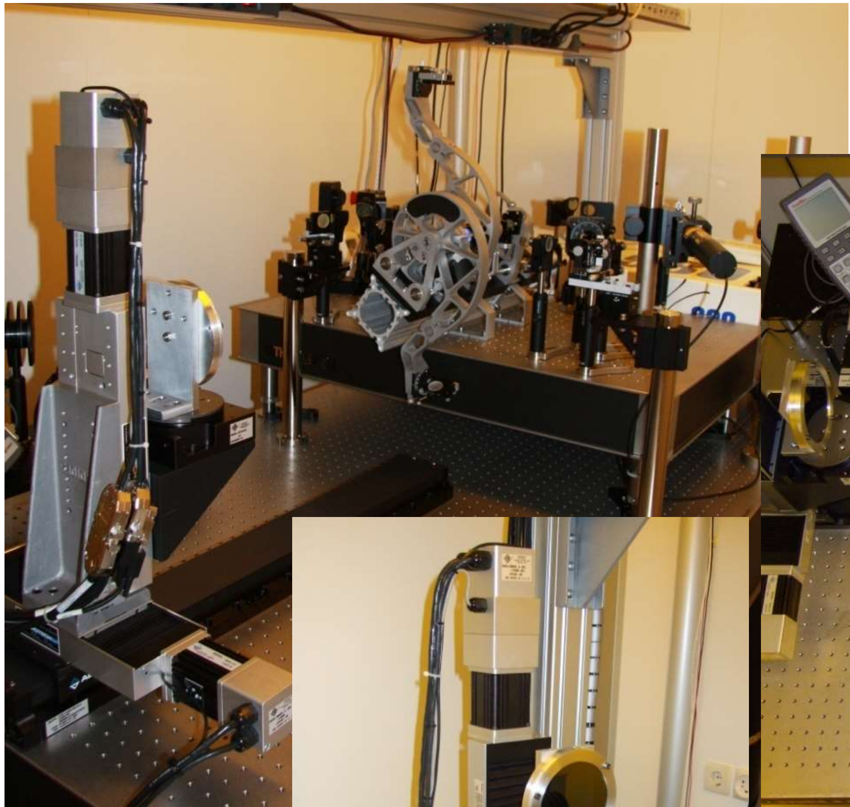

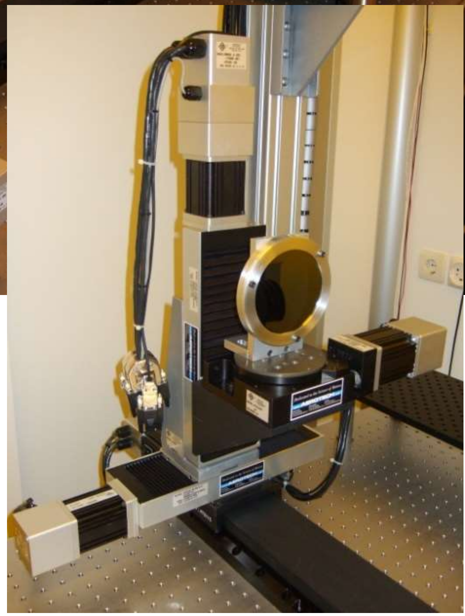

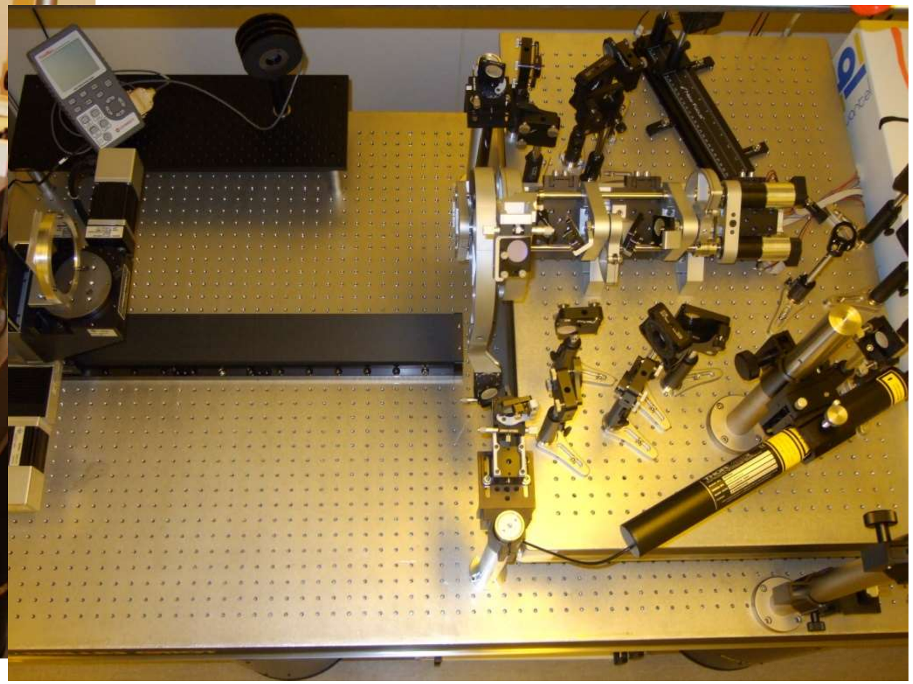

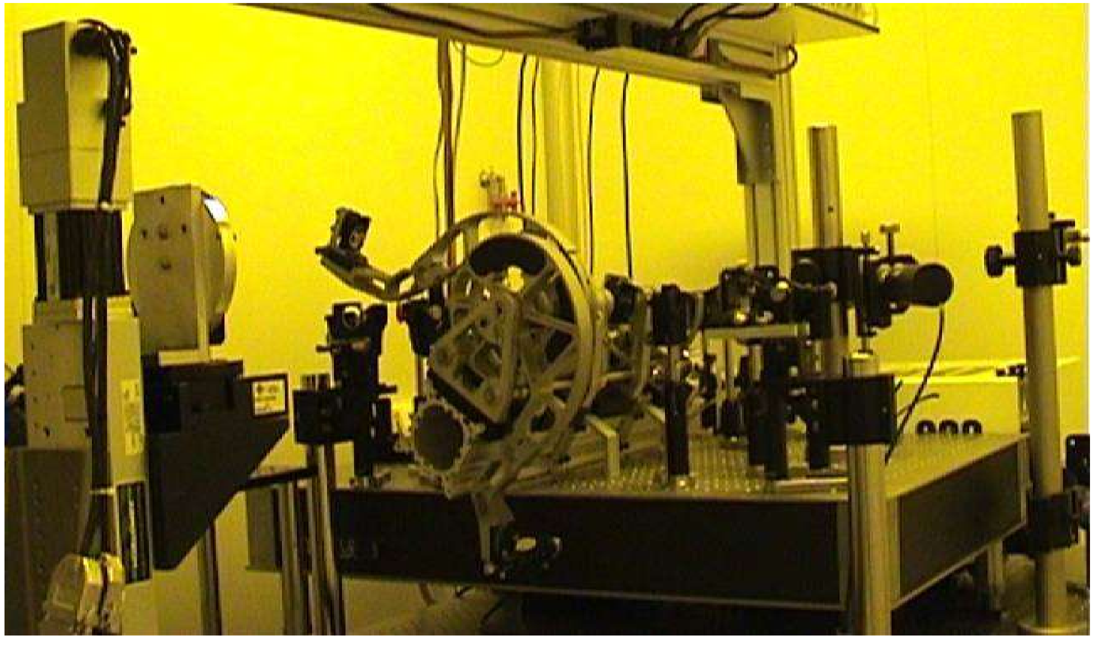

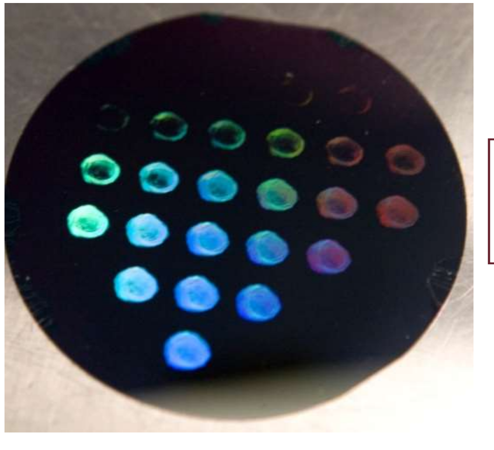

Resultado proceso, resina sobre silicio

Resultados – 3 Haces

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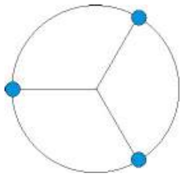		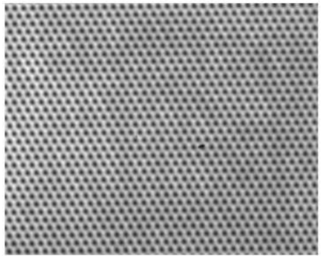	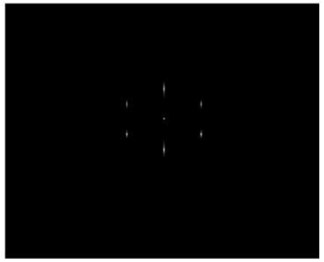	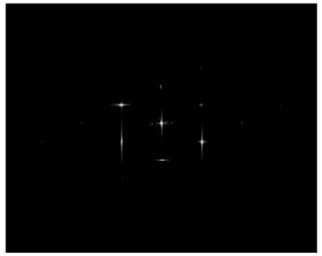
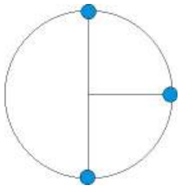		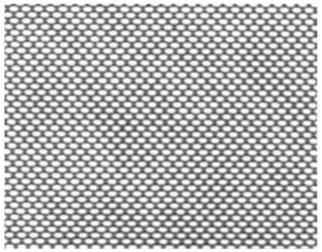	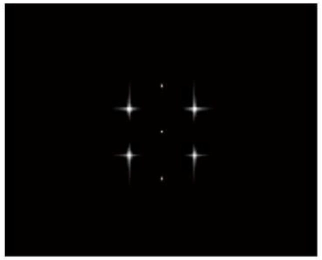	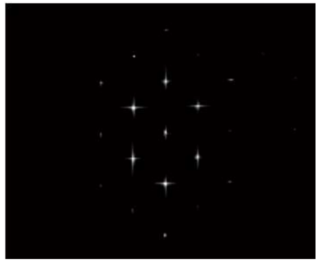

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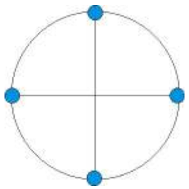
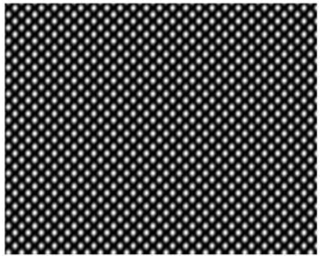
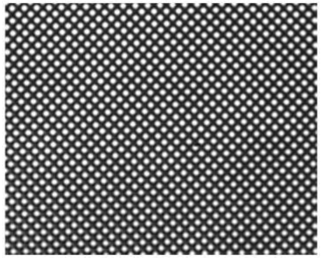
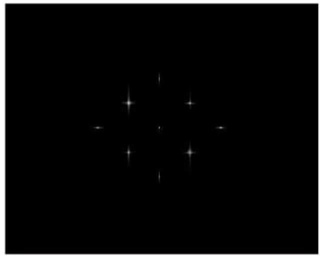
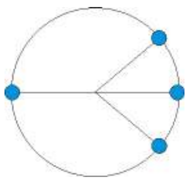
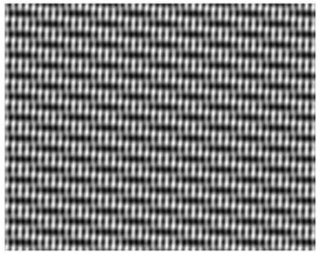
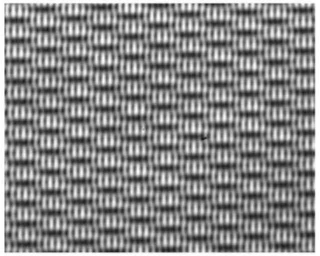
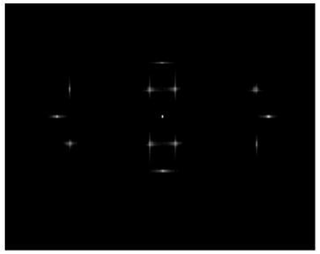
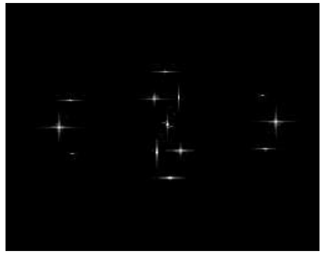
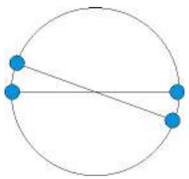
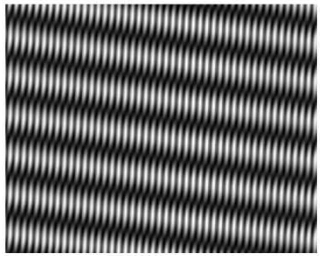
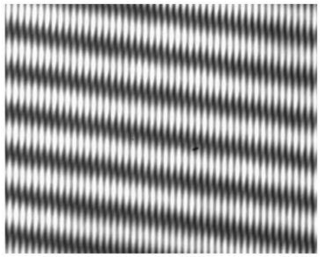
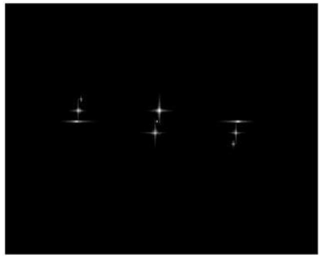
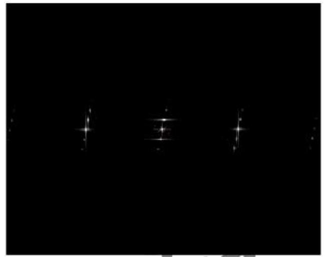
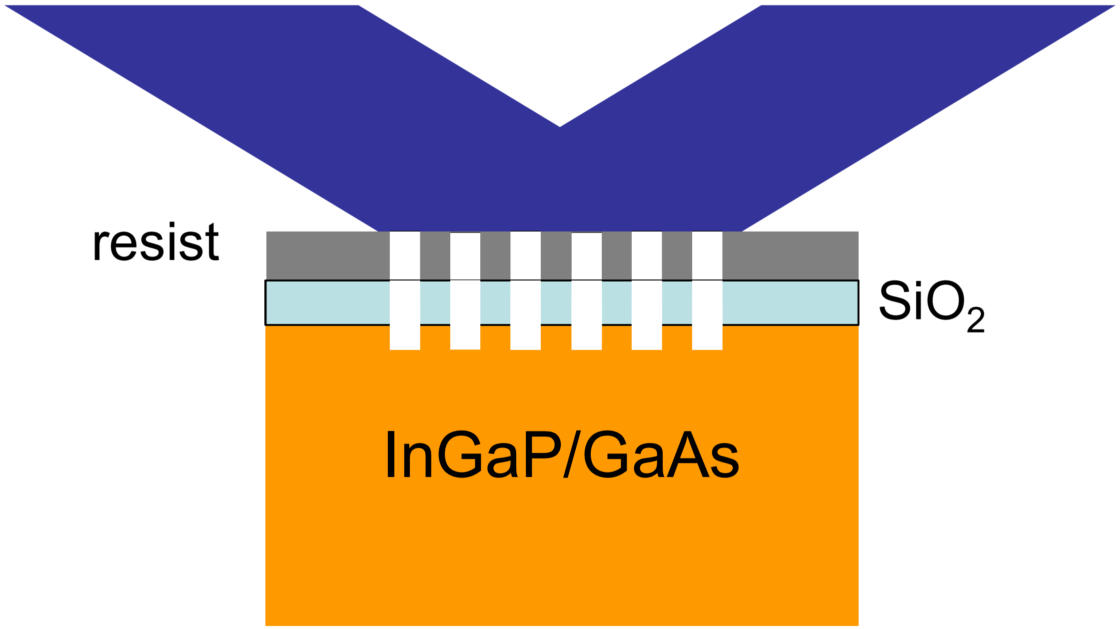
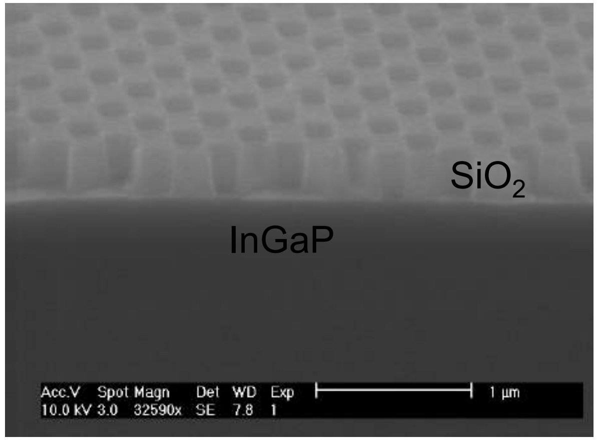
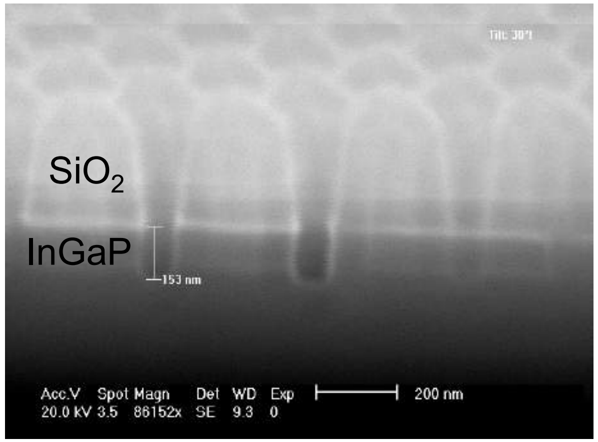
				
				
				

Holographic lithography of photonic crystal surface emitting lasers.

High quality semiconductor lasers for beam control of PCSELs

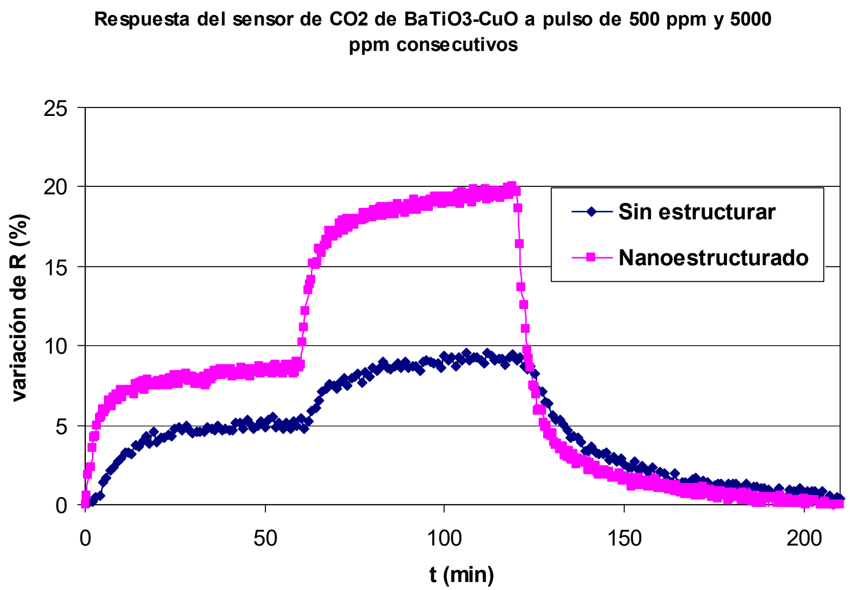


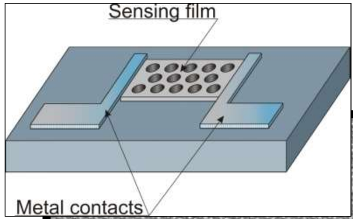


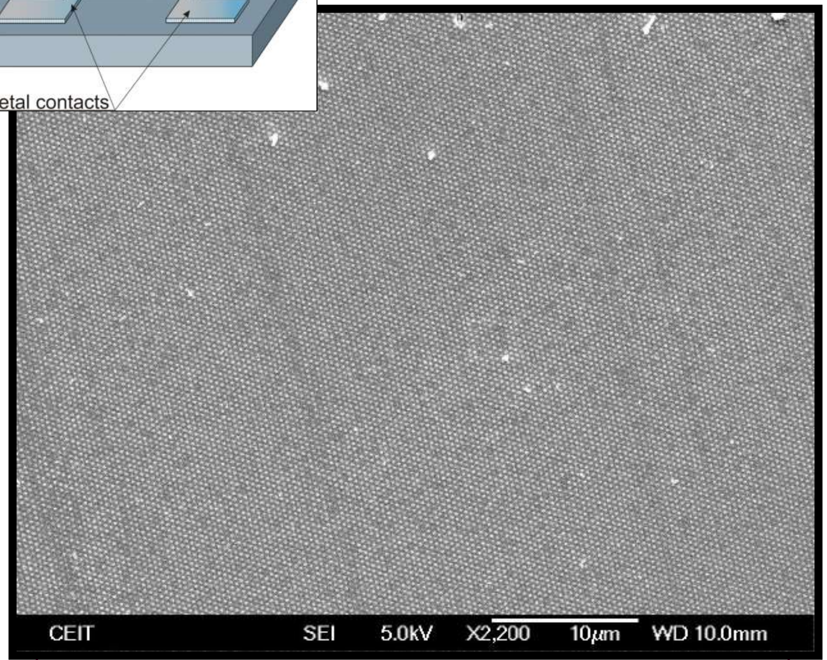


Project: Integration of intelligent systems for security (ISIS) MCYT.

Direct structuration of metallic oxides thin-films for gas sensing applications





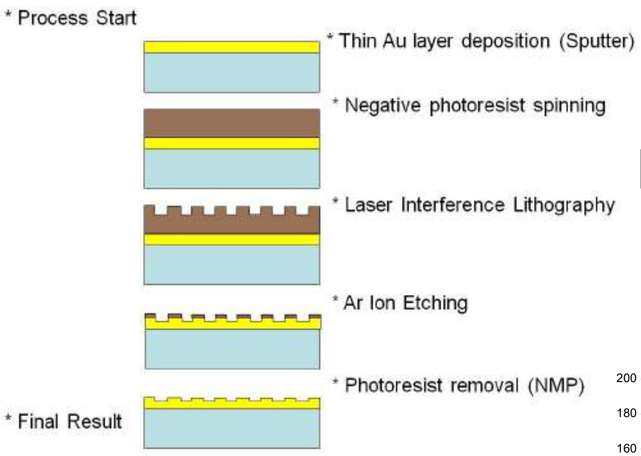


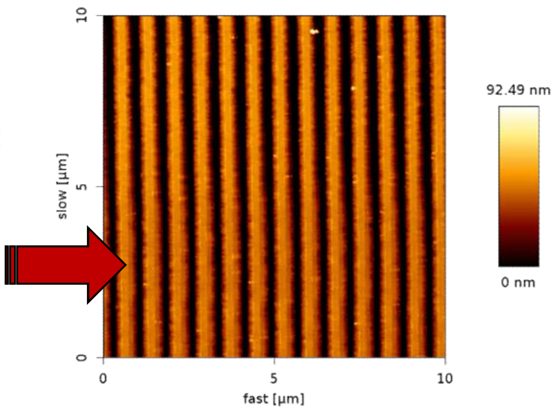
$BaTiO_3$:CuO nanostructured films

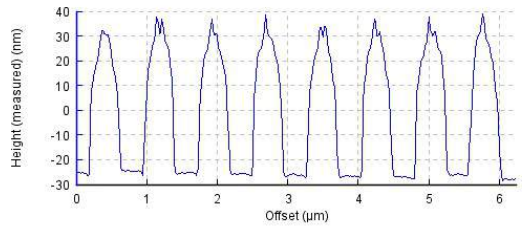
Fabrication of metallic of gratings for SPP sensors

High quality, large area gold gratings are needed for surface plasmon coupling for (bio)chemical sensor aplications

Fabrication process

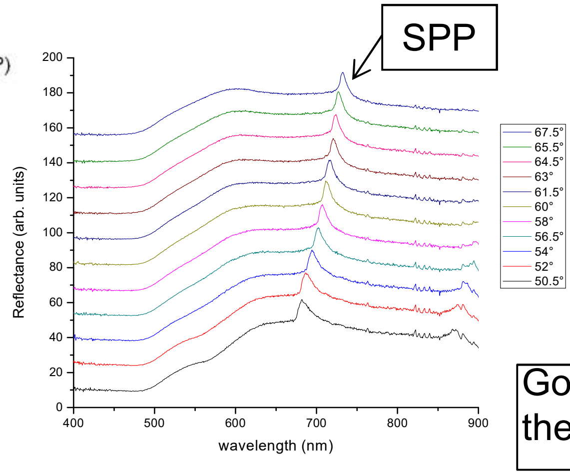


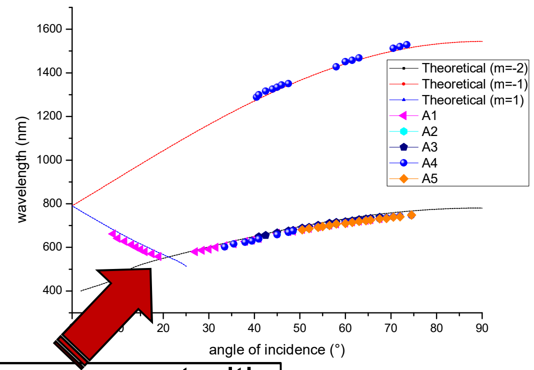




Good surface definition

Enhanced reflectance at specific wavelength in p-polarized light due to SPP coupling

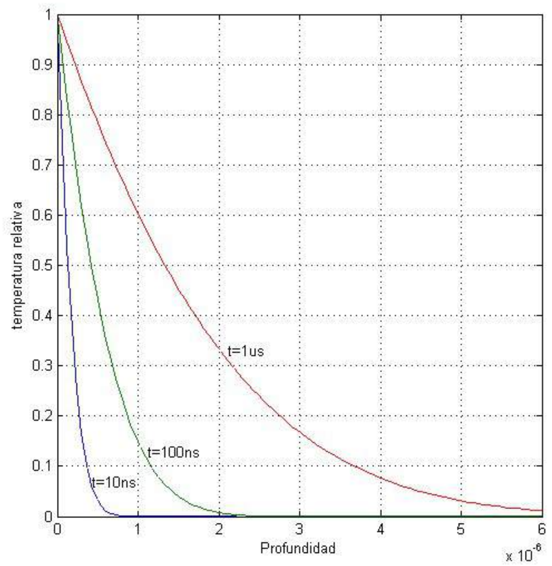




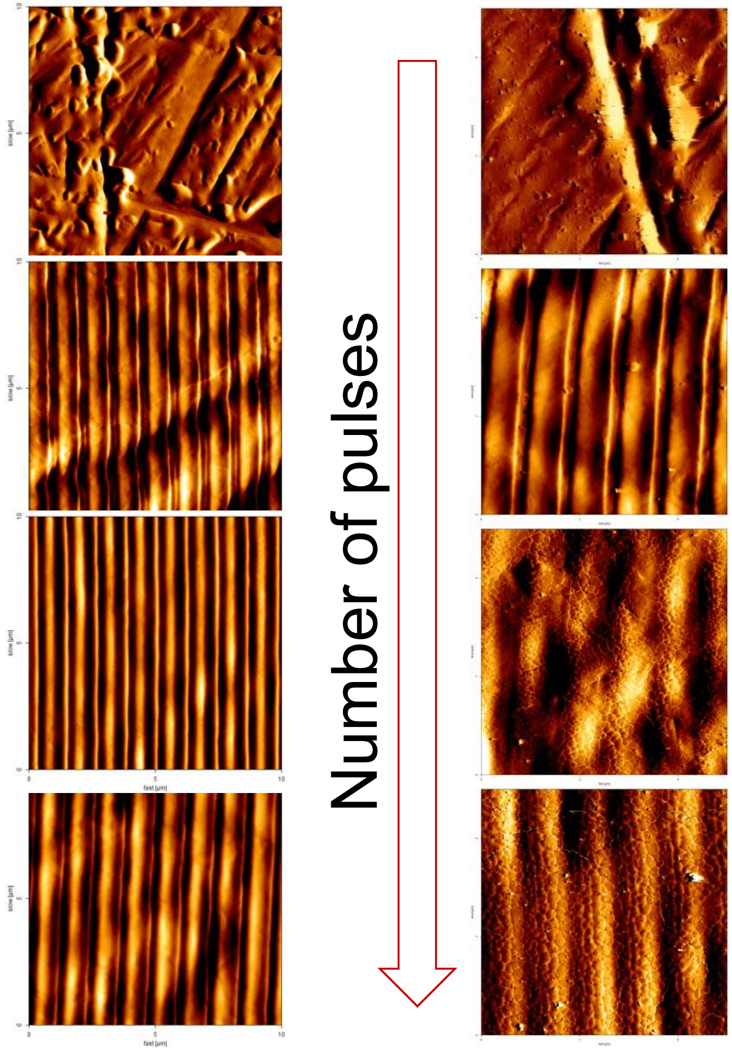
Good agreement with theoretical models

Surface texturing of metallic bulk materials

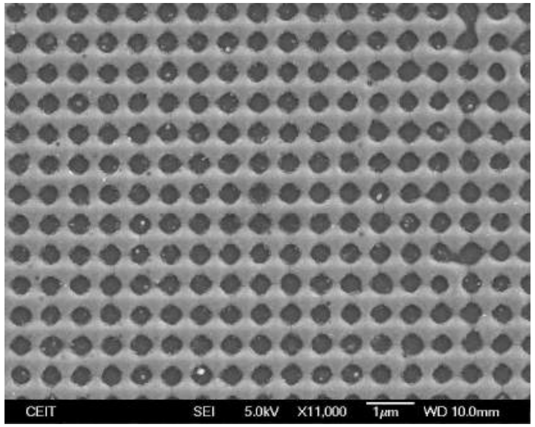
- Surface texture control in large areas with minimum damage

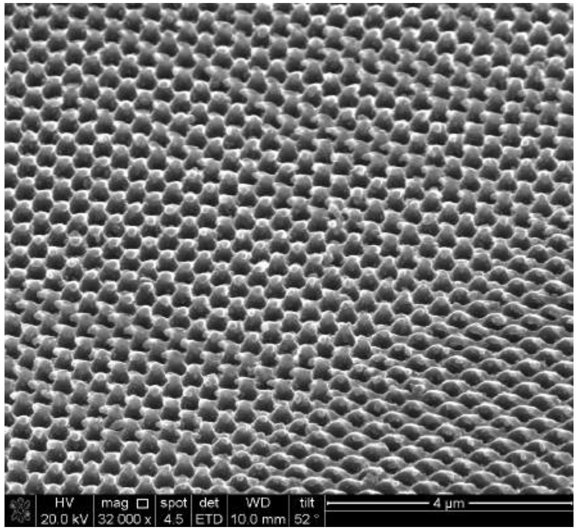


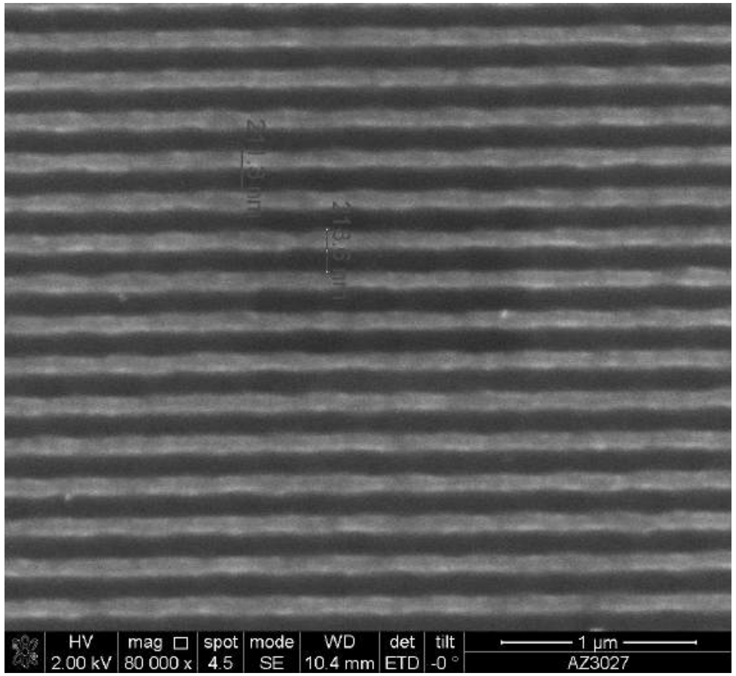
Damage controled with the laser pulse duration



2D patterned titanium grid by direct laser ablation



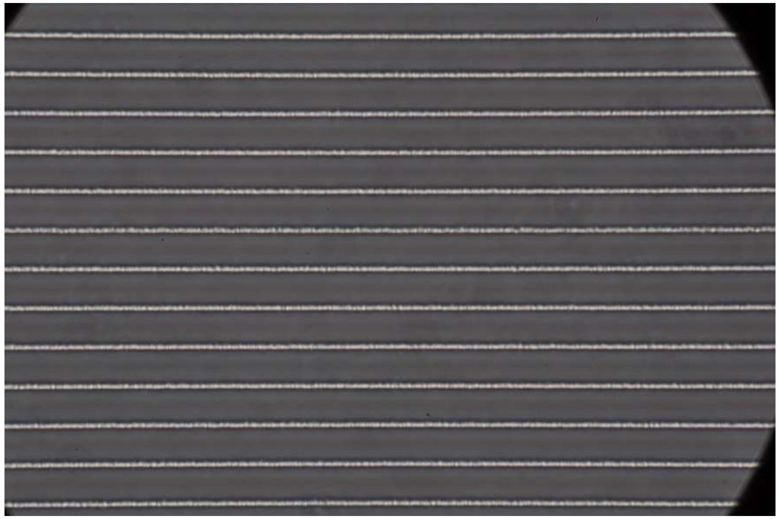




211nm periodic pattern in photoresist

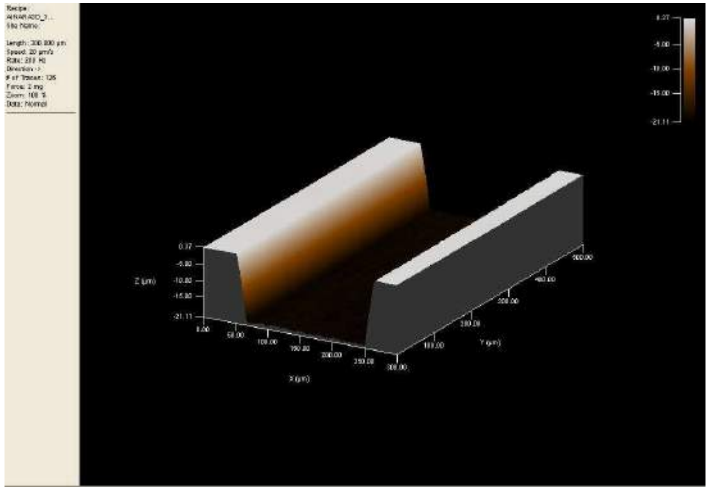
2D kapton surface relief fabrication by direct laser exposure

Project: Microtecnología in-vitro para diagnóstico rápido (MivDIRA) ETORTEK

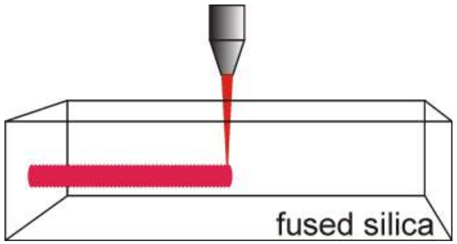


5µm waveguides written by femtosecond laser in fused silica

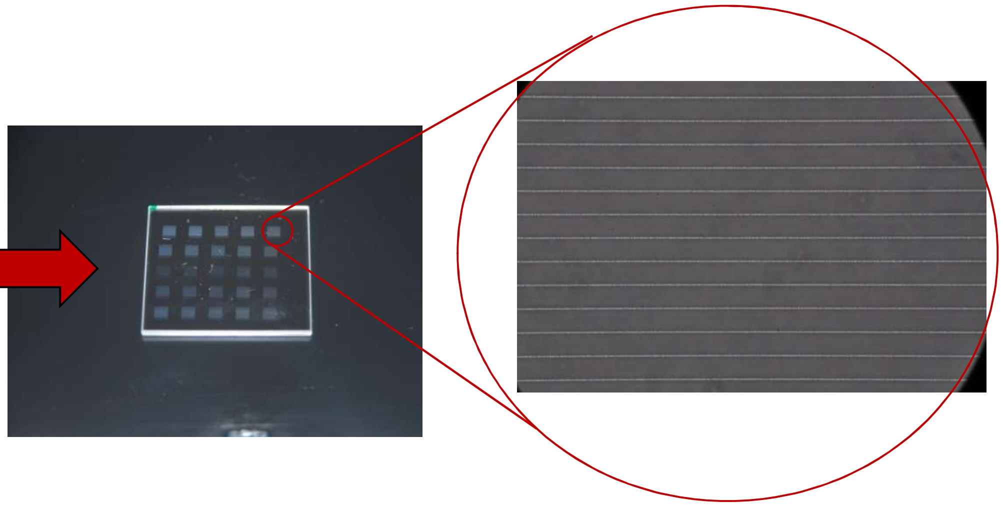
Relief of a 20x200µm surface channel defined by femtosecond laser ablation in fused silica



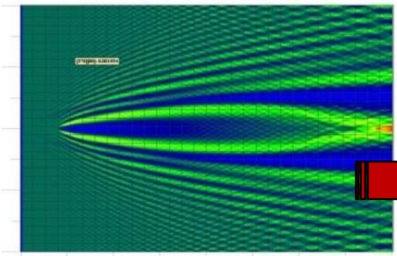
Design and fabrication of phase and polarization gratings



The femtosecond laser induces a refractive index change in the focal point.

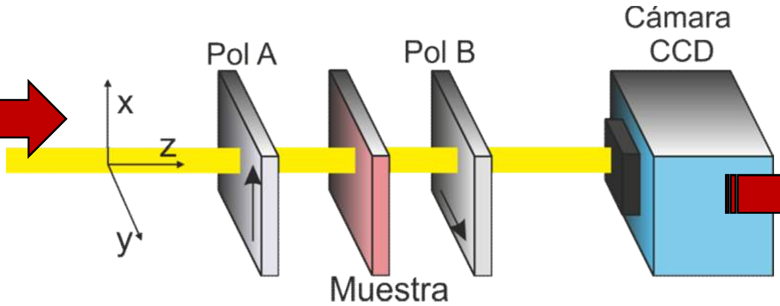


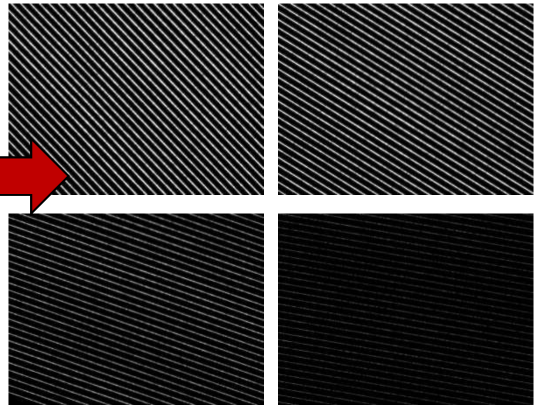
Embedded phase grating with a period of 25μm



FDTD modelling and simulation

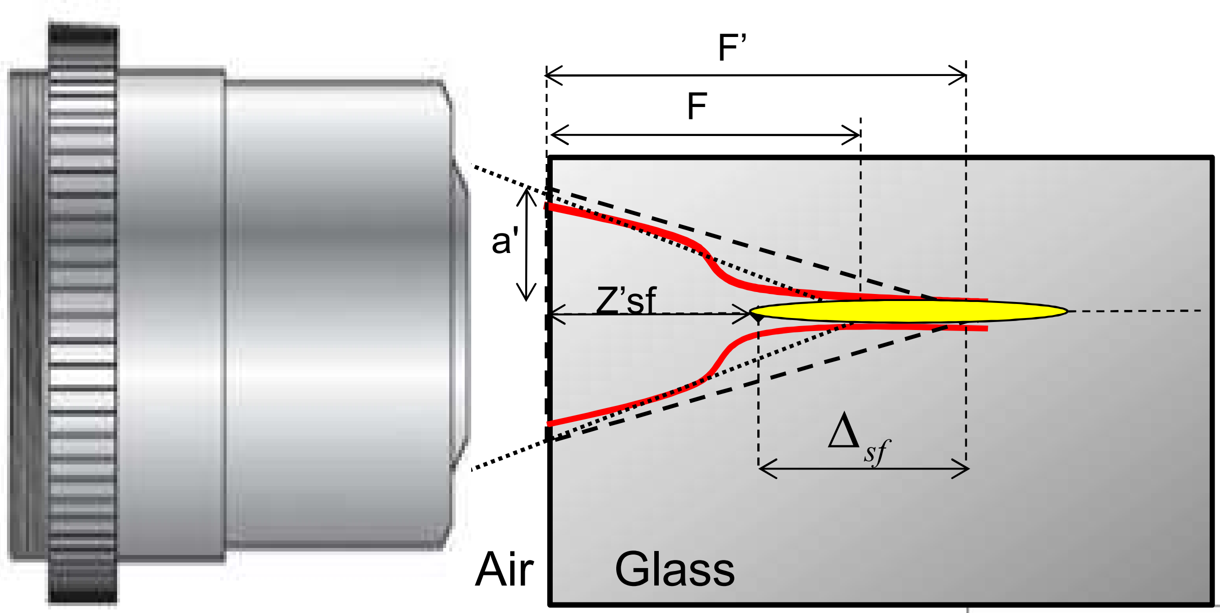
Light polarization state characterization





Change of the polarization state induces an angle dependent intensity

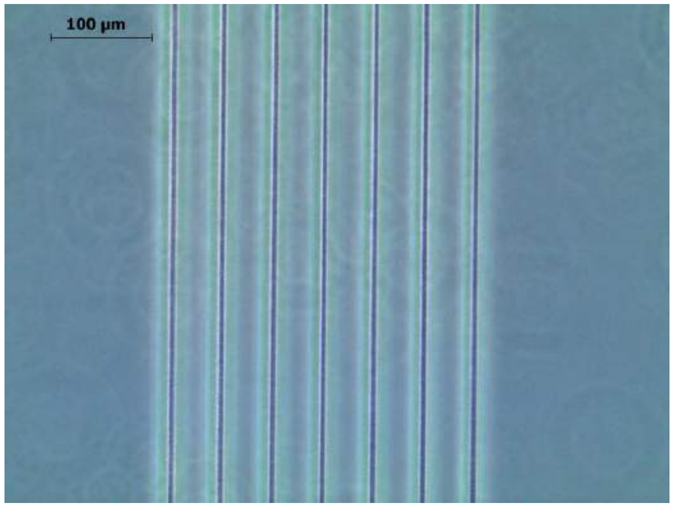
Design and fabrication of phase and polarization gratings

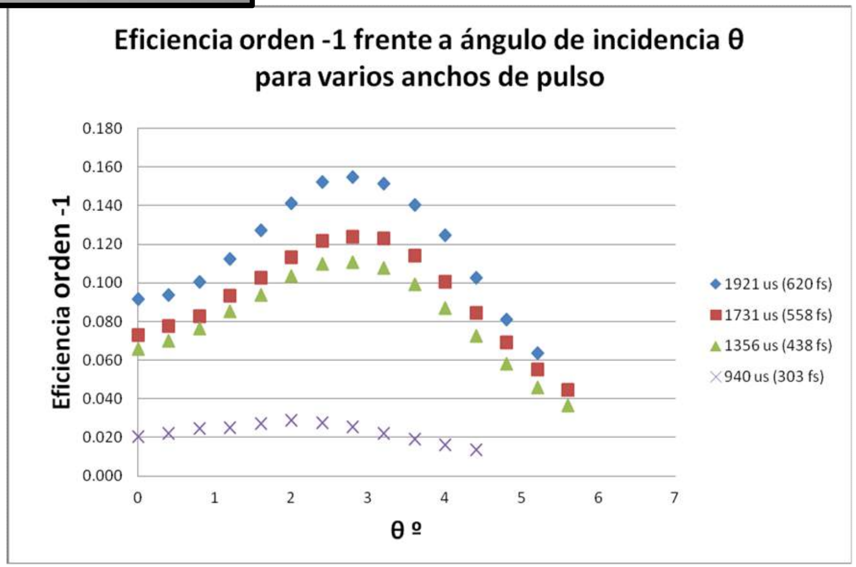


$$z_{sf} = \frac{\pi . a^2 / \lambda}{n_v . \sqrt{P_{peak}/P_{cr} - 1}};$$

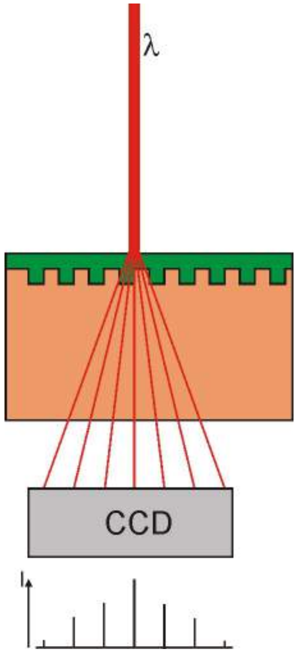
$$\frac{1}{Z'_{sf}} = \frac{1}{Z_{sf}} + \frac{1}{F'}$$

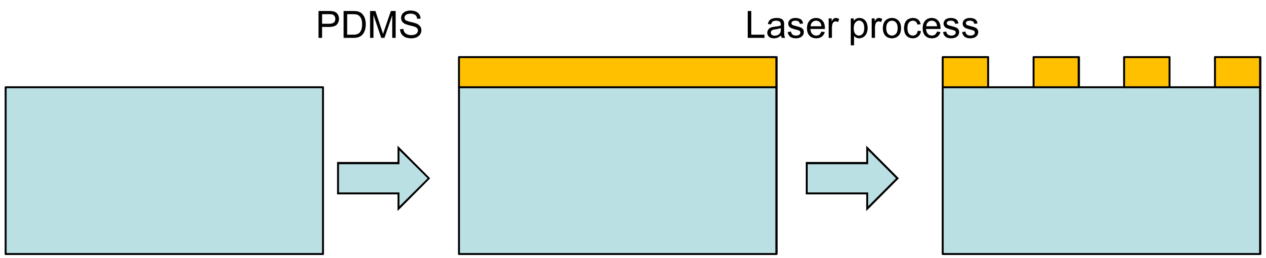
$$\Delta_{sf} = F' - Z'_{sf}$$

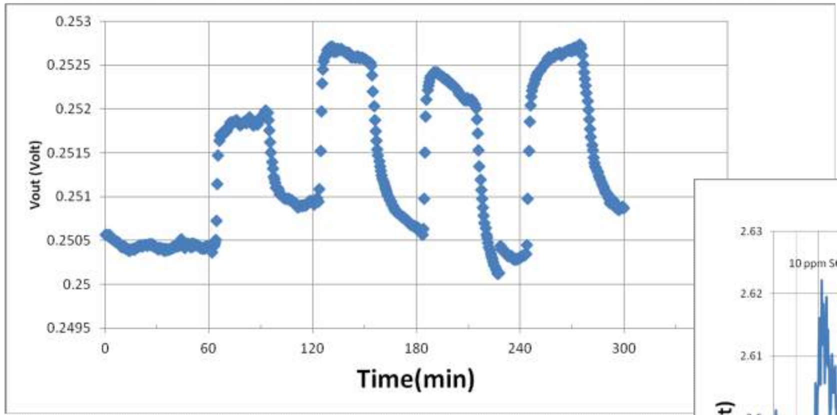




Optical sensor based in gratings

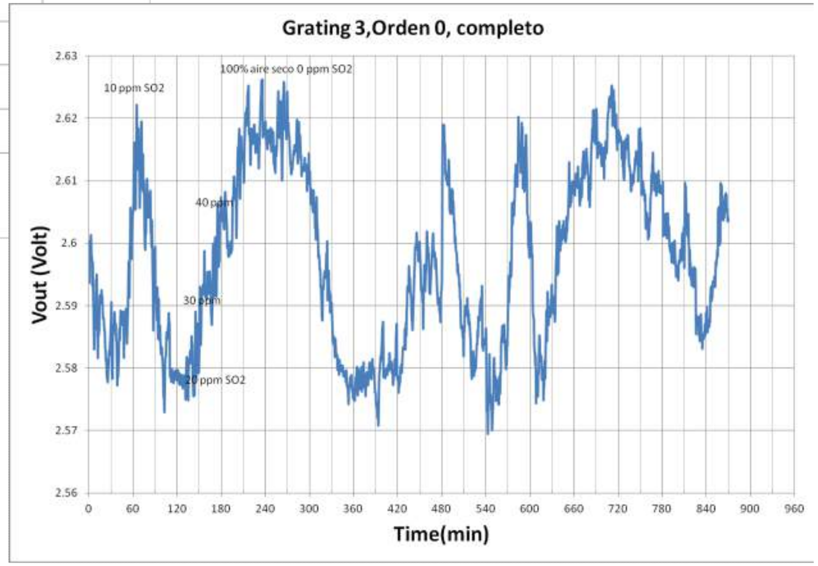






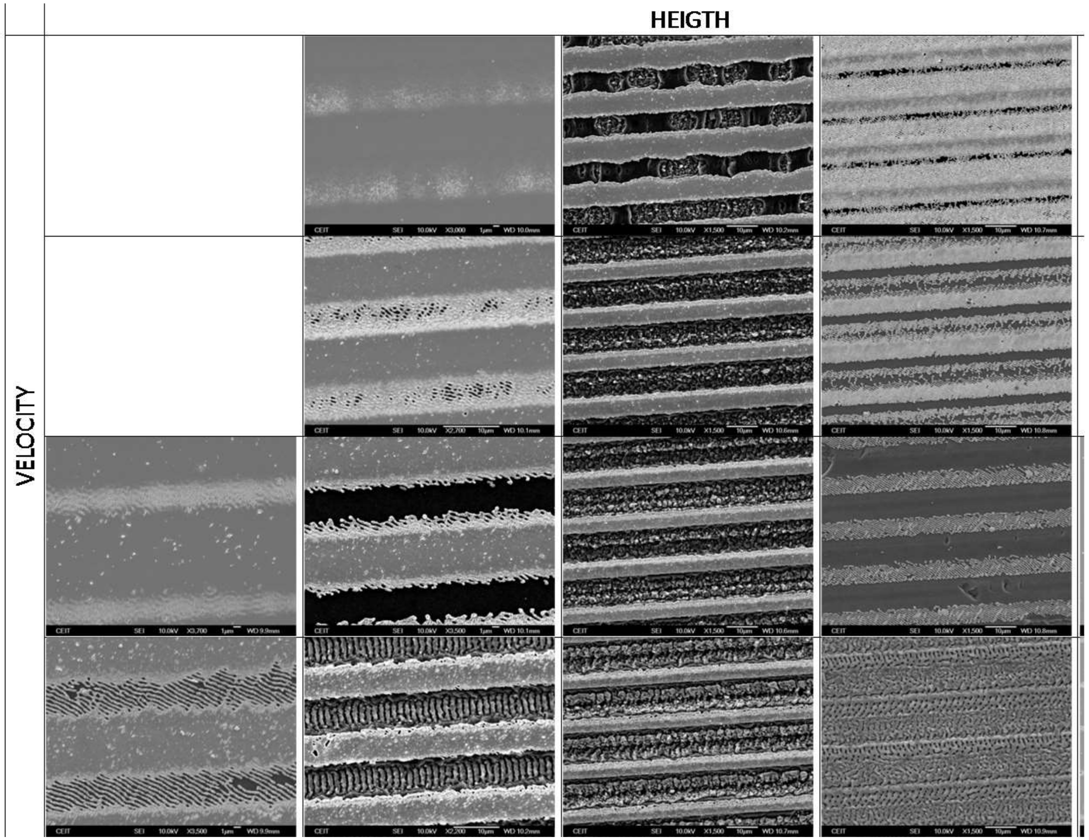
Sensitivity to humidity

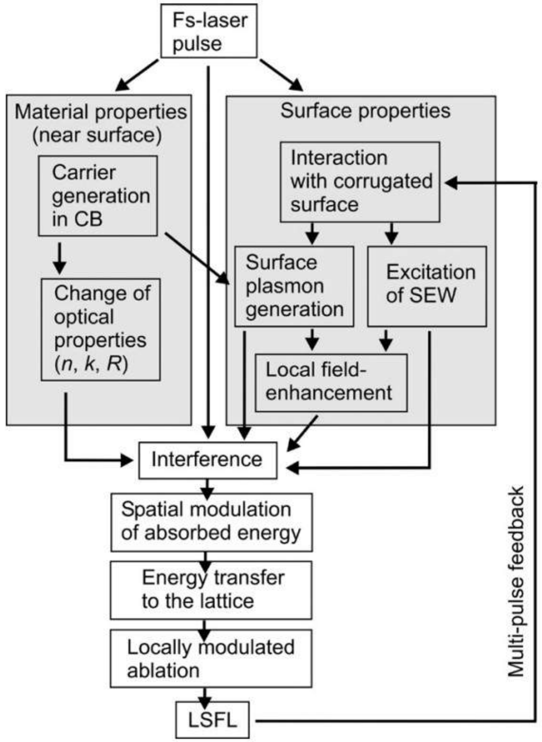
Sensitivity to SO_2



Sensing principle: change in the intensity of difraction orders caused by the change in refractive index derived from the gas interaction with the material

Fabrication of Laser induced periodic structures





Bonse et al., Applied Surface Science 257 (2011) 5420–5423

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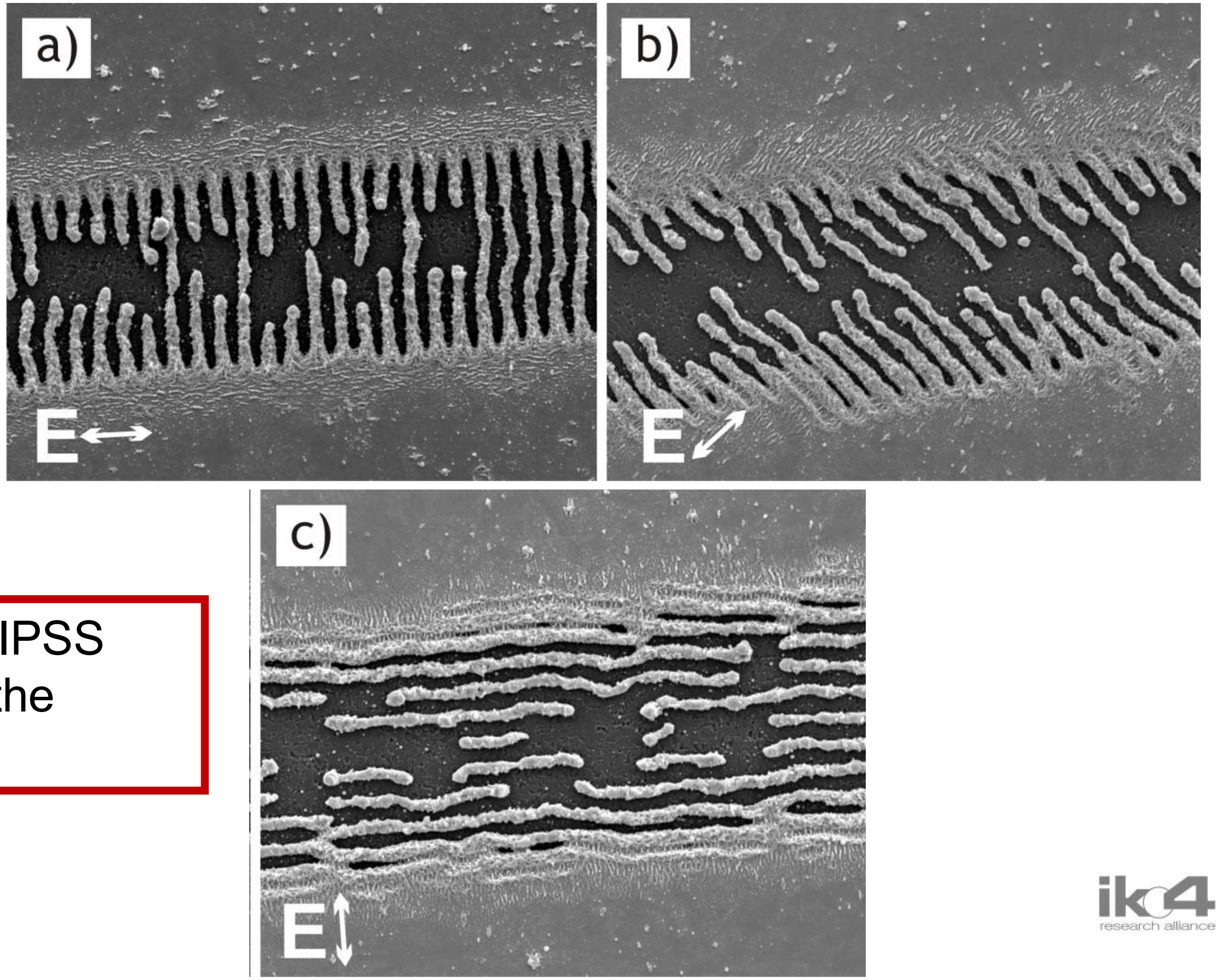
Fabrication of Laser induced periodic structures in Pt thin films



The direction of the LIPSS can be controlled by the electric field

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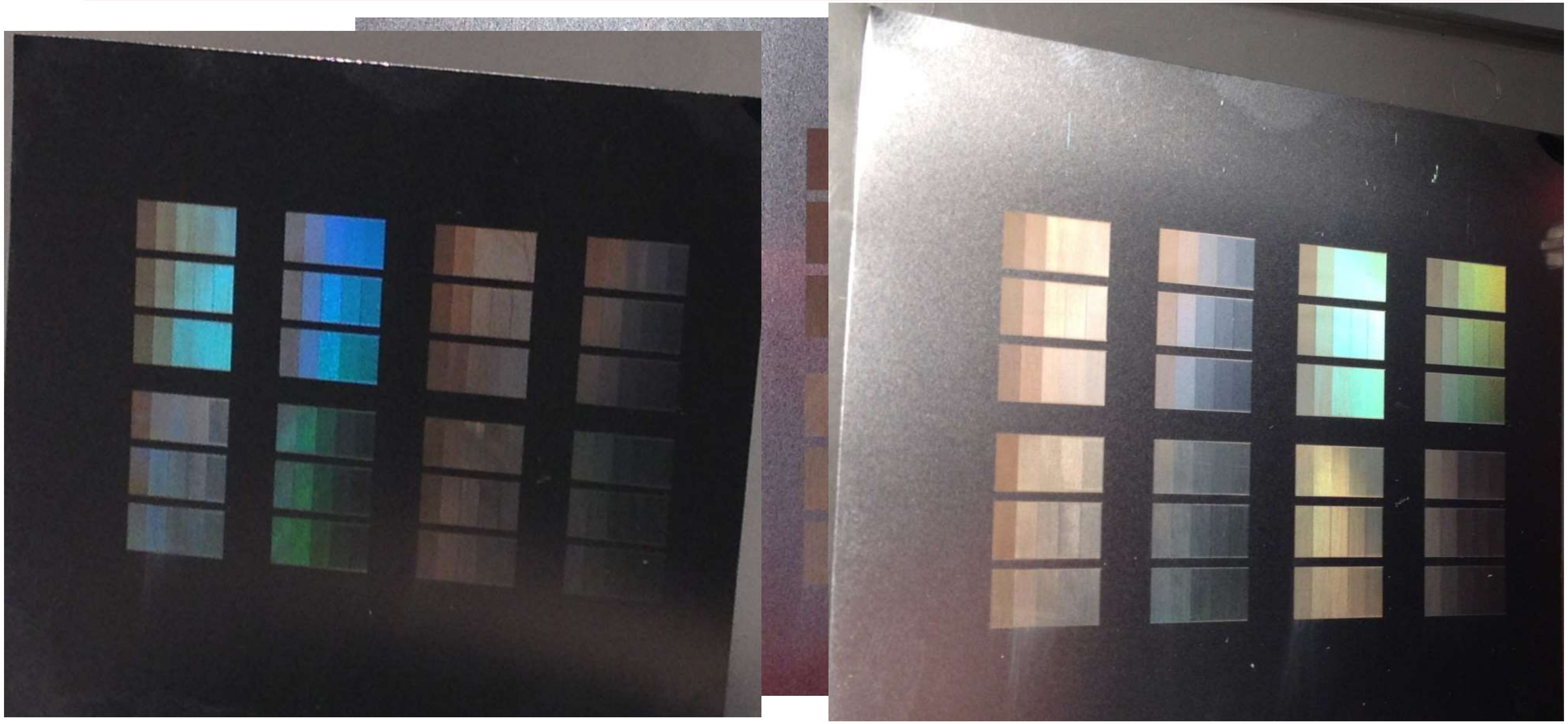
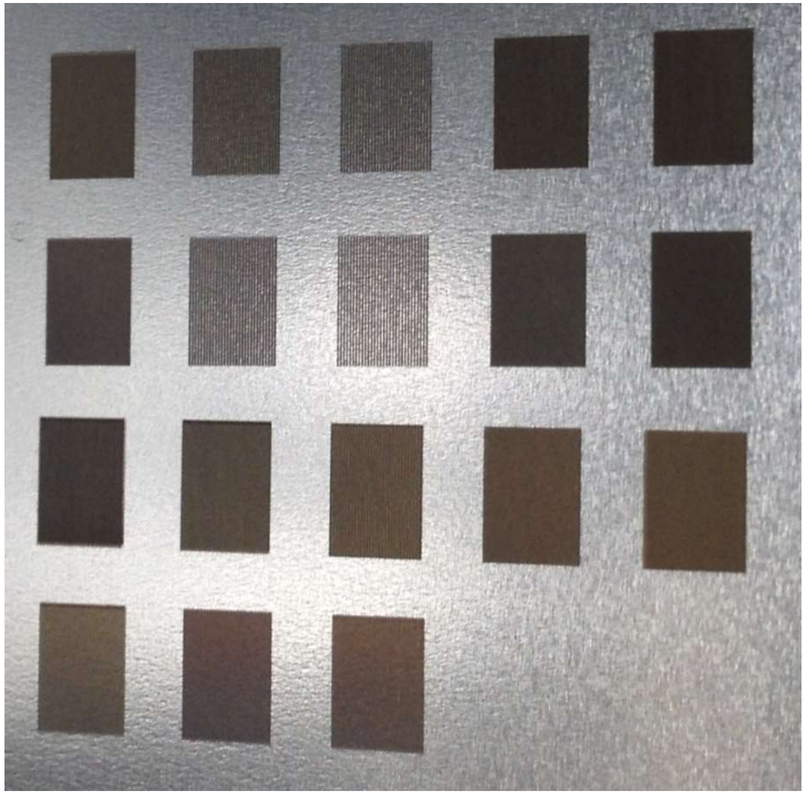
Laser induced periodic structures for decorative applications

LIPSS can be used for the generation of iridiscences in metal due to light refraction.



Laser induced periodic structures for decorative applications

The refraction of light depends both on angle and azimut.



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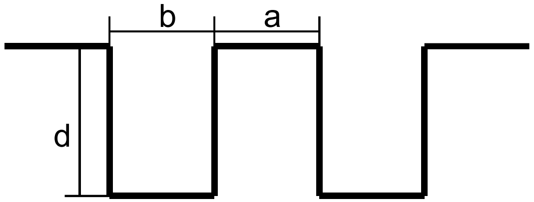
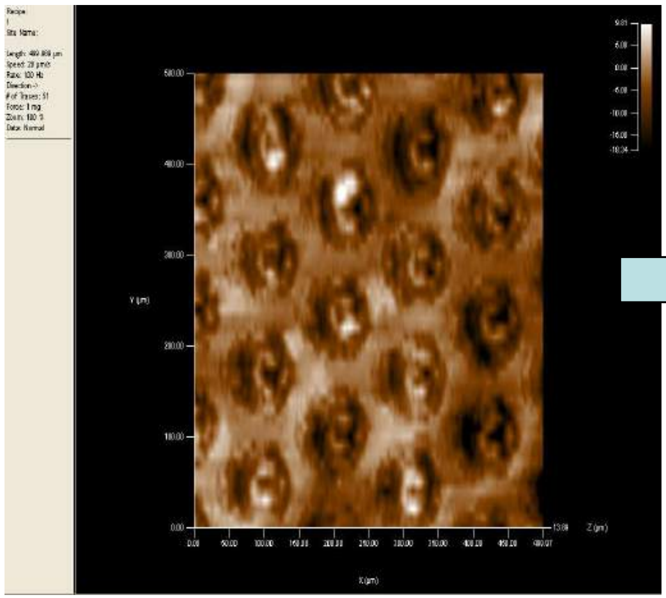
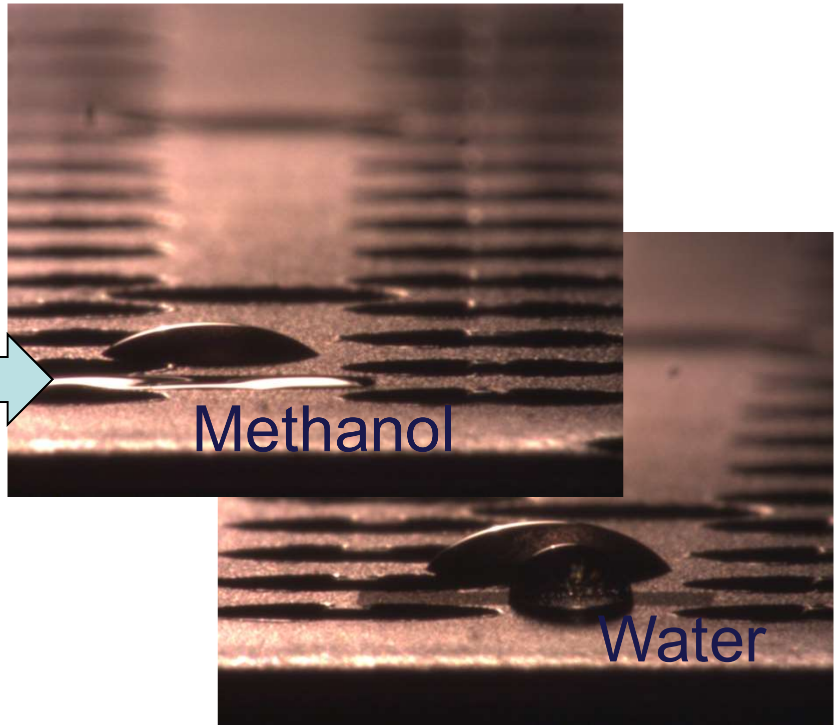
Fabrication of (super)hydrophobic surfaces through surface nano/microstructuration

Surface microstructuring gives only a limited control on the wetting angle of water on a surface

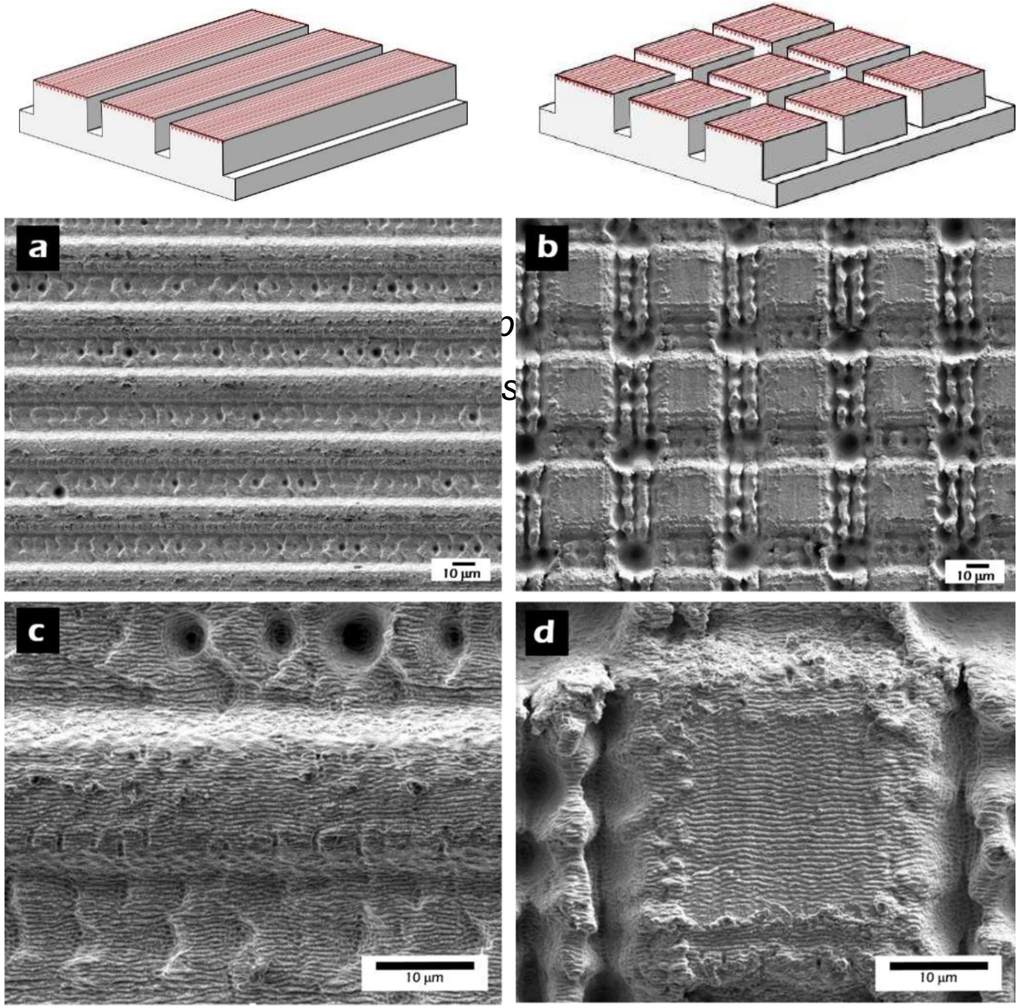
$$\cos\theta_c = \frac{1}{\left(\frac{b}{a}+1\right)^2}(1+\cos\theta)-1$$







Fabrication of (super)hydrophobic surfaces through surface nano/microstructuration



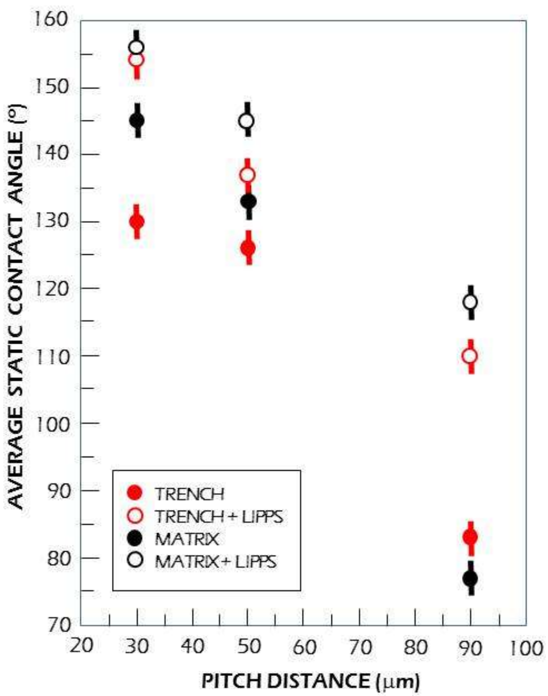
a & c.- Trench micro-nano patterns with a pitch distance of 50 µm

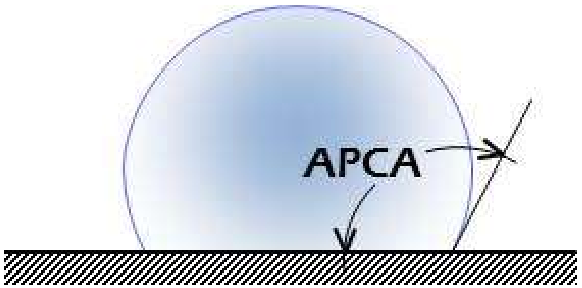
b & d.- Matrix micro-nano patterns with a pitch distance of 50 µm

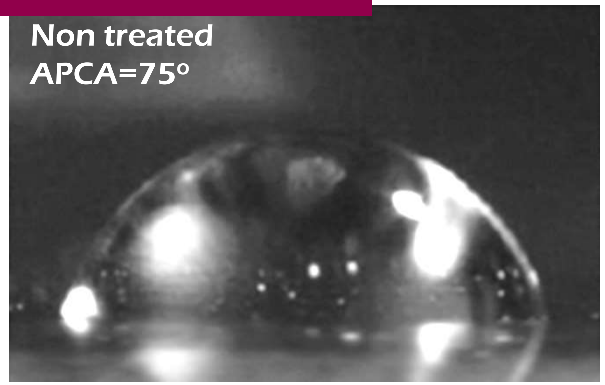
Hierarchical micro/nanostructures fabricated in a one step laser process can produce -larger wetting angles.

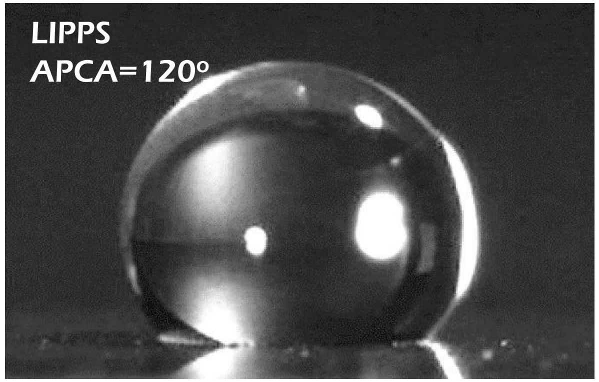
Fabrication of (super)hydrophobic surfaces through surface nano/microstructuration

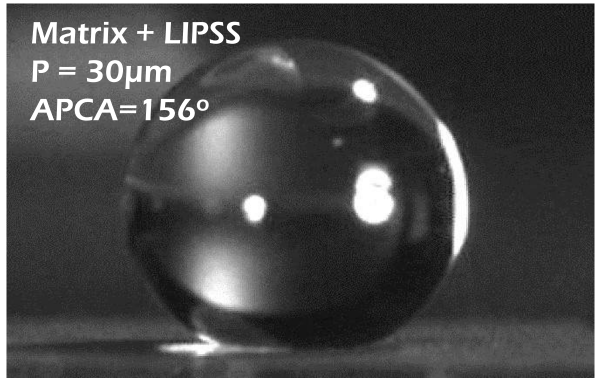
Suerhydrophobic regime can be reached with no chemical process in stainless steel





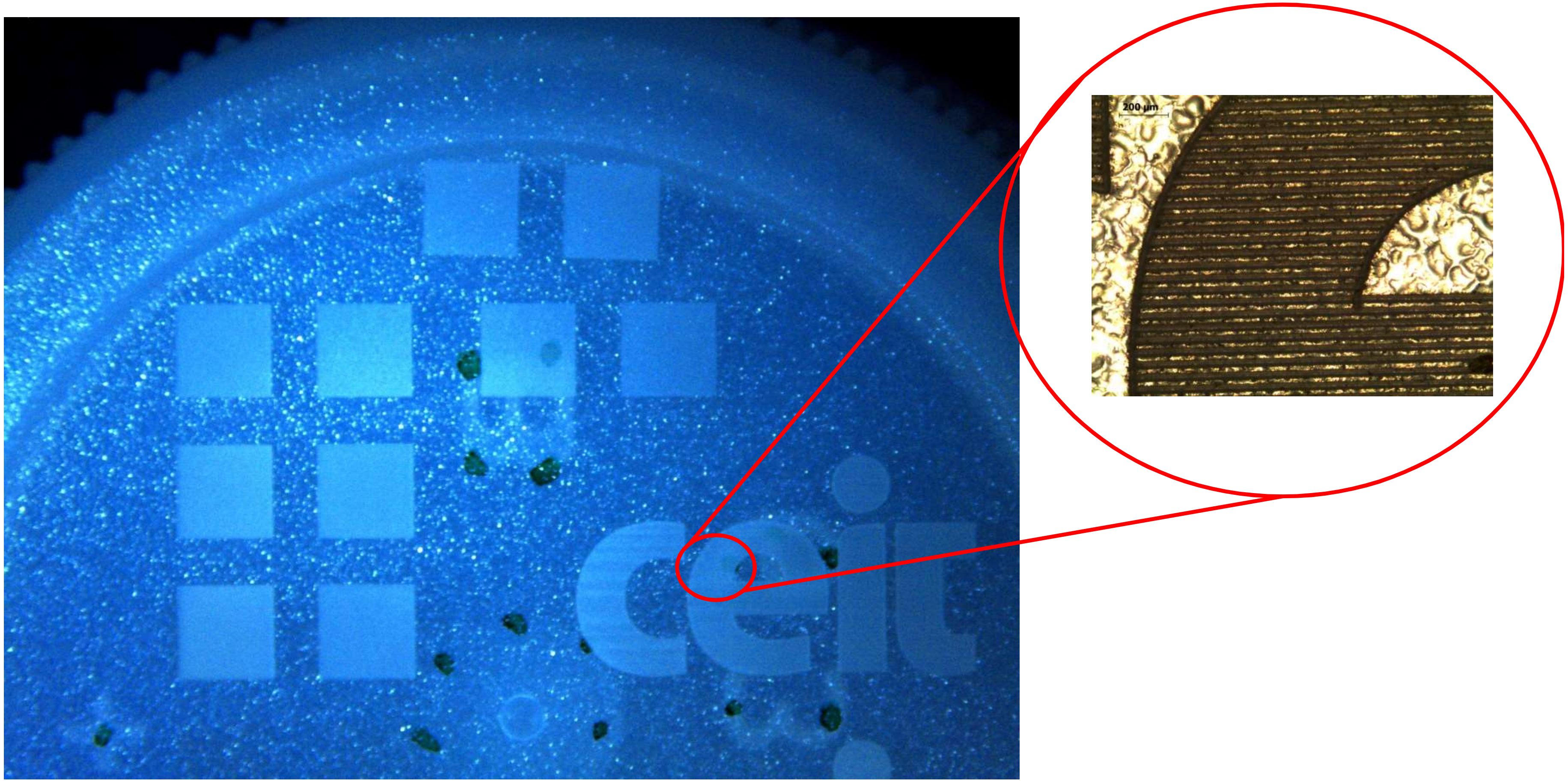






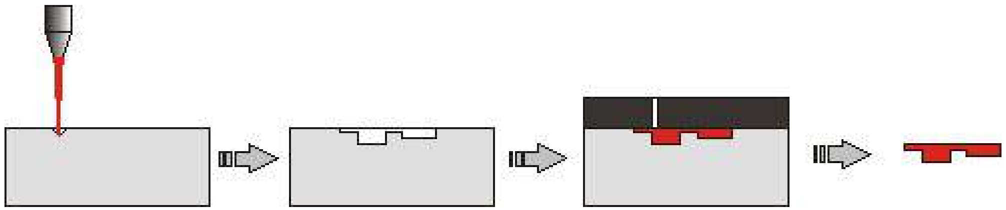
Mecanizado de precisión de piezas de inyección

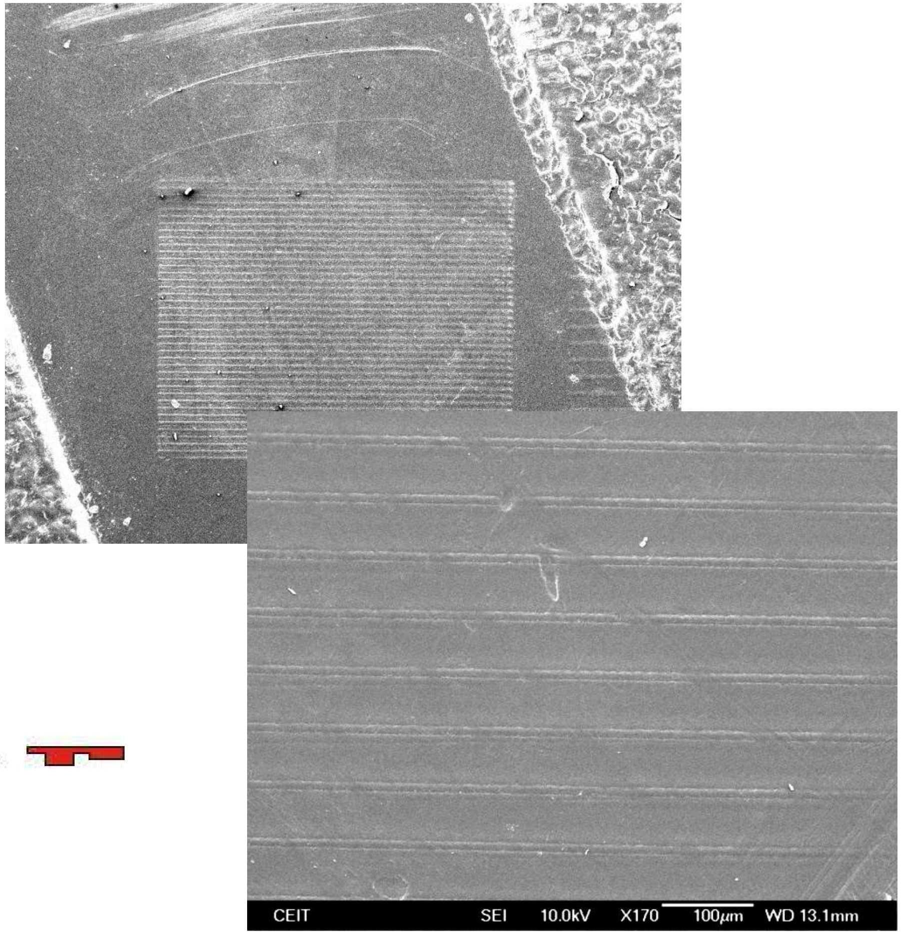
Procesado directo



Fabrication of plastic microstructures using a mold structured by femtosecond laser

Fabrication of high precision molds for plastic injection. Tested in Polystyrene to achieve injection features of 10μm



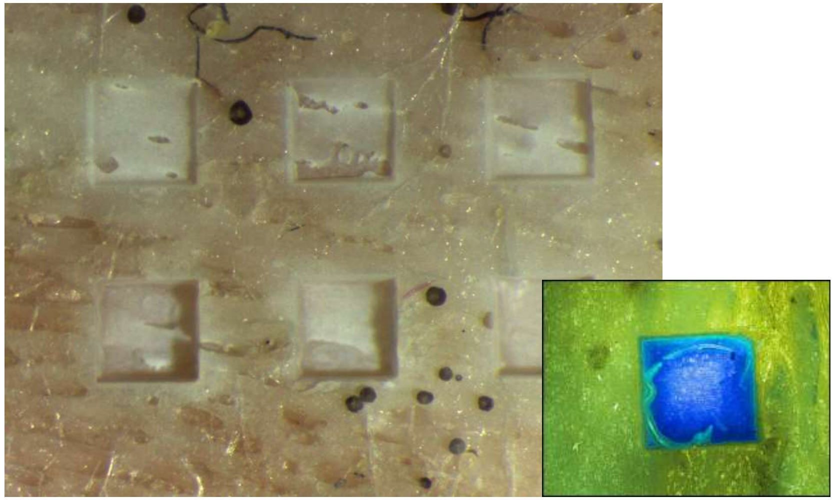


Precission micromachining of bone tissue with femtosecond lasers for medical applications

The micromachining of bone with picosecond lasesr burns a layer of the tissue and produces a rough surface texture.

Picosecond laser

Femtosecond pulses produce highly precise and repeatable surface ideal for medical applications



Femtosecond laser

More information

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