

microrelleus

Industrialization of functional texturing for different applications

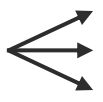
Raúl García, Microrelleus S.L.
EPIC MEETING ON LASER SURFACE FUNCTIONALIZATION



FUNCTIONAL TEXTURING

- 1) Who we are
- 2) Femtosecond laser technology
- 3) Functional texturing
 - Hydrophobicity / Anti-scratch / Light diffraction and design texturing / Selft lubricating / Osseo-integration
 - Lighting (prototypes, microstructuring, micro-optics)
- 4) Microrelleus services

Who we are

- Service provider for industry 
 - Industrial engraving
 - Laser texturing
 - Laser microstructuring
- Company creation: 1983 (Pantograph → Die-Sinking EDM → CNC Milling → Laser)
- Facilities in Barcelona – Spain
- 2013: first laser texturing service company in Spain
- **2016: pioneers in femtosecond laser service in 5 axis**
- **2022: pioneering in larger parts 5 axis femtosecond laser processing → contact us for more details!**



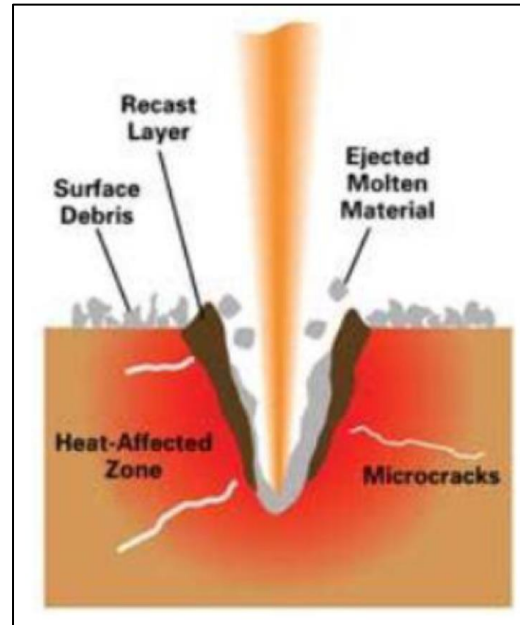
Technology - What a femtosecond laser is?

Characteristics:

- Ultra-short pulse duration laser
- (almost no thermal effect over the material)
- Clean, Sharp and burr-free micro milling
- High quality surface finishing
- 5 axis
- Milling over any material
 - Plastic
 - Glass
 - Hard metal
 - Steel
 - Carbide silicium
 - Etc.
- Optimal technology for:
 - Microcavities in mold
 - Microfluidic channels
 - Micro milling for stamping tool
 - Micro structuring
 - Etc.

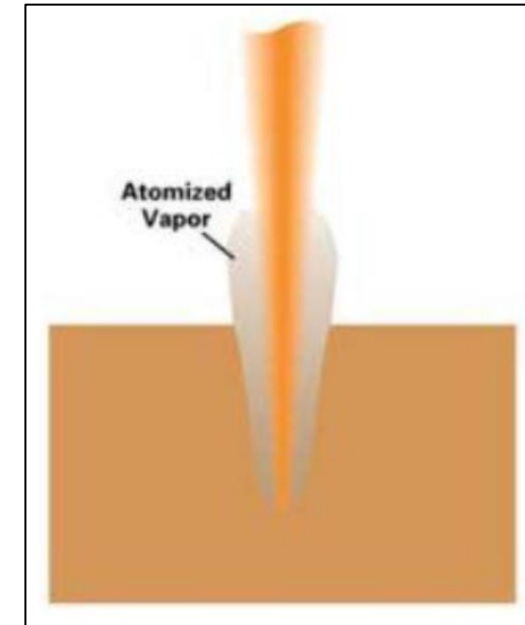
Nanosecond laser (10^{-9} sec)

- Heat affected zone
- Burr



Femtosecond laser (10^{-15} sec)

- “Cold” ablation
- Absolutely burr-free



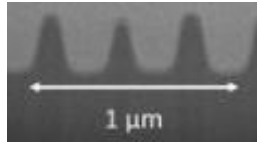
*Femtosecond laser beam diameter:
from $50\mu\text{m}$ to $10\mu\text{m}$

Technology - Machining technology positioning

We can achieve smaller milling details than conventional technologies in an industrial way (not in a laboratory) and on any material!!

→ New micromilling/texturing possibilities on **Mould** or directly on **PMMA/PC prototypes**

nanometers



Nanotechnology processes (litography, etc.)
Down to some nm (nanometers)

Femtosecond laser technology
Down to $10\mu m$ (0,01mm)

Conventional technologies:
Milling-machine, die-sinking EDM, etc.
From several millimeters to aprox. $100\mu m$ (0,1mm)

millimeters



- * Machine capacity: 600x400x300mm
- * Much more capacity in 2022 for big tool/parts texturing!



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Working over mold vs working over final part

POSSIBILITIES

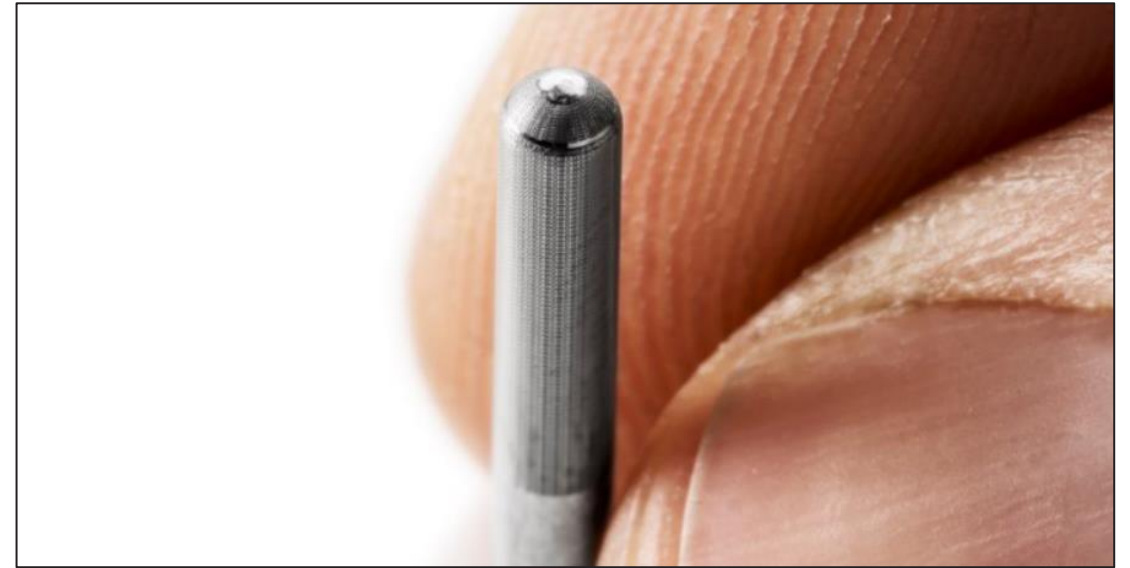
- Because of the “cold” ablation of the femtosecond laser, we can work over almost any material.
- That let us the possibility of working over mold or directly over final part

WHEN WOULD WE LIKE TO WORK DIRECTLY OVER FINAL PART?

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

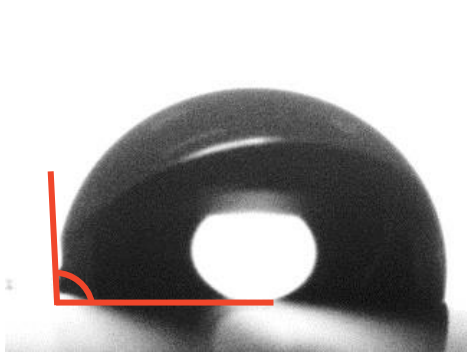


Femtosecond laser micro-milling over tempered steel mold

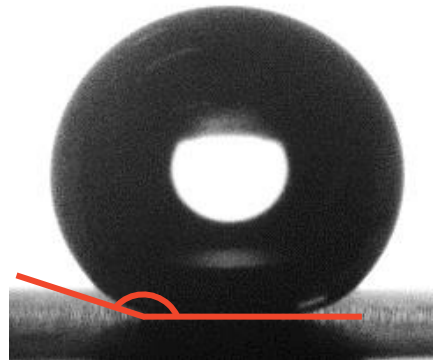


Femtosecond laser micro-milling over final part

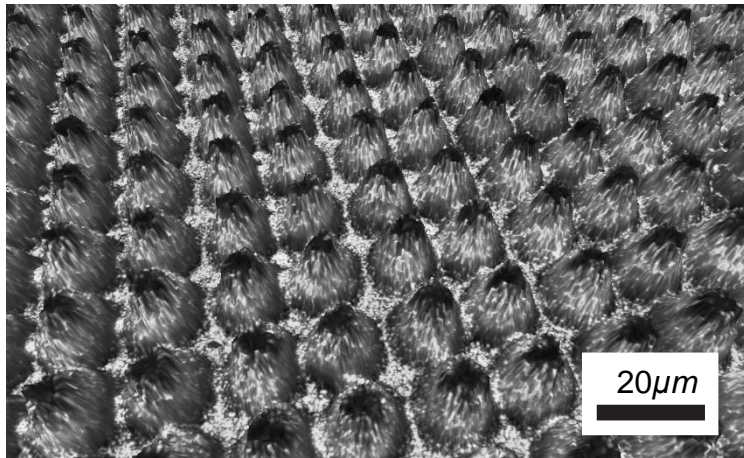
Functional texturing - Hydrophobicity



Contact angle before
texturing: 102°



Contact angle after
texturing: 160°



Confocal analysis of the micro/nano structure

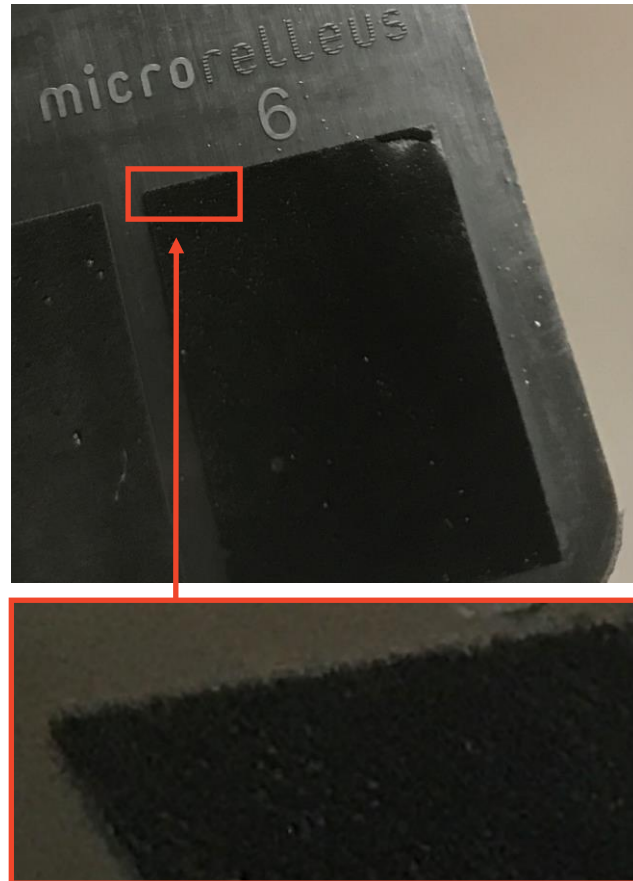


Functional texturing - Hydrophobicity

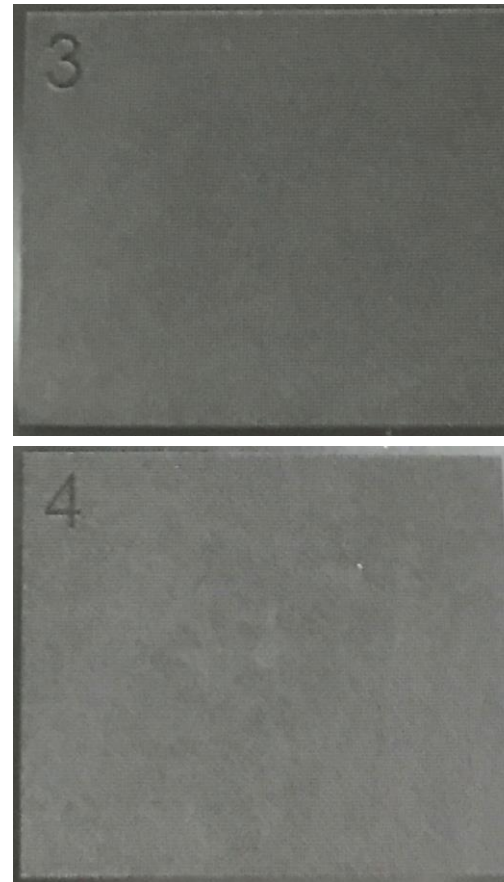


Functional texturing – Sensitive texturing

- Peach skin effect



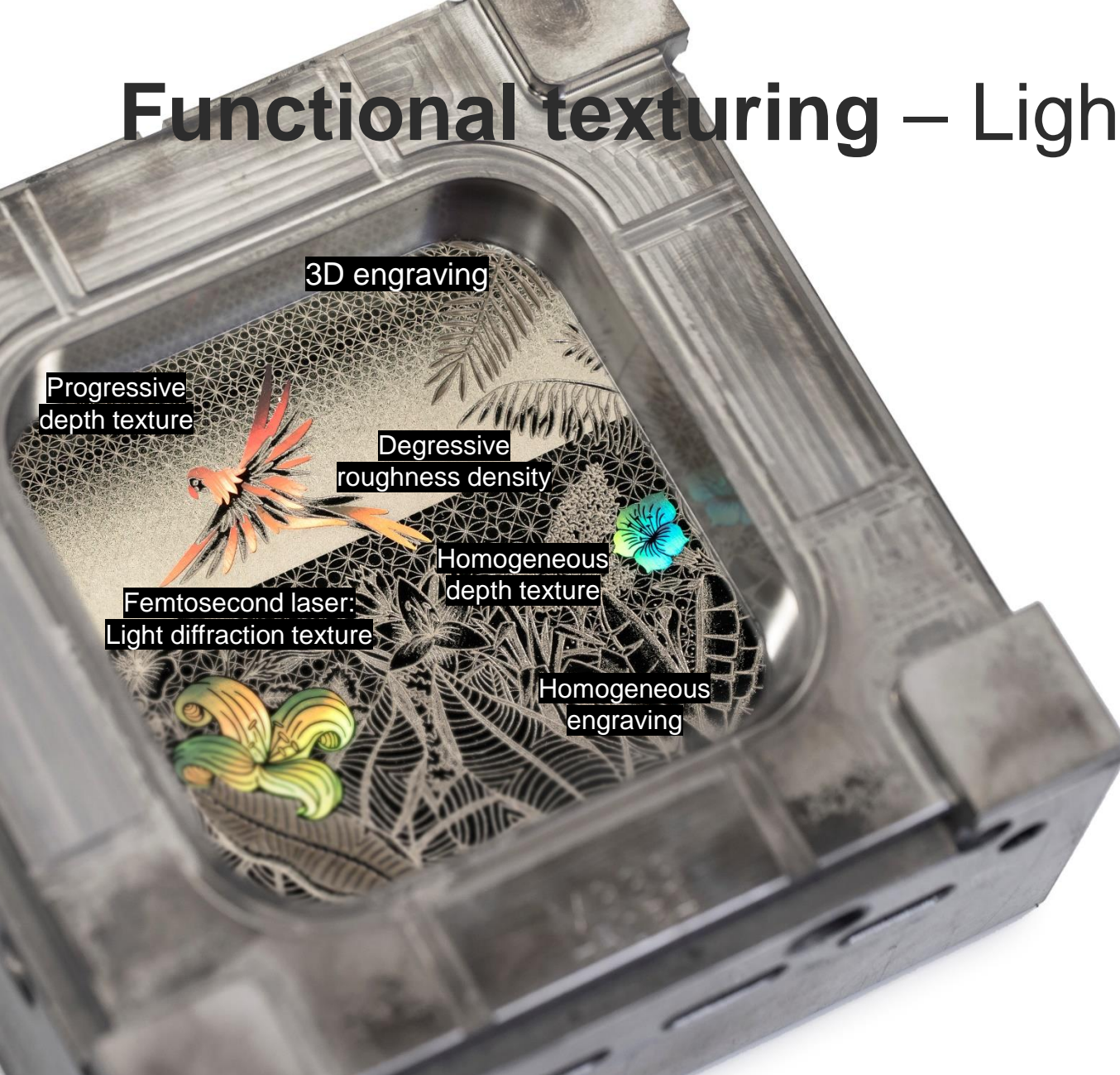
- Soft-touch effect



- Anti-scratch



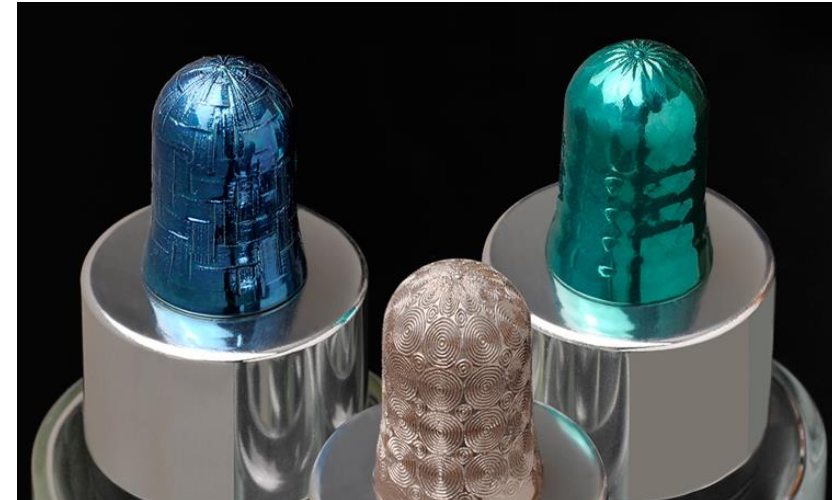
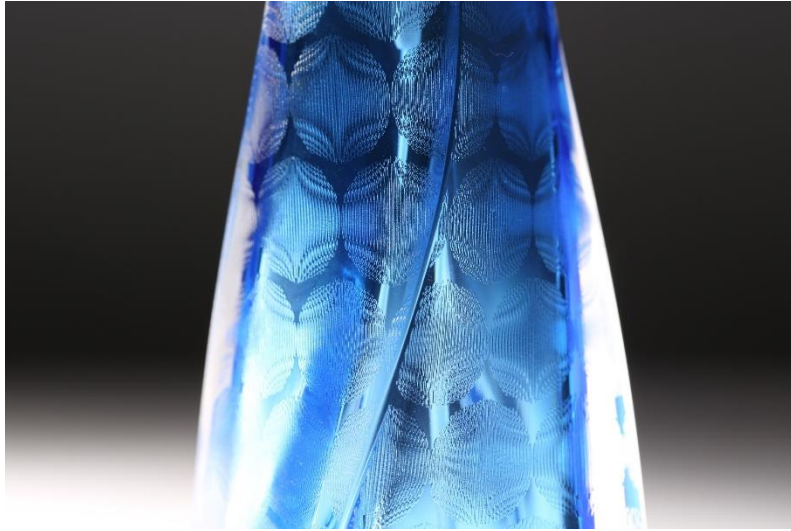
Functional texturing – Light diffraction (design)



Functional texturing – Light diffraction (design)



Design texturing

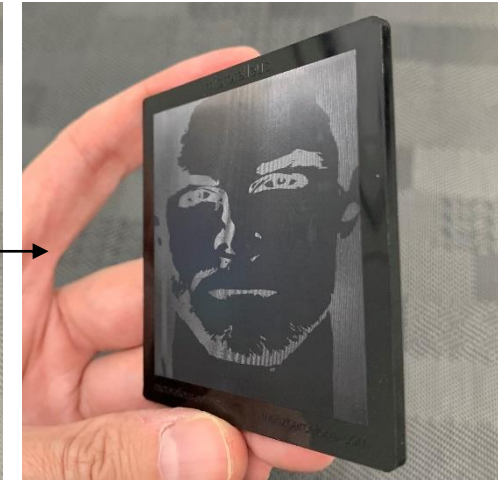
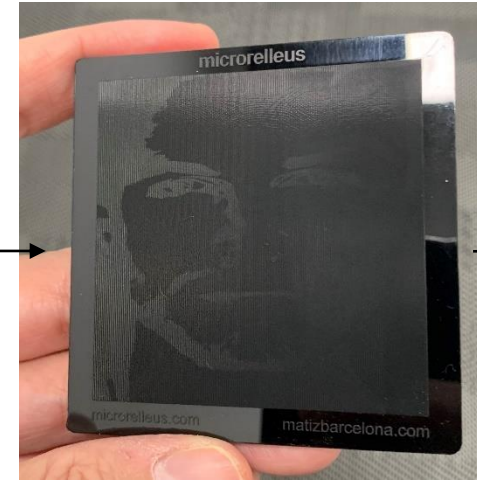
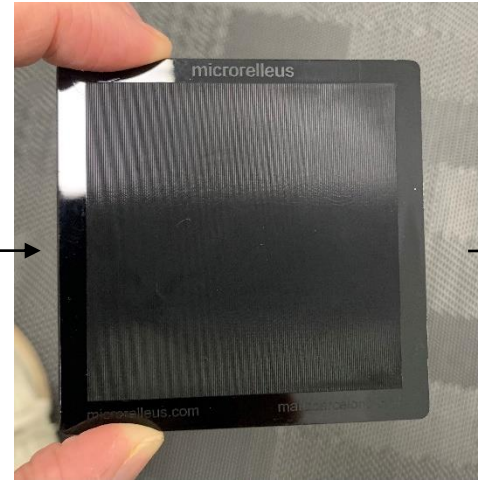
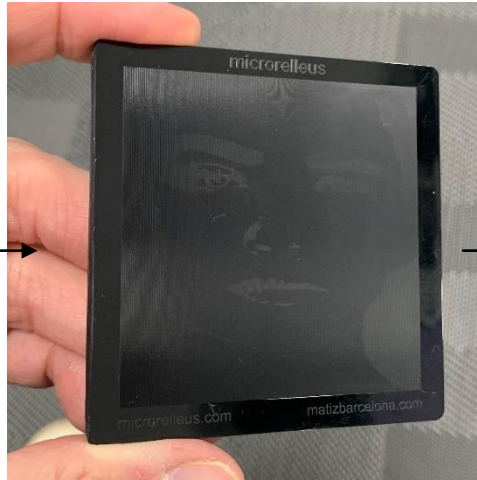
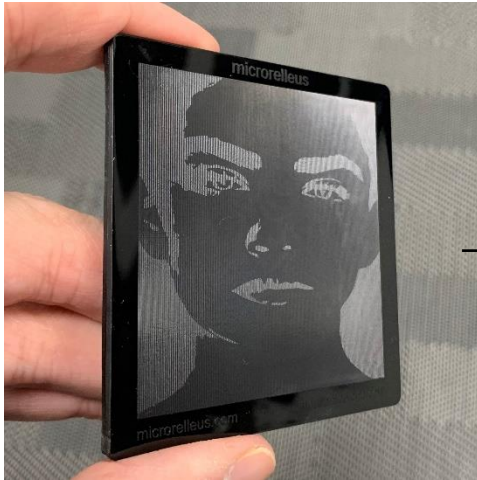


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Design texturing

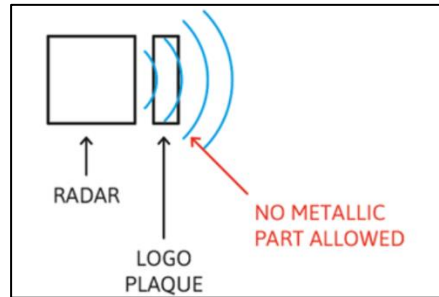
Microstructure engraved on mould for hologram effect on final injected part



Design texturing – Case Study: Land Rover Defender

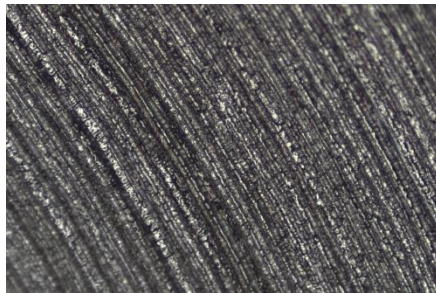
1. Customer request

Customer asks Microrelleus possibility to imitate brushed aluminum on mold to avoid metallic part because of new position of the radar



2. Microrelleus feedback and first action

Microrelleus analyzes using confocal microscope the desired material imitation and creates a design proposal.

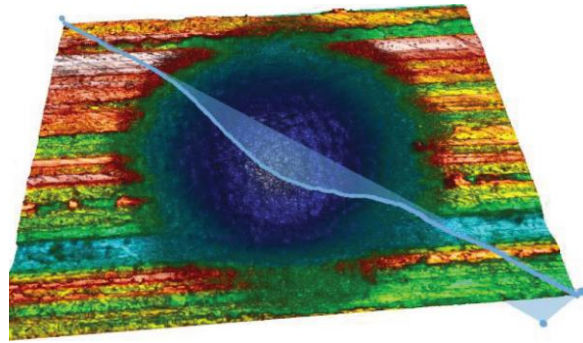


3. Texturing the mold insert and final part

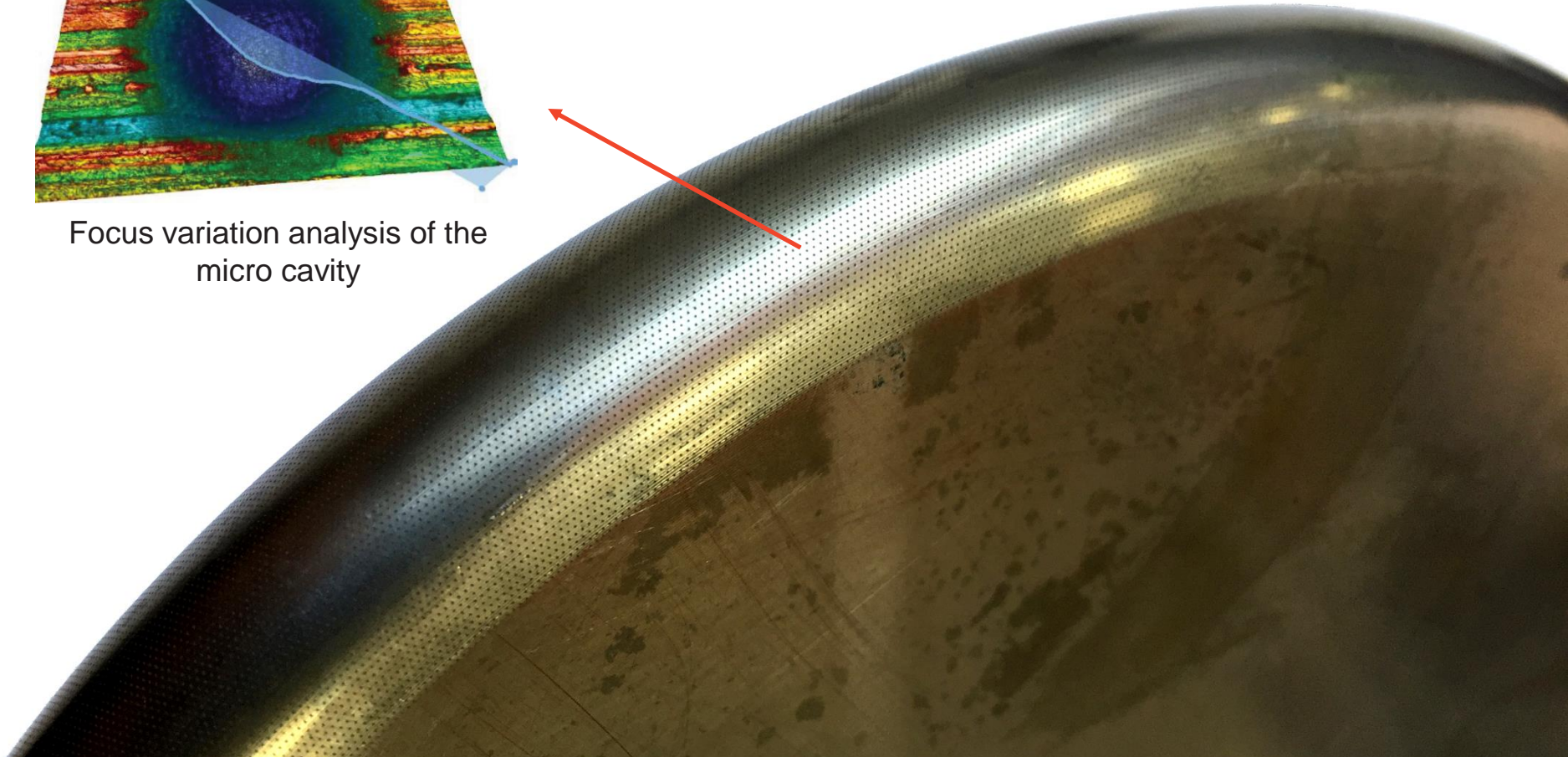
Thanks to our texturing limitless design possibility the radar can develop its function.



Functional texturing – Self-lubricating



Focus variation analysis of the
micro cavity

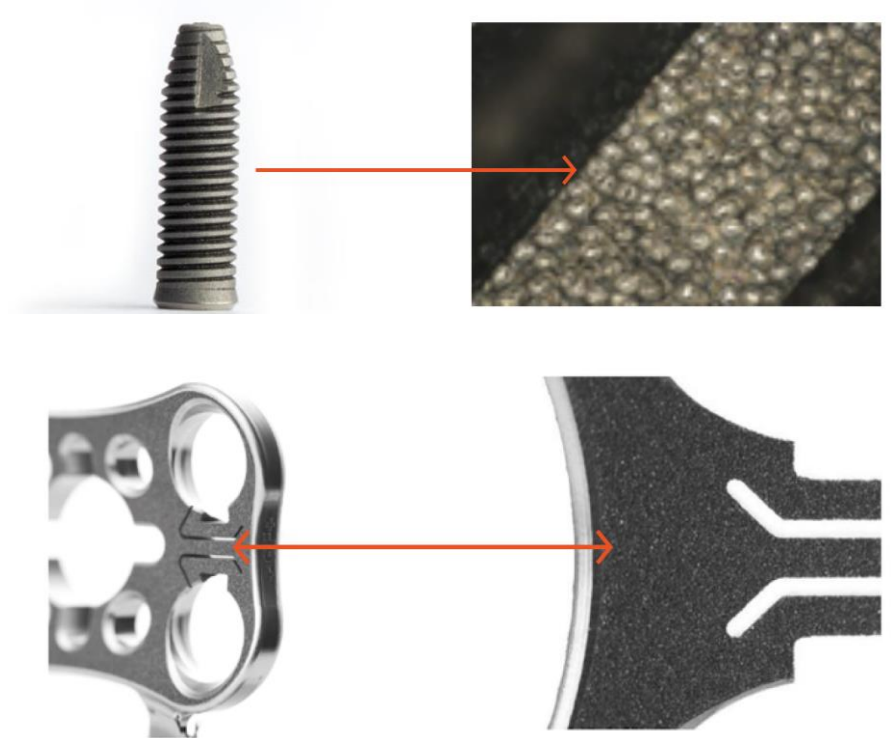


Functional texturing – Osseointegration

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

Benefits of using femtosecond laser:

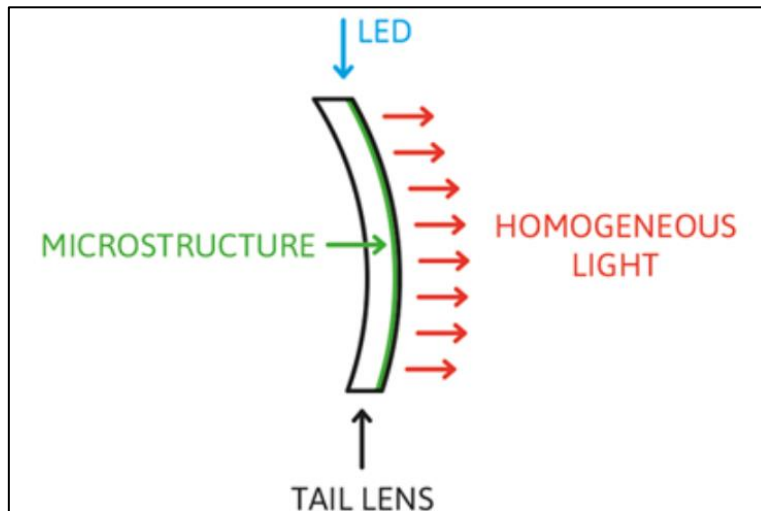
- 1) Cost-effective solution
- 2) Digital process:
 - 1) Controlled texturing
 - 2) No park masking required
 - 3) Possibility of different textures with one set-up
 - 4) 100% reproducible
- 3) Remove manual handling operations in texturing and cleaning
- 4) Reduction of contamination
- 5) High accuracy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



Lighting prototypes – Case Study: Cupra Tavascan

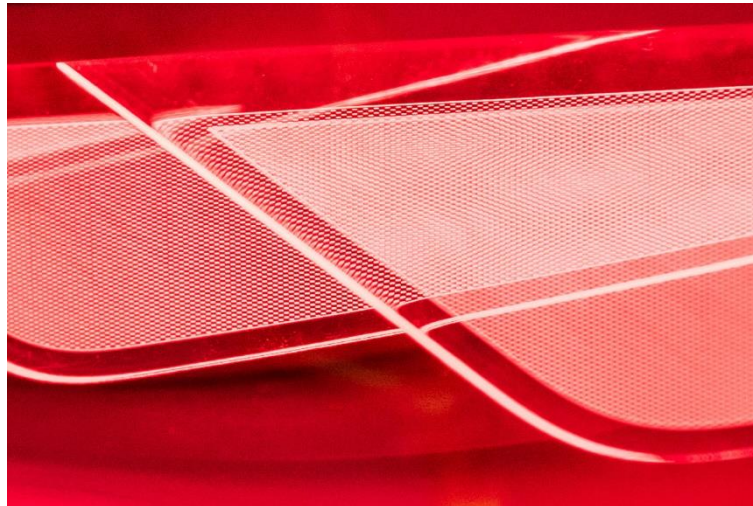
1. Customer request and Microrelleus feedback

Cupra explains Microrelleus idea to introduce microstructuring for a new concept of tail lenses. The purpose is to reach light homogeneity from a perpendicular placed light source.



2. Microstructuring concept and prototype texturing

When the microstructure is decided Microrelleus engraves the final 3D shape prototype. The goal is to obtain a functional prototype.

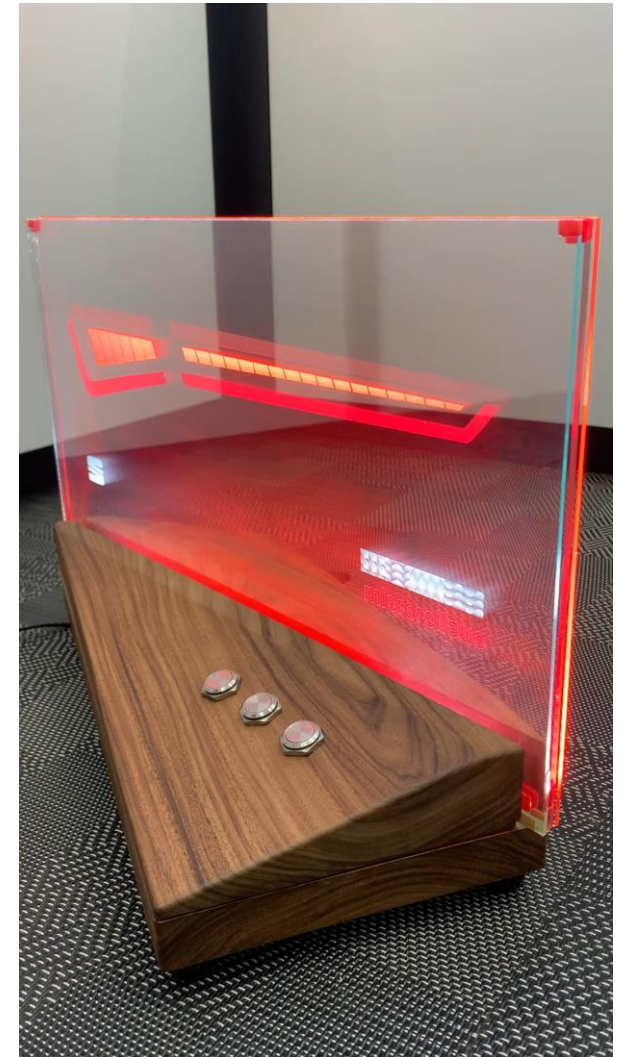
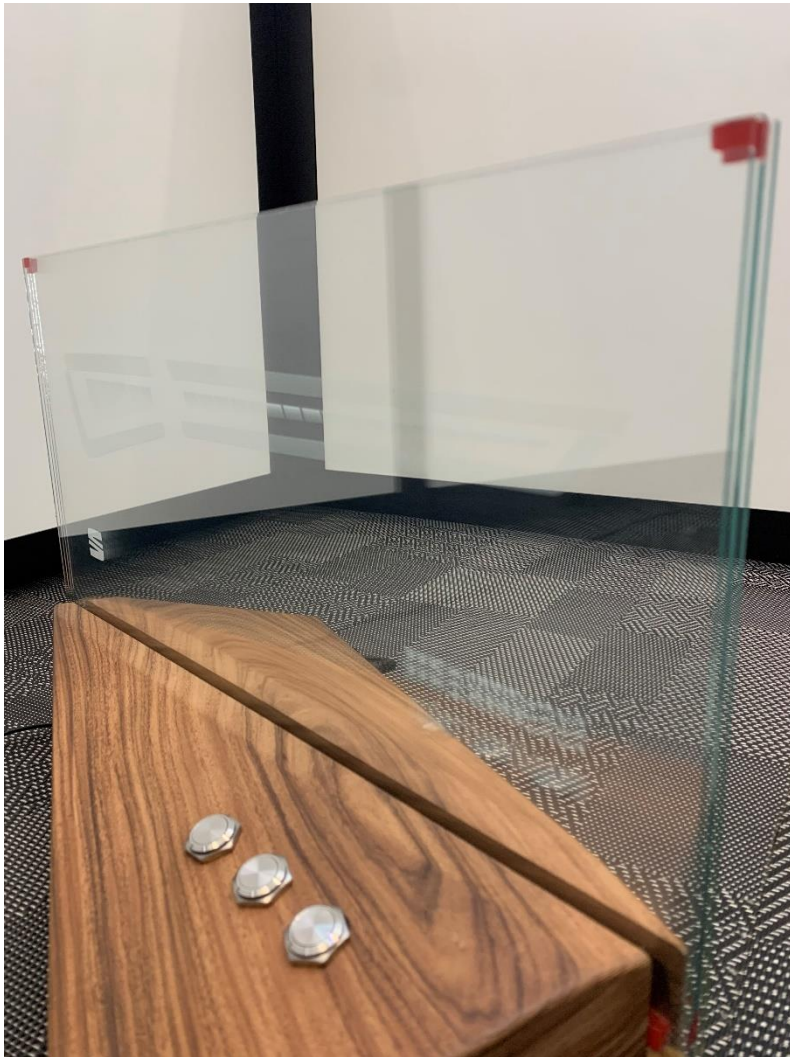


3. Final product – Cupra Tavascan concept

Femtosecond laser technology allowed Cupra engineers to evolve from uniform lines to uniform surfaces that provide their designs the opportunity to work in three dimensions



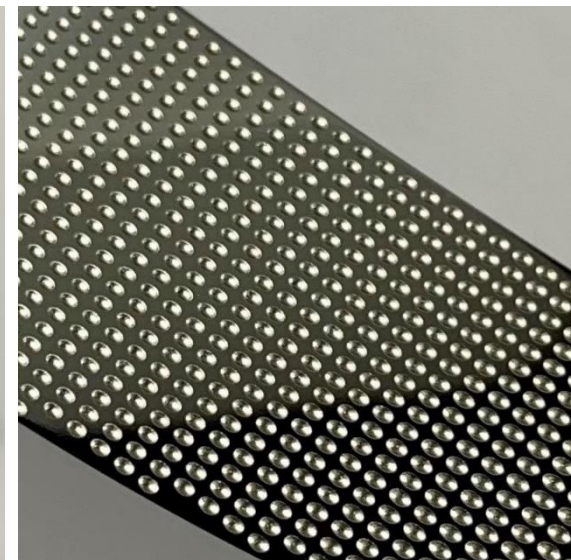
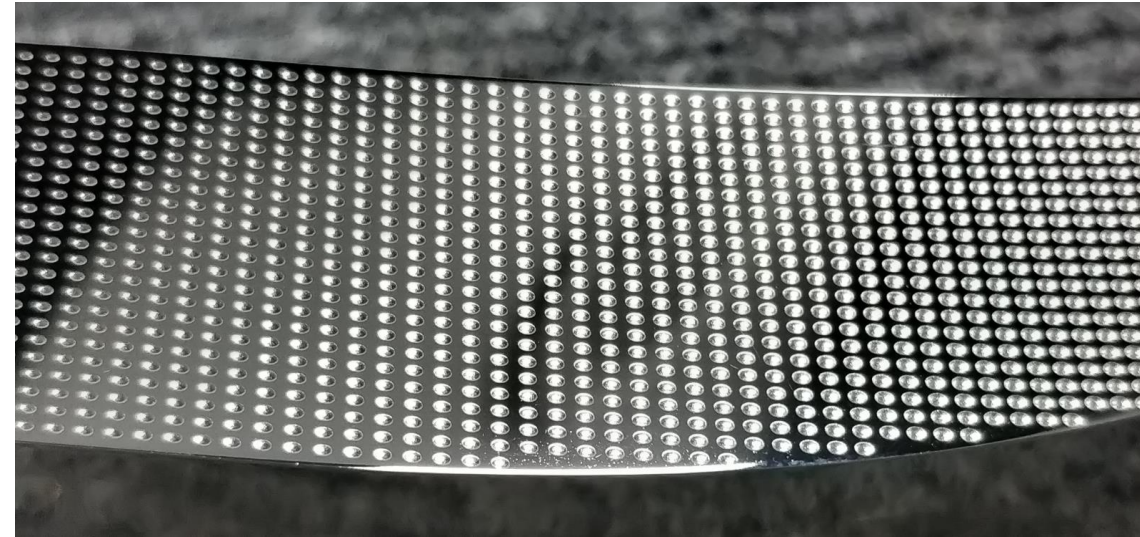
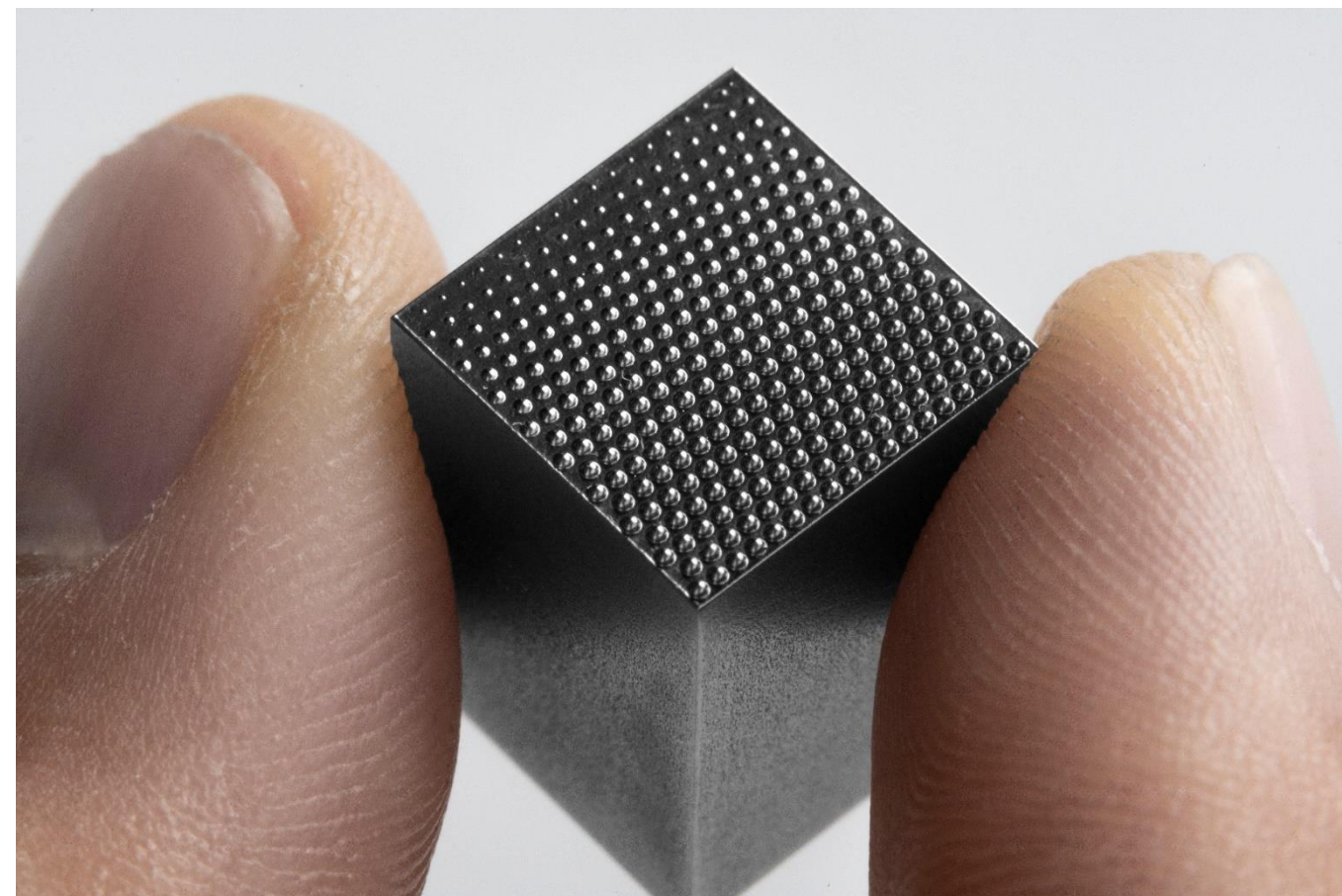
Lighting prototypes – microstructure and texture



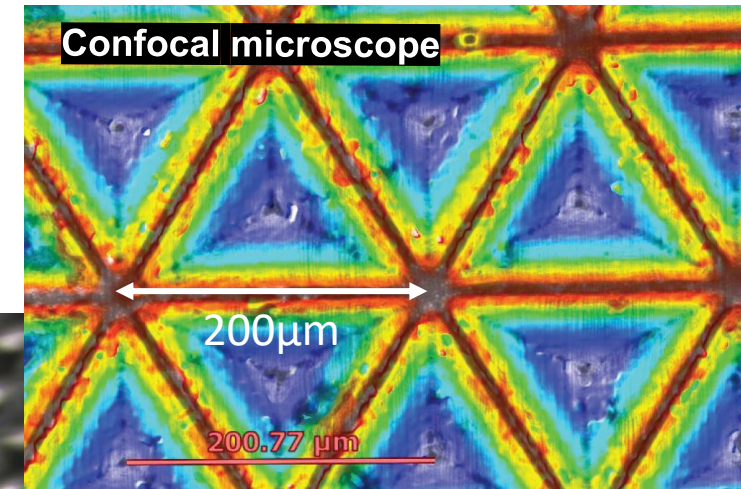
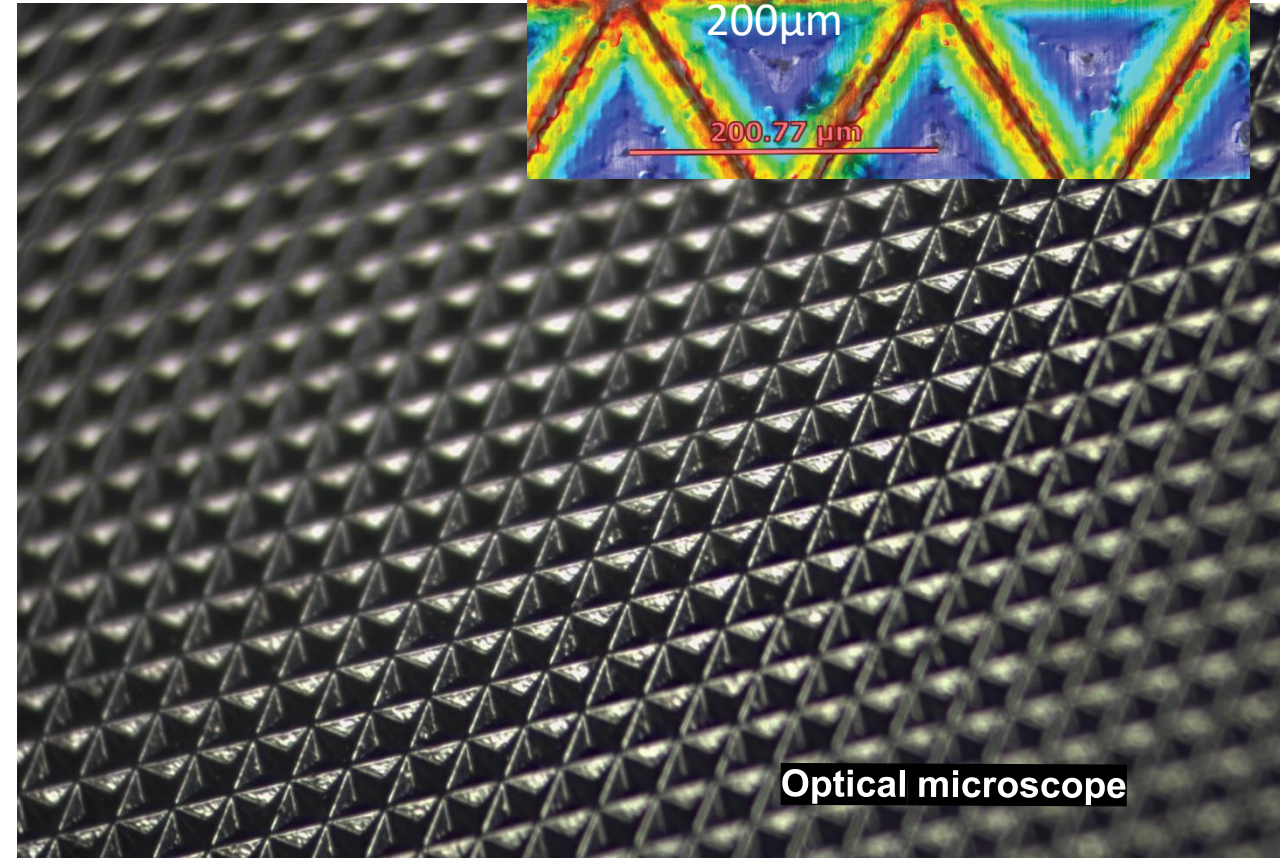
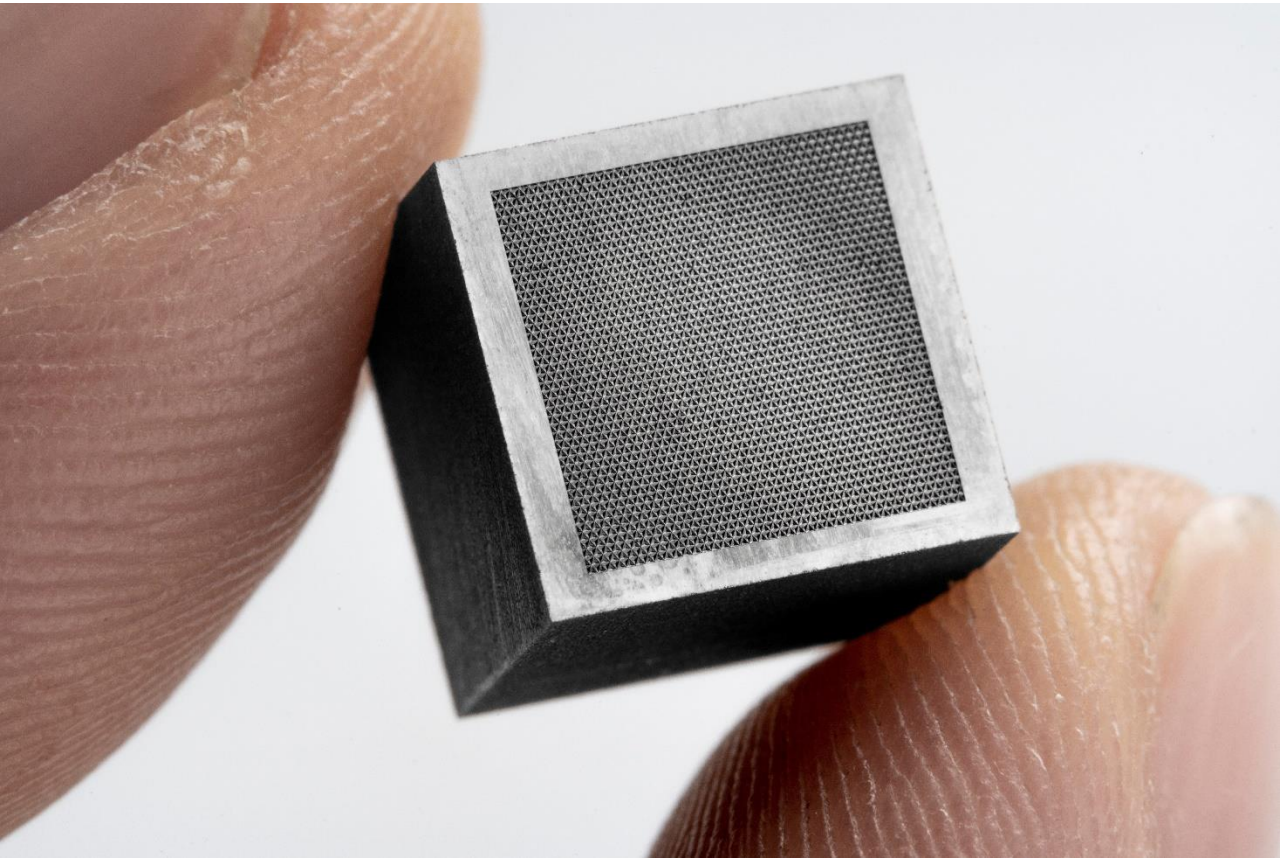
Lighting prototypes – microstructure and texture



Mold microstructuring for lighting

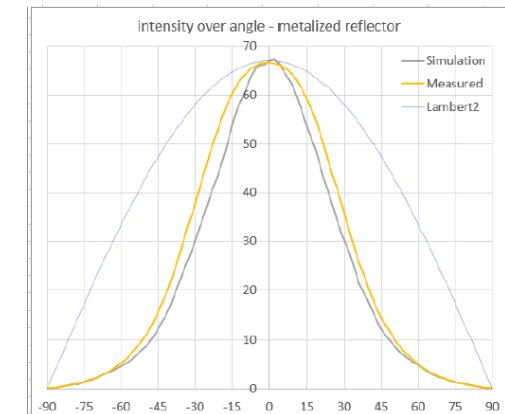
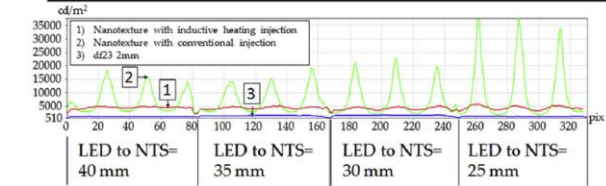
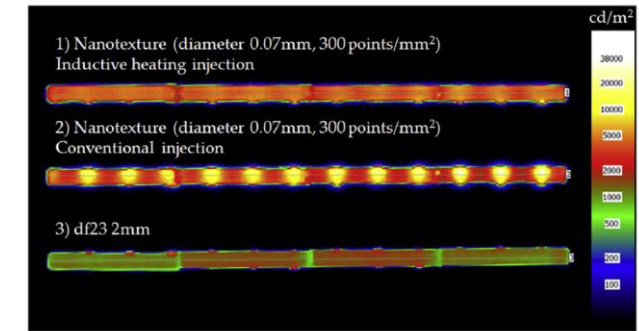
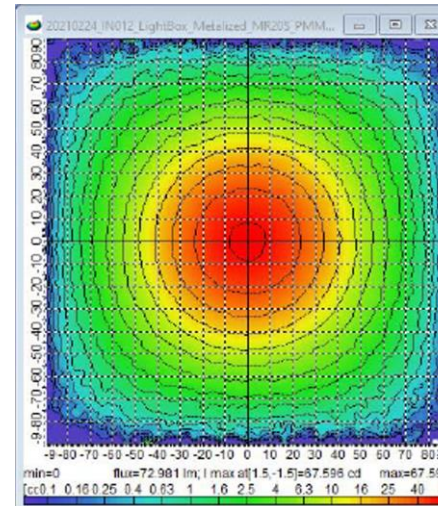
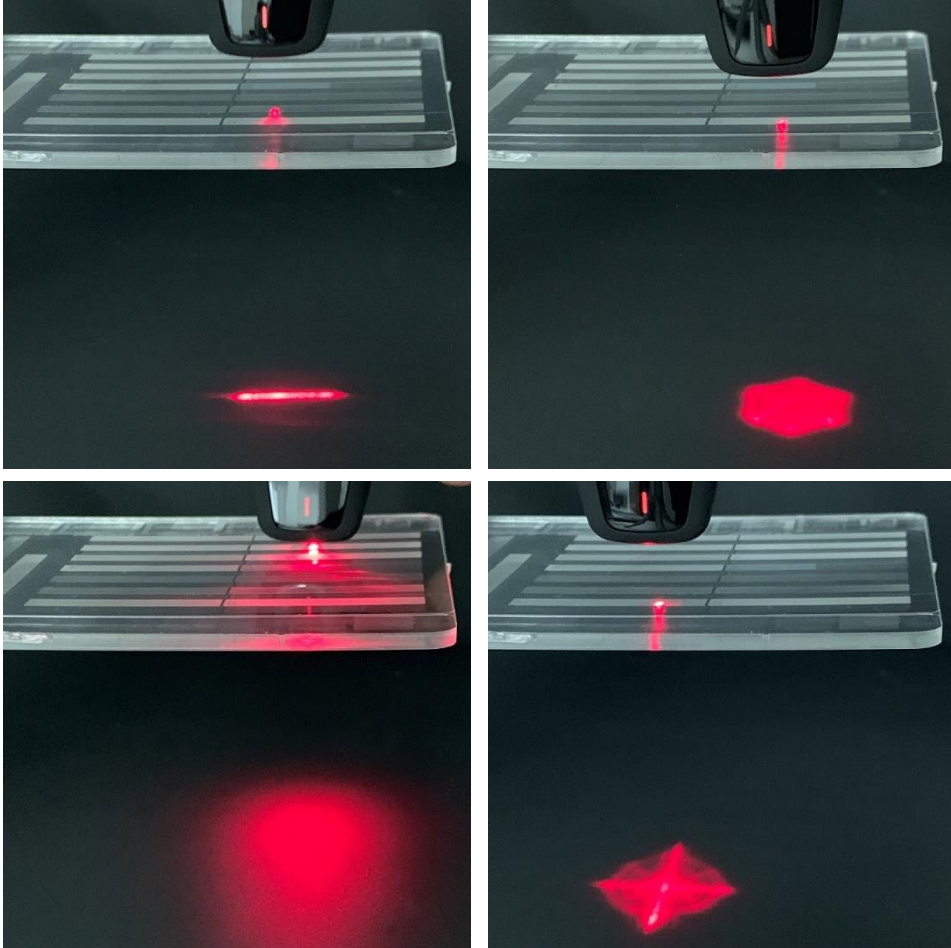


Mould microstructuring for lighting



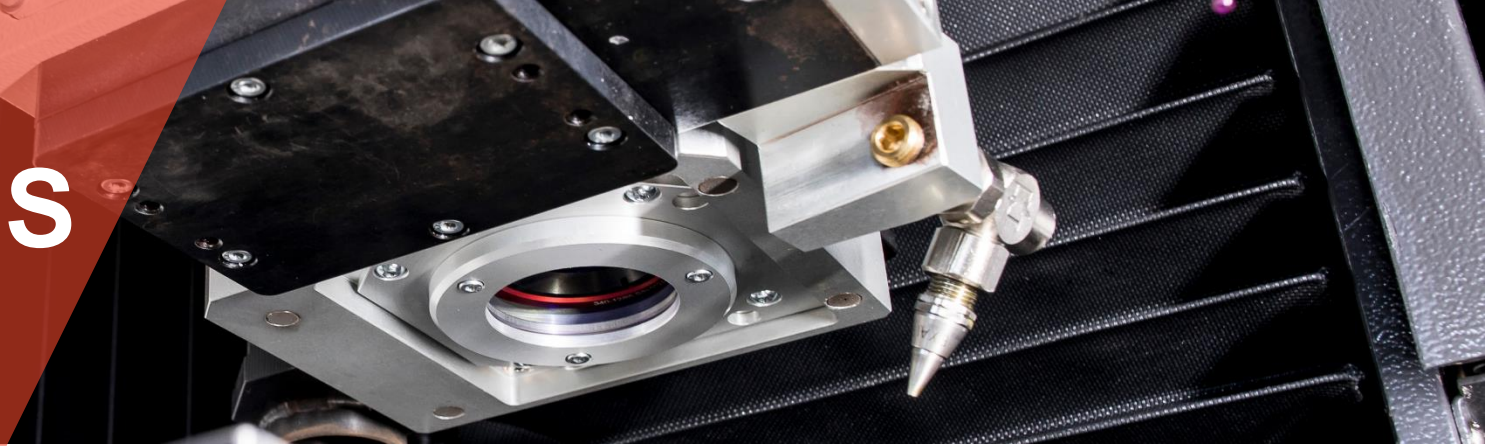
Mould texturing for lighting

Homogeneous light diffusion and light direction 1D and 2D



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 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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