

microrelleus



Industrialization of functional texturing for different applications

Raúl García – Microrelleus SL – EPIC Online Technology Meeting on Surface Structuring





FUNCTIONAL TEXTURING

- 1) Who we are
- 2) Femtosecond laser technology
- 3) Functional texturing
- 4) Microrelleus services

Who we are

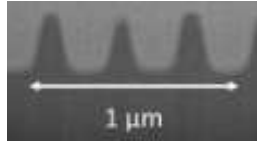
- Service provider for industry: laser micro-milling, laser texturing, industrial engraving
- Company creation: 1983 (Pantograph → Die-Sinking EDM → CNC Milling → Laser)
- Facilities in Barcelona – Spain
- 2013: First laser texturing service company in Spain
- **2016: Femtosecond laser service in 5 axis**



Technology - Machining technology positioning

Femtosecond laser: ultra-short pulse duration laser

nanometers



Achieving smaller milling details

Nanotechnology processes (litography, etc.)

Down to some nm (nanometers)

Femtosecond laser technology

Down to $10\mu\text{m}$ (0,01mm)

Conventional technologies:

Milling-machine, die-sinking EDM, etc.

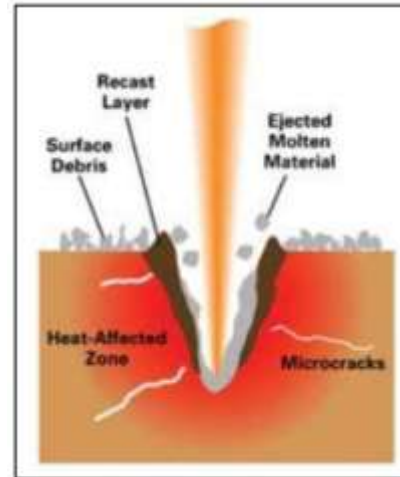
From several millimeters to aprox. $100\mu\text{m}$ (0,1mm)

millimeters



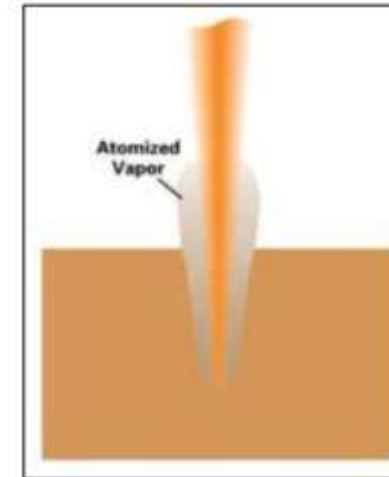
Nanosecond laser (10^{-9}sec)

- Heat affected zone
- Burr



Femtosecond laser (10^{-15}sec)

- "Cold" ablation
- Absolutely burr-free



*Femtosecond laser beam diameter:
from $50\mu\text{m}$ to $10\mu\text{m}$



*Machine capacity: 600x400x300mm

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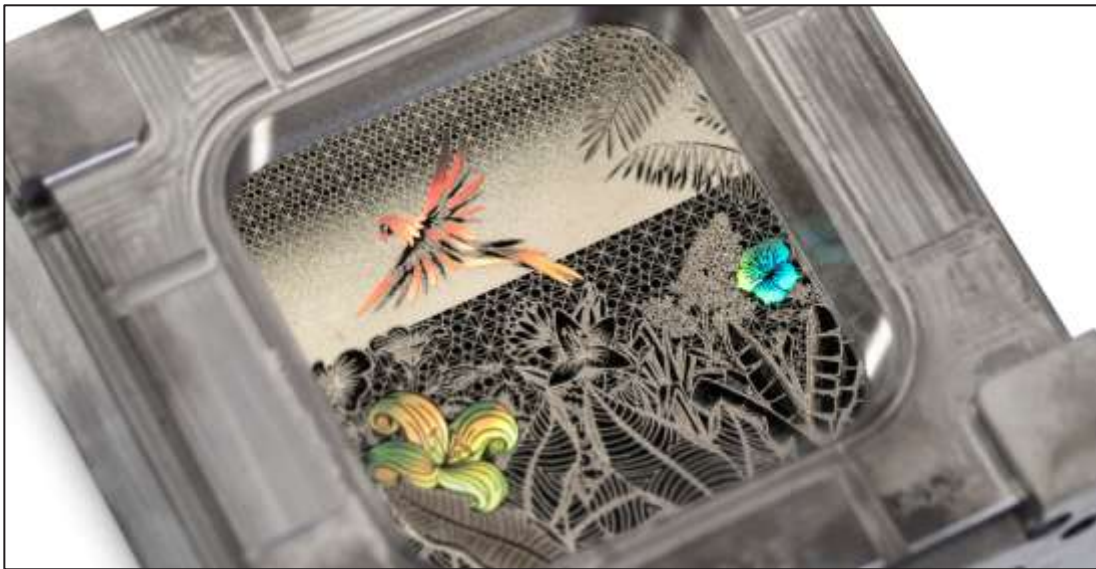
Working over mold vs working over final part

POSSIBILITIES

- Because of the “cold” ablation of the femtosecond laser, we can work over almost any material.
- That let us the possibility of working over mold or directly over final part

WHEN WOULD WE LIKE TO WORK DIRECTLY OVER FINAL PART?

- Series that require micro-milling: microfluidic devices, special lighting devices, prosthesis, etc.
- Prototypes

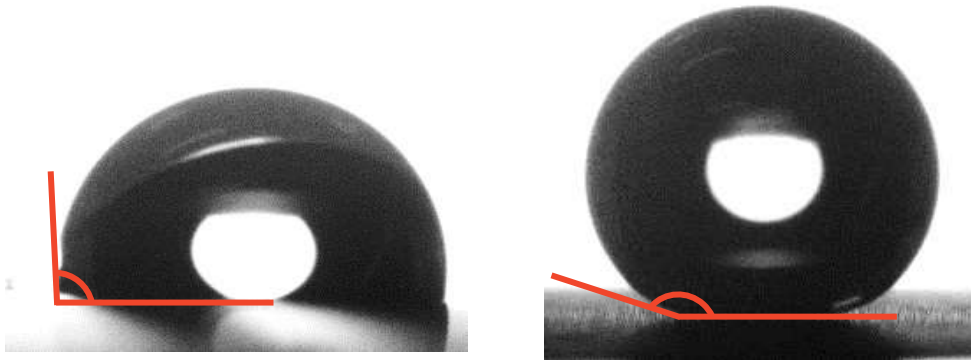


Femtosecond laser micro-milling over tempered steel mold



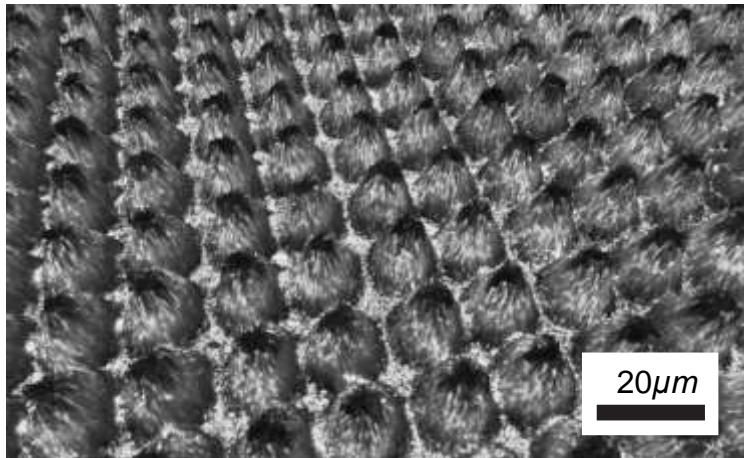
Femtosecond laser micro-milling over final part

Functional texturing - Hydrophobicity



Contact angle before texturing: 102°

Contact angle after texturing: 160°



Confocal analysis of the micro/nano structure



Plastic texturized

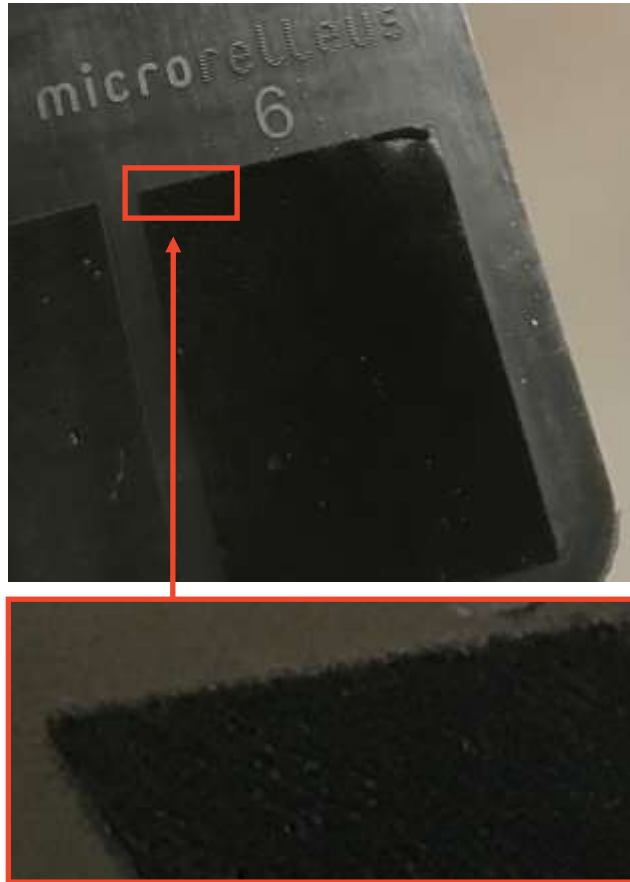
Plastic not texturized

Functional texturing - Hydrophobicity

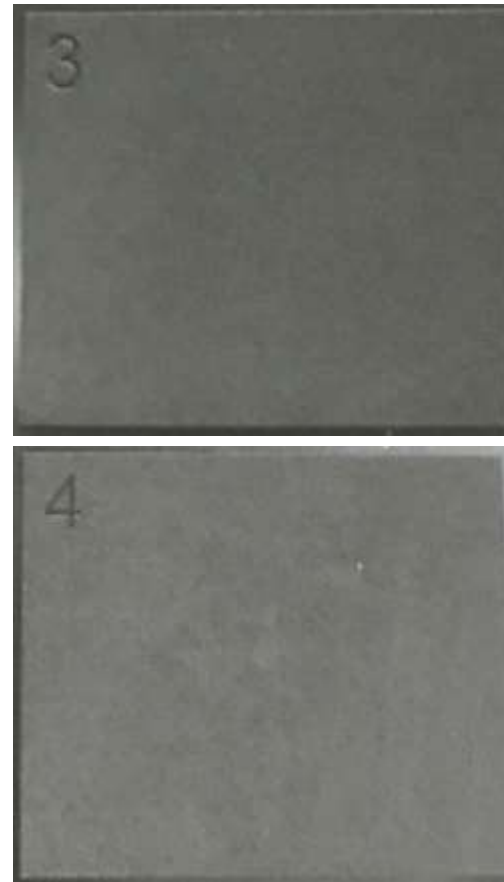


Functional texturing – Sensitive texturing

- Peach skin effect



- Soft-touch effect



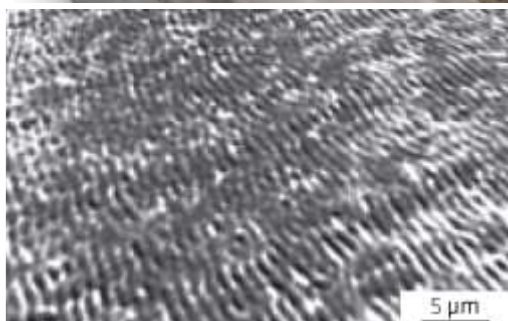
- Anti-scratch



Functional texturing – Design



Textured mold



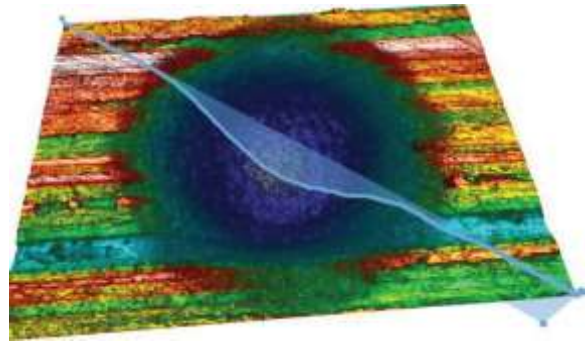
Original design



Functional texturing – Light diffraction (design)



Functional texturing – Self-lubricating



Focus variation analysis of the micro cavity

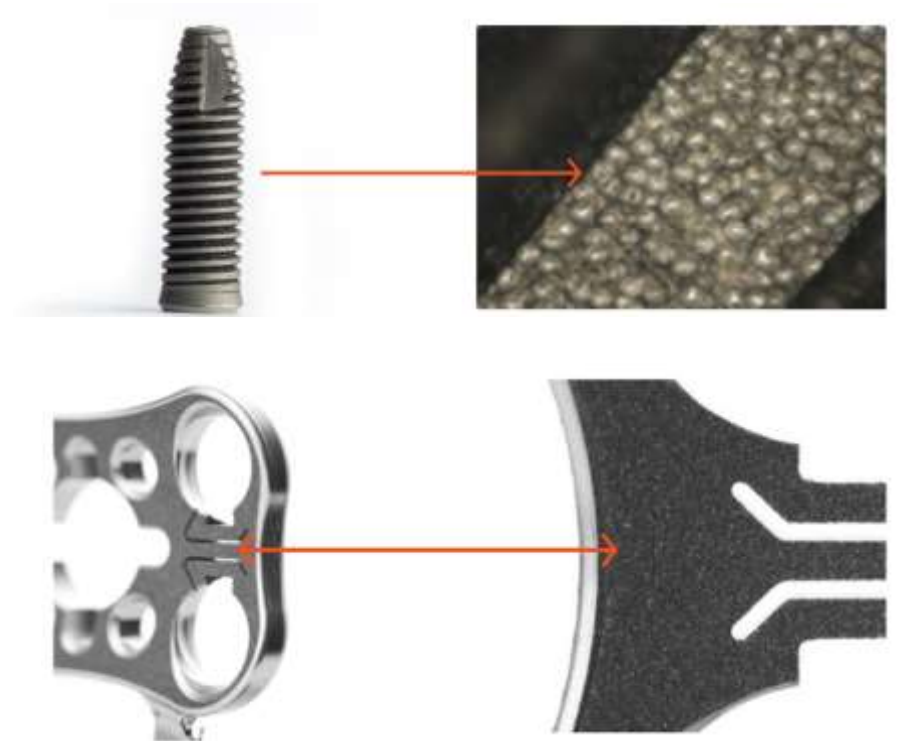


Functional texturing – Osseointegration

For improving osseointegration for Spine Plate, Hip-Joint or dental implants.

Benefits of using femtosecond laser:

- 1) Cost-effective solution
- 2) Digital process:
 - 1) Controlled texturing
 - 2) No park masking required
 - 3) Possibility of different textures with one set-up
 - 4) 100% reproducible
- 3) Remove manual handling operations in texturing and cleaning
- 4) Reduction of contamination
- 5) High accuracy process
- 6) Reduced time to market



Functional texturing – Lighting prototypes

Because of the “cold ablation” of the laser we can achieve details, textures and millings that were not possible before on prototype (both for functional or design purposes with the light)

VDI30 and VDI 36 engraved directly over PMMA

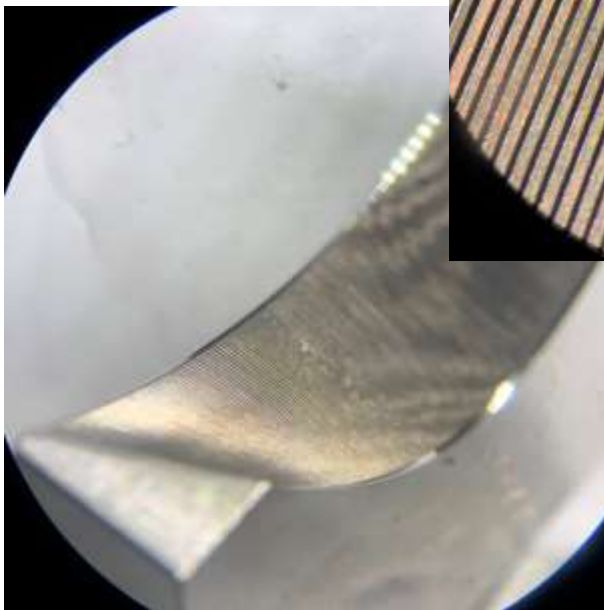
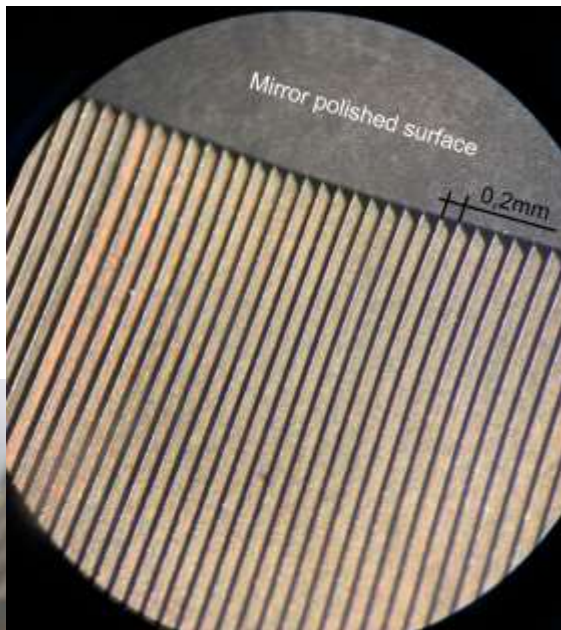


Microstructuring for a “light curtain”

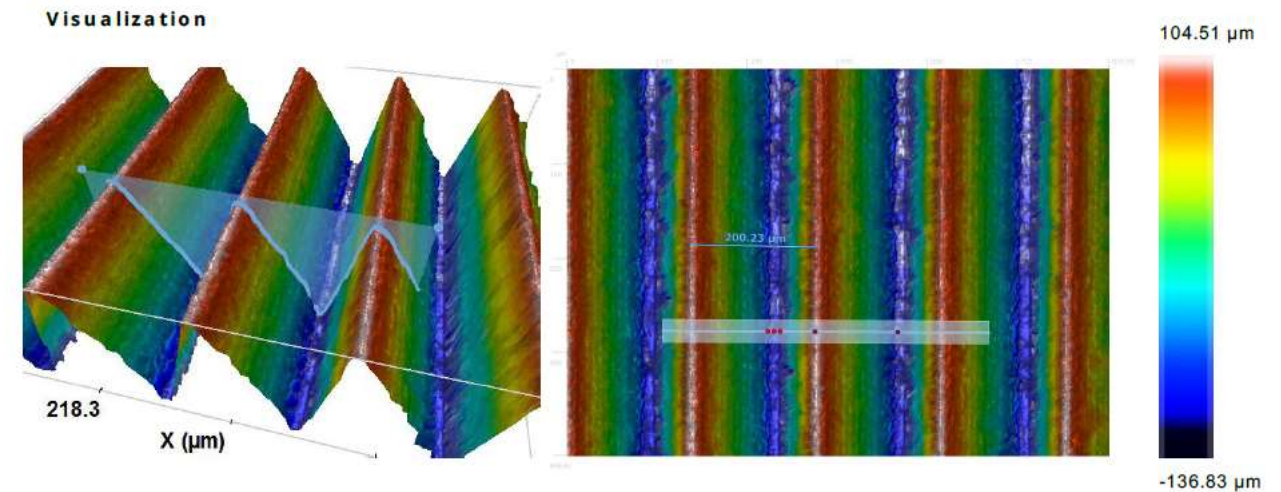


Functional texturing - Microstructuring for lighting

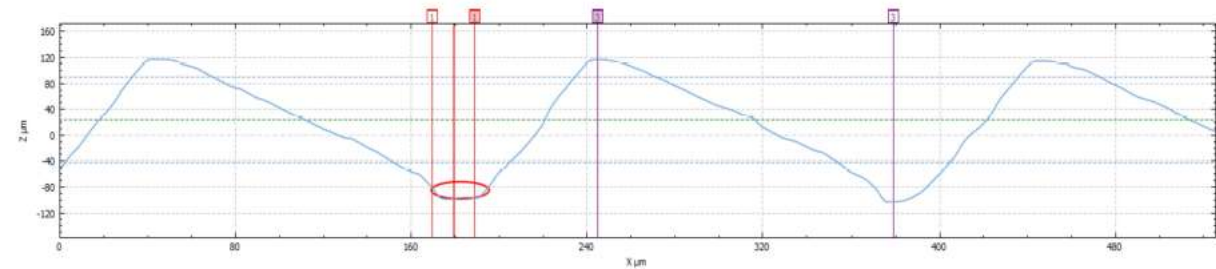
Optical microscope 40x



Confocal microscope analysis of the structure



Profile

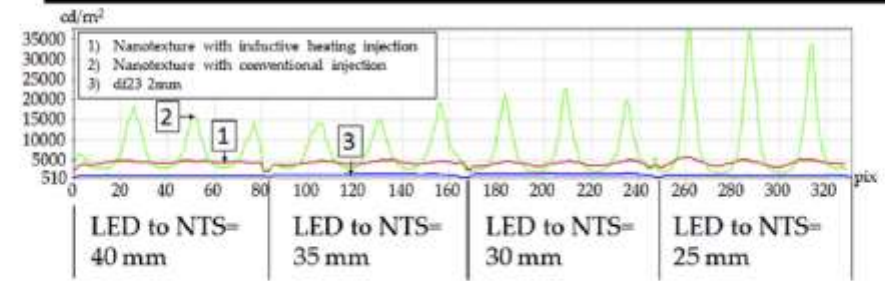
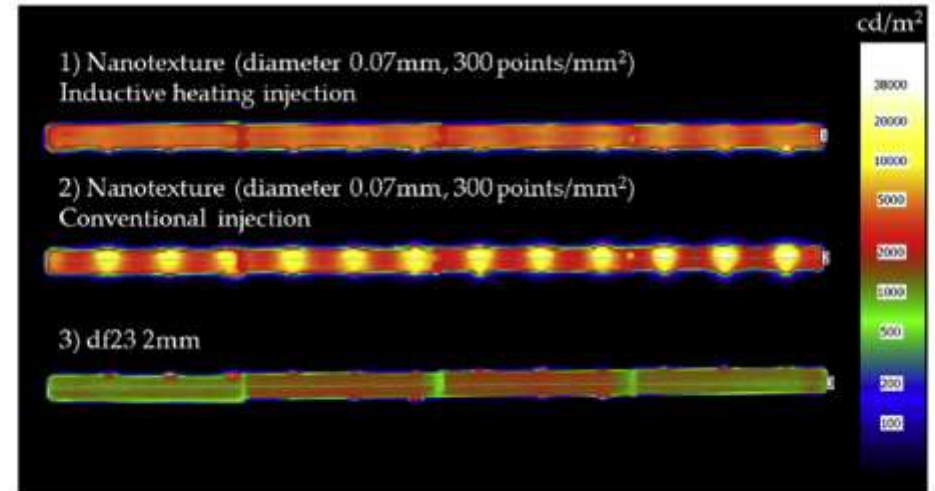
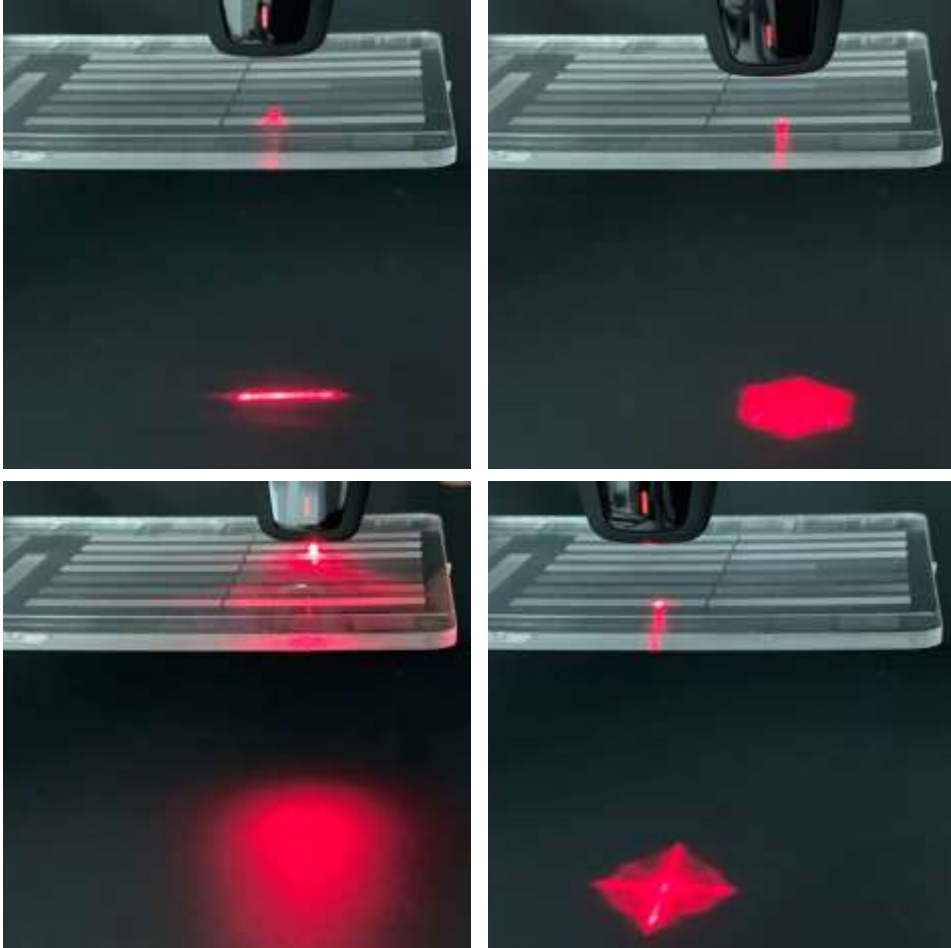


Notes

- | | | | |
|---|----------|---------------------------------|--|
| 1 | Circle | $D_{xy} = 26.415 \mu\text{m}$ | $A_{xy} = 548.00 \mu\text{m}^2$ |
| 2 | Distance | $\Delta L = 200.23 \mu\text{m}$ | $\Delta Z = 132.22 \text{ nm}$ $\angle = 0.04^\circ$ |

Functional mold texturing

HOMOGENEOUS LIGHT DIFFUSION AND LIGHT DIRECTION 1D & 2D



Luminance images and luminance plots of nanotexture with optical diameter 0.07 mm and 300 points/mm² connected at 8 V. The four areas match with the four distances between LED and NTS/df23 defined in the mock-up, from left to right: 40 mm, 35 mm, 30 mm and 25 mm.

Pina-Estany, J., García-Granada, A. A., & Corull-Massana, E. (2018). Injection moulding of plastic parts with laser textured surfaces with optical applications. *Optical Materials*, 79, 372-380. Textures: Microrelleus

MICRORELLEUS SERVICES



WHAT CAN WE OFFER WITH THE FEMTOSECOND LASER TECHNOLOGY:

- Laser microstructuring, laser texturing and industrial engraving service focused on maximizing the added value of our customers.
- Femtosecond laser applied over final part: single part or serial production
- Femtosecond laser applied over mold or tool
- R&D for customer: as this is a very new and disruptive technology there are a lot of new manufacturing possibilities, so we develop and test our new customers needs.
- We collaborate with Technology Centers and Universities to offer complete solutions to our customers: texture or microstructuring design for functionality, test on laboratory, prototypes, etc.
- Our customers: final product manufacturers, mold-makers, plastic injectors, OEM's, Tier 1, Tier 2, etc.

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Laser microstructuring
Laser texturing
Industrial engraving

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