

microrelleus

**EPIC ONLINE TECH. MEETING
ON LIGHTING FOR AUTOMOTIVE**

Femtosecond laser service - High accuracy laser micro-processing



LIGHTING APPLICATIONS

- 1) Who we are
- 2) Femtosecond laser technology
- 3) Lighting prototypes – microstructuring and texturing over PMMA and PC
- 4) Mould microstructuring for lighting
- 5) Mould texturing

Who we are

- Service provider for industry 
 - Industrial engraving
 - Laser texturing
 - Laser microstructuring
- Company creation: 1983 (Pantograph → Die-Sinking EDM → CNC Milling → Nanosecond Laser → Femtosecond laser)
- Facilities in Barcelona – Spain
- 2013: first laser texturing service company in Spain
- **2016: femtosecond laser service in 5 axis**
- **2022: pioneers bigger and more advanced femtosecond laser machine (up to 1700kg in 5 axis and optical window 200x200x100mm)**

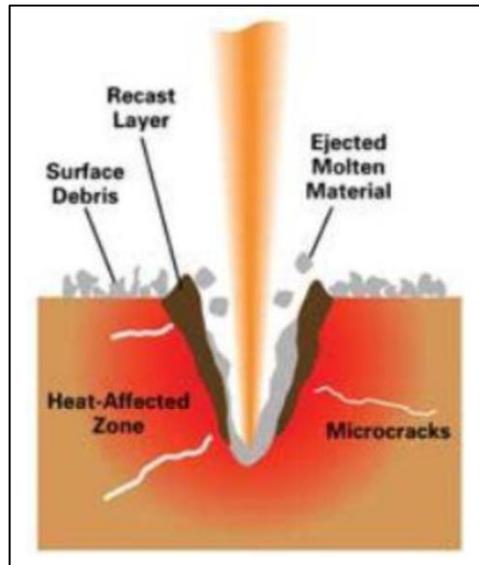


Technology - What a femtosecond laser is?

Ultra-short pulse duration laser (almost no thermal effect over the material)

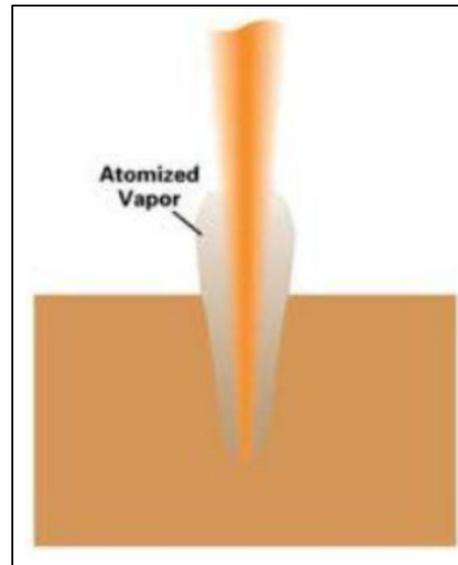
Nanosecond laser (10^{-9} sec)

- Heat affected zone
- Burr



Femtosecond laser (10^{-15} sec)

- “Cold” ablation
- Absolutely burr-free



Femtosecond laser beam diameter:
from $\varnothing 90\mu\text{m}$ down to $\varnothing 15\mu\text{m}$

FEMTOSECOND LASER ENGRAVING ON FOR LIGHTING:

Microstructuring:

Microstructures and freeform micro-optics in the tempered steel inserts or plastic prototypes

Benefits: smaller details in a conventional mould → new design and functional possibilities

Texturing:

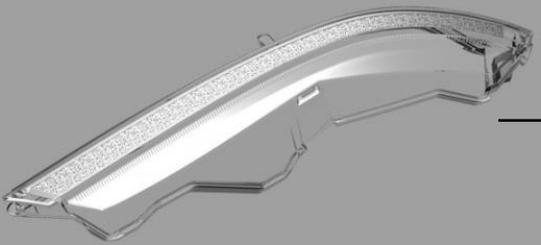
Texture inserts to achieve different properties

Benefits: controlled process, repeatability, homogeneous and stable results. New possibilities

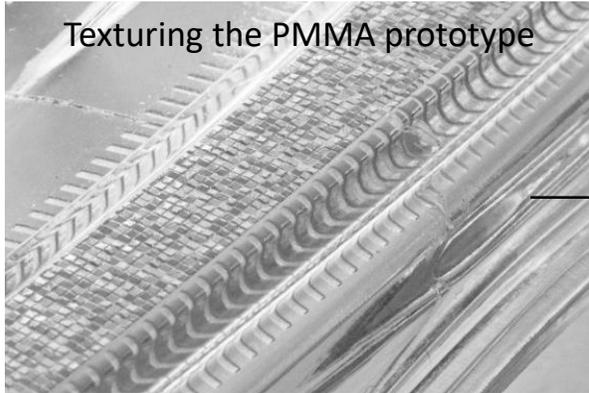
Lighting prototypes and production mould

Seat León 2020 – signal mirror indicator

Initial idea of customer and render



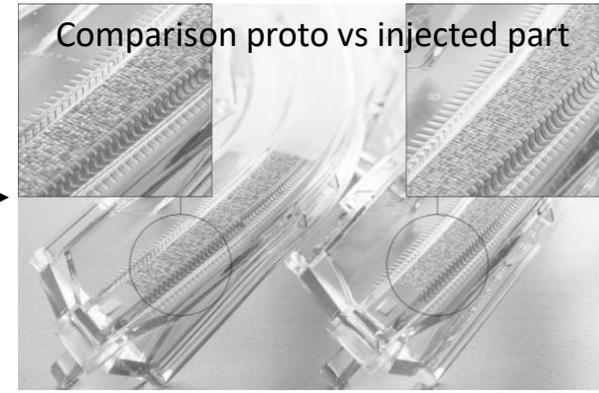
Texturing the PMMA prototype



Texturing the mould inserts

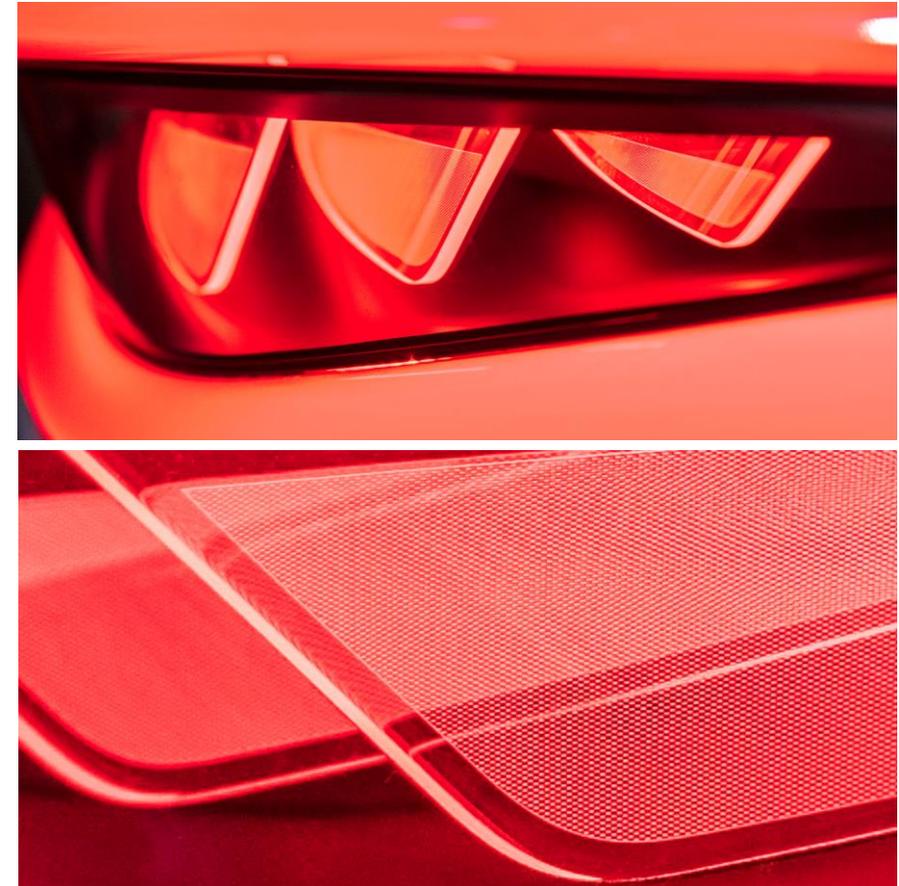


Comparison proto vs injected part

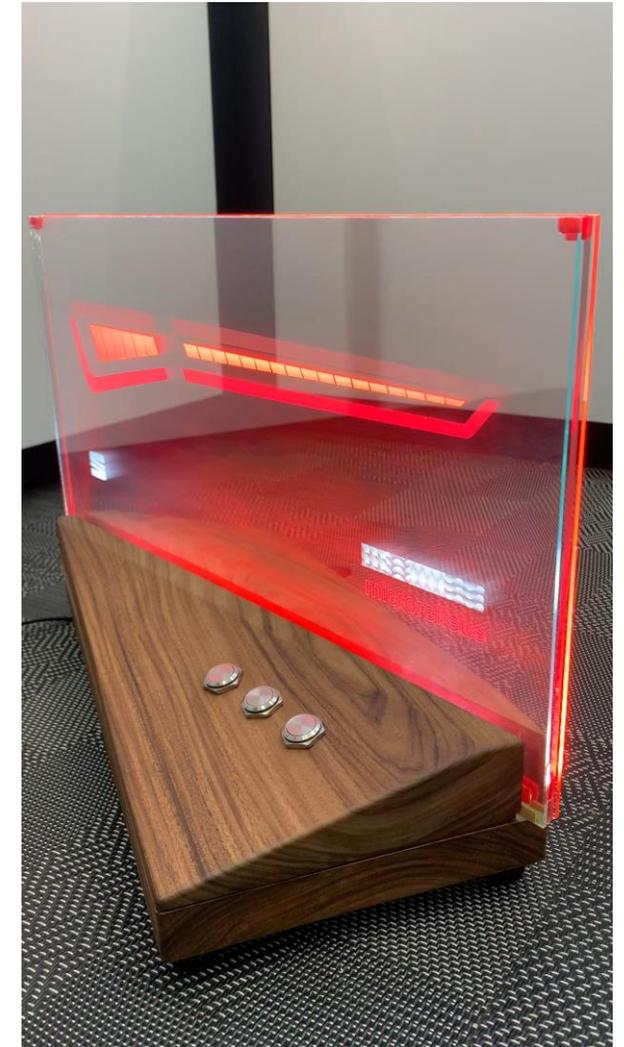


Lighting prototypes – microstructure and texture

Cupra Tavascan concept car: microstructuring for a new concept of tail lenses.
The purpose is to reach light homogeneity from a perpendicular placed light source.



Lighting prototypes – microstructure and texture



Lighting prototypes – microstructure and texture

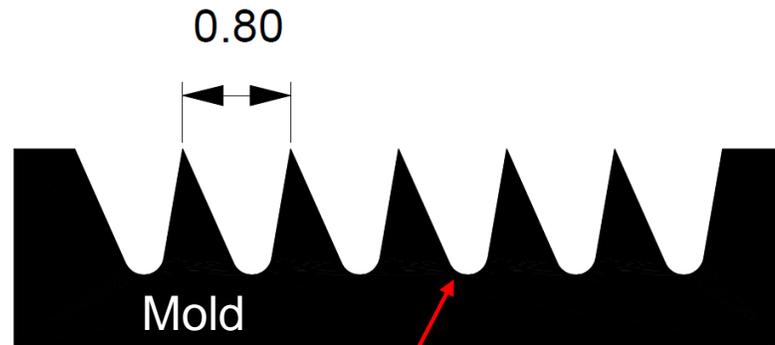


Mould microstructuring for lighting

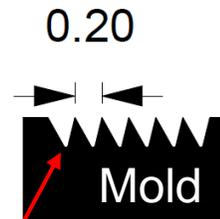
Because of the “cold ablation” of the laser, we can engrave microstructures on mould

- Absolutely burr-free
- Very good tolerances
- High quality surface finishing
- With very sharp edges

Minimum size comparison between tool and femtosecond laser machining:



RADIUS USING TOOL R 0,15mm



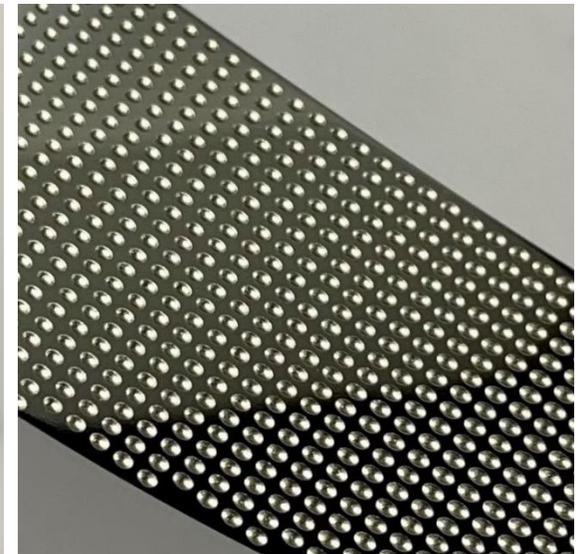
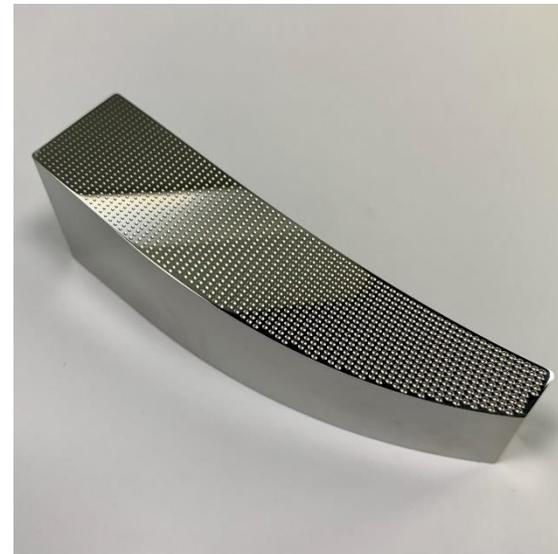
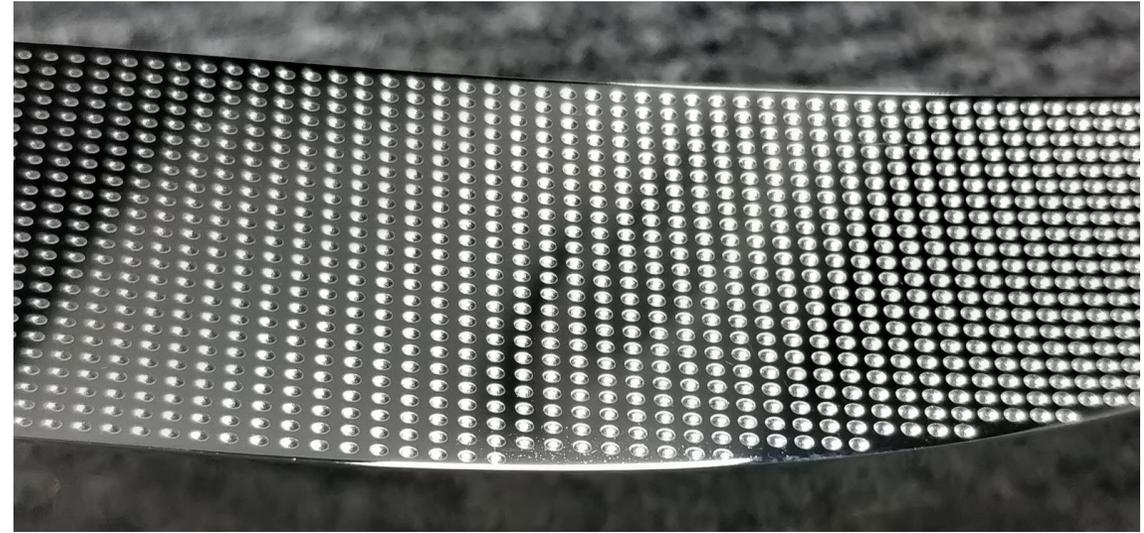
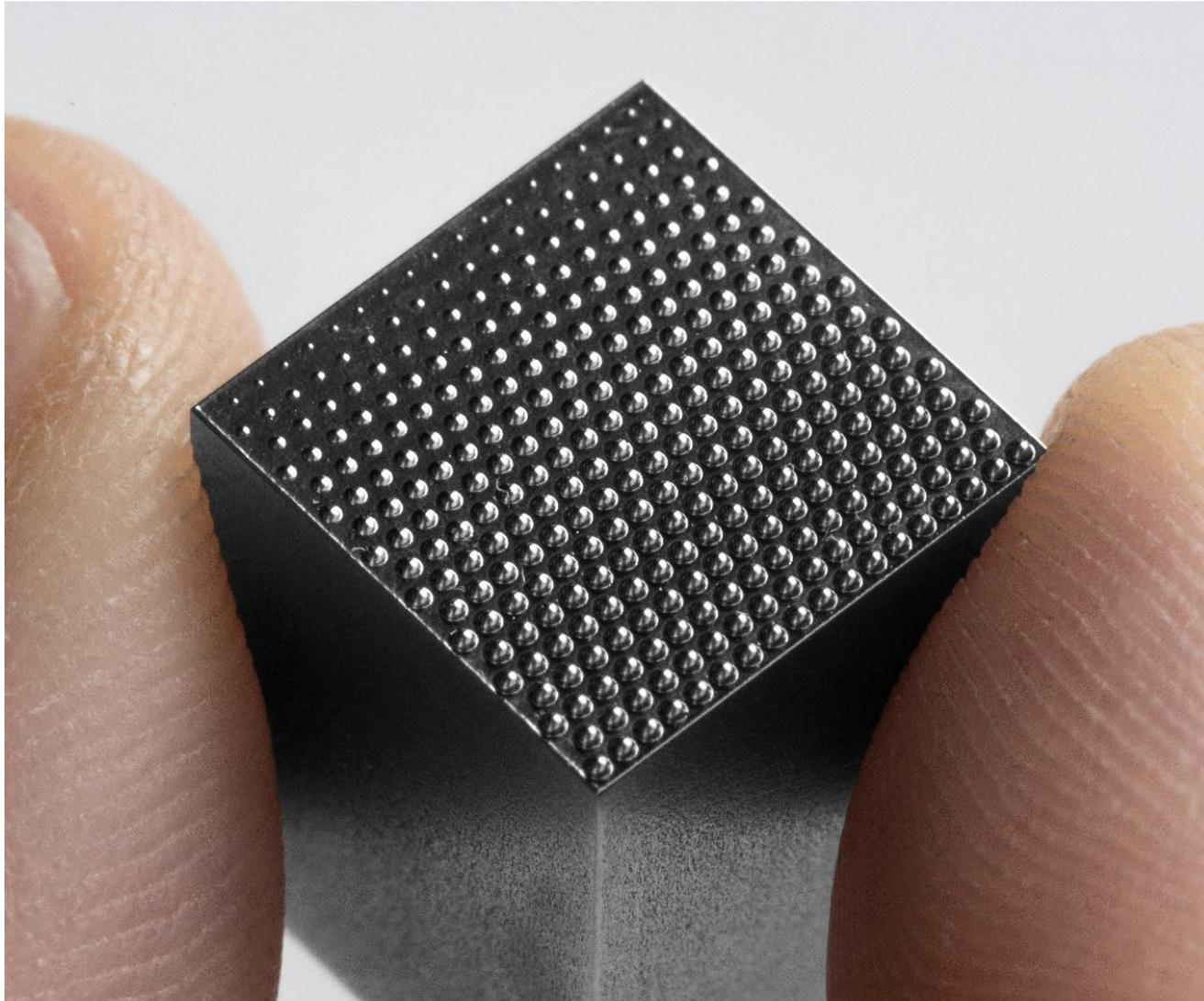
RADIUS FEMTOSECOND LASER R 0,015mm

**LIMITLESS DESIGN
POSSIBILITIES!**
We can engrave
freeform micro-optics
and microstructures
on mould inserts

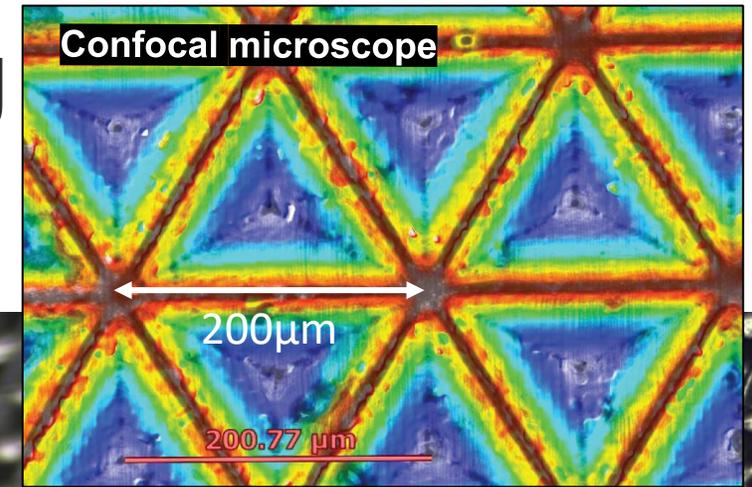
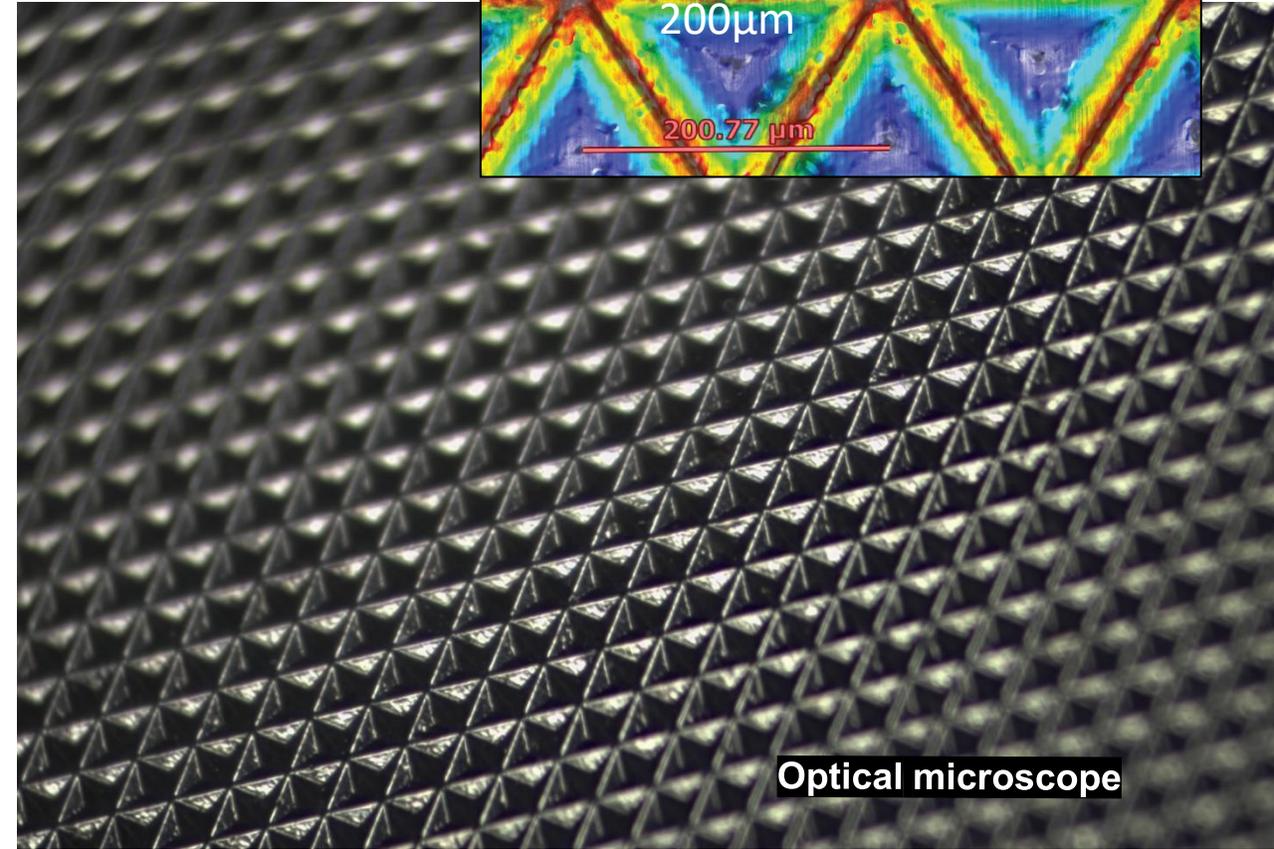
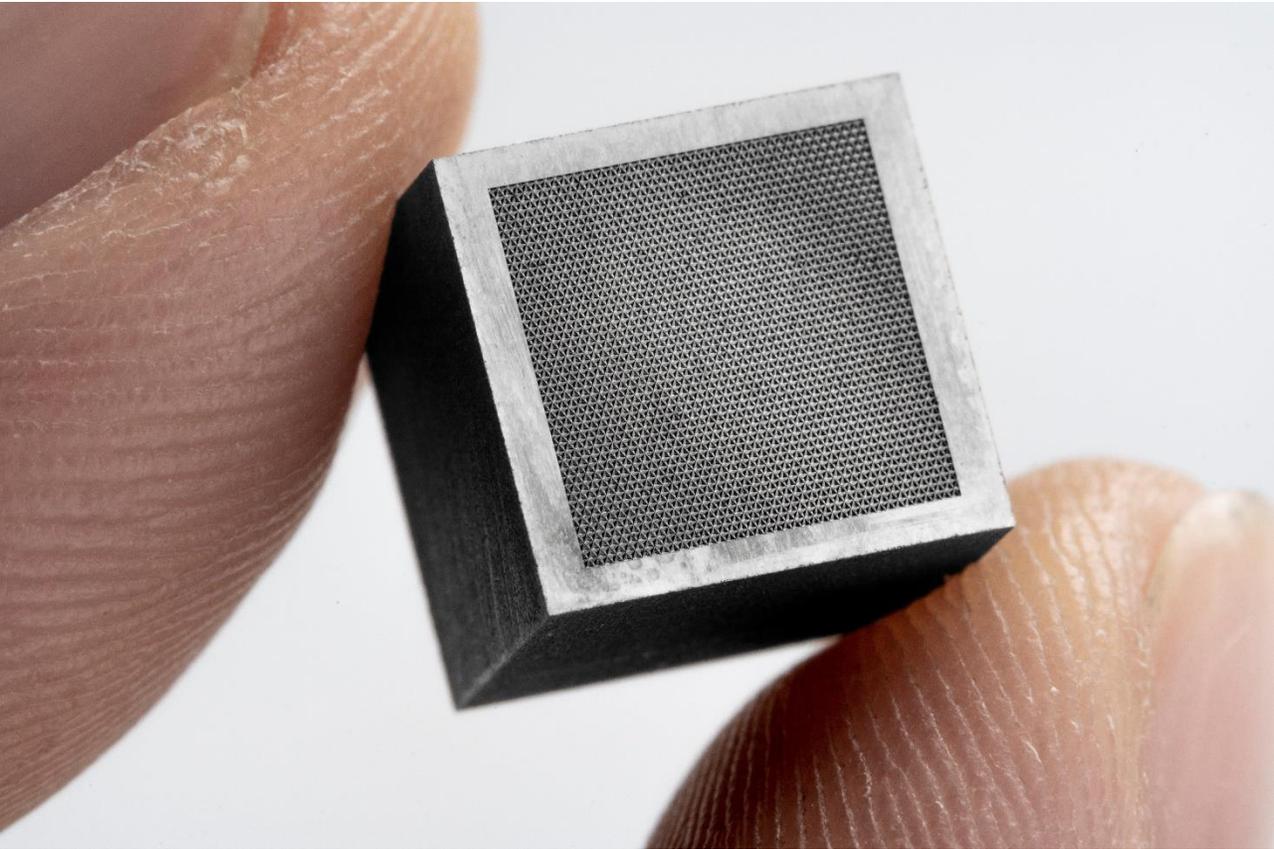
*Which is the minimum
size we can achieve?
Ask us for our design guide!!*

We can achieve radii 10 times smaller than using conventional machining!!

Mould microstructuring for lighting

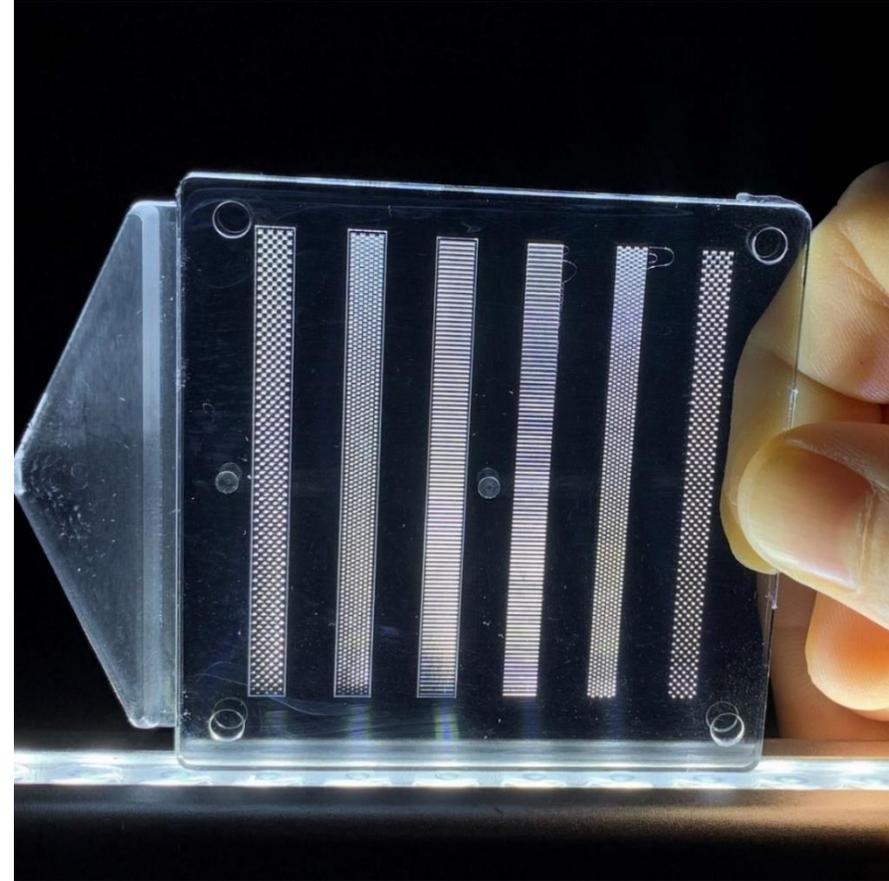
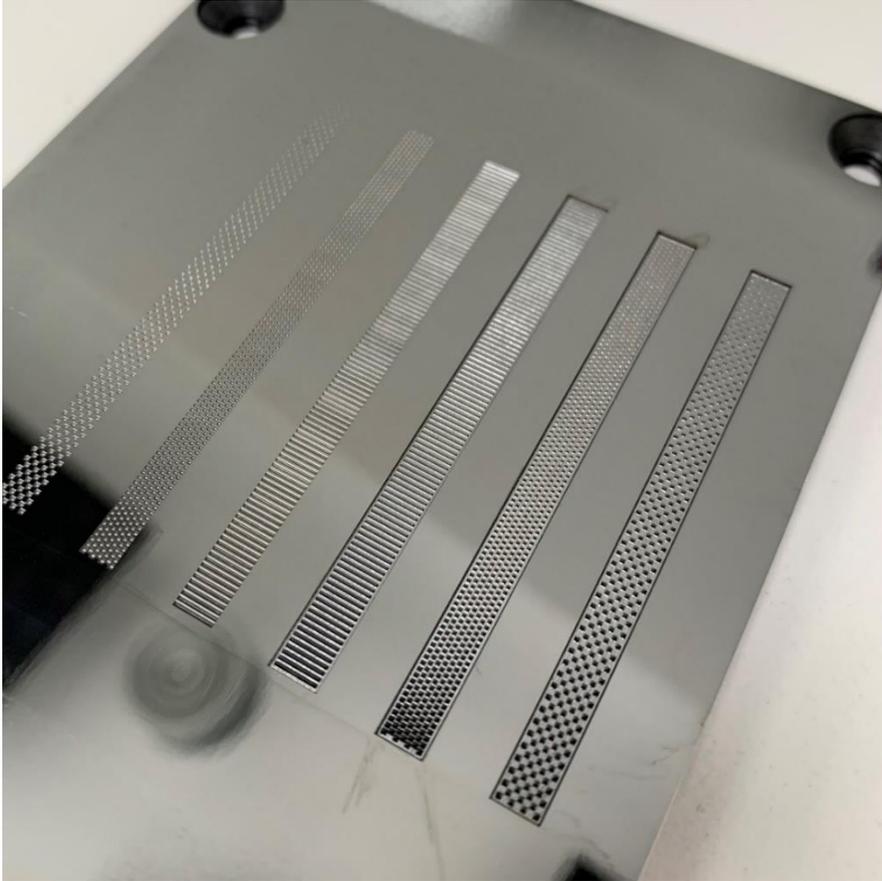


Mould microstructuring for lighting



Mould microstructuring for lighting

Different microstructure designs for achieving homogeneous light intensity in a light guide
Customer: Weidplas



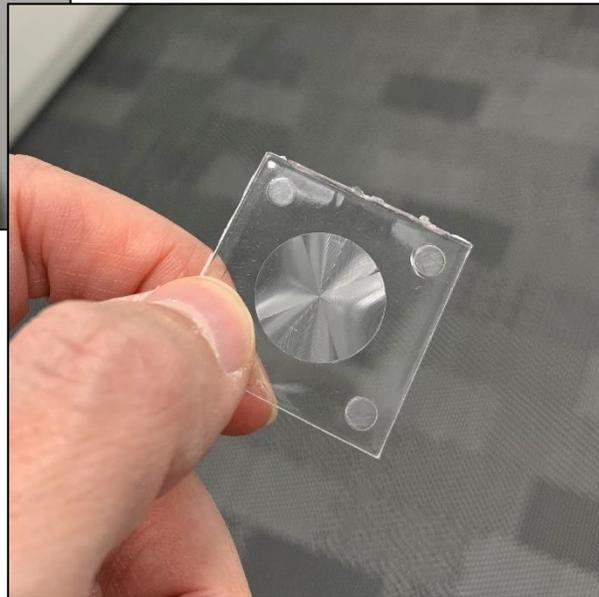
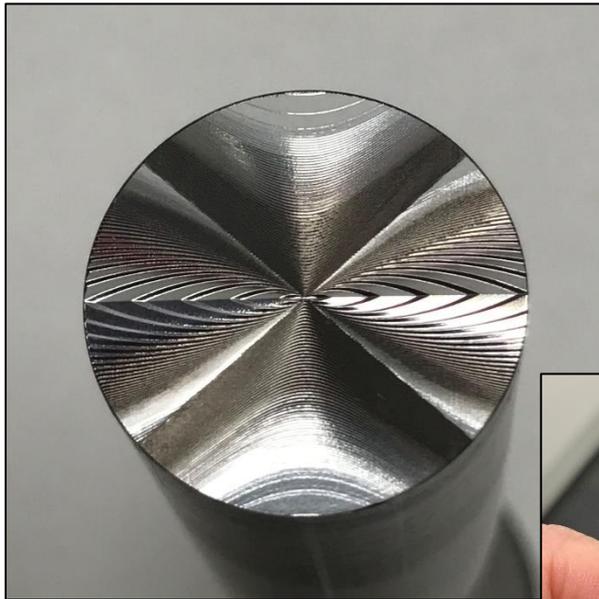
Mould microstructuring for lighting

Seat Ibiza 2021

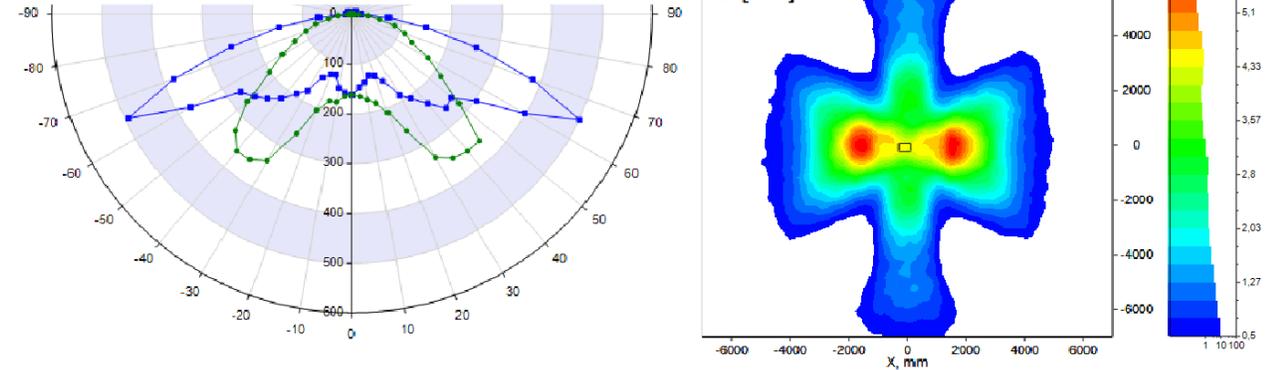


Femtosecond laser quality – Freeform micro-optic

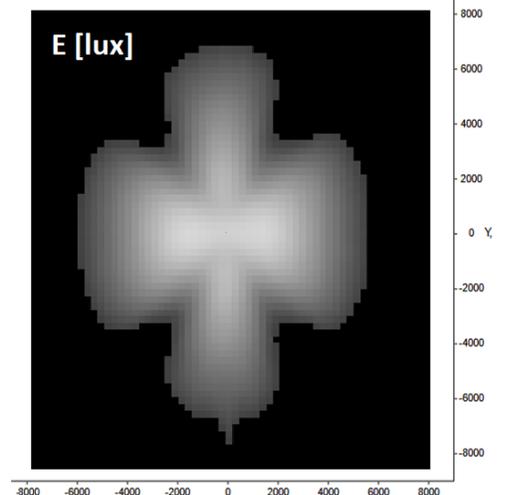
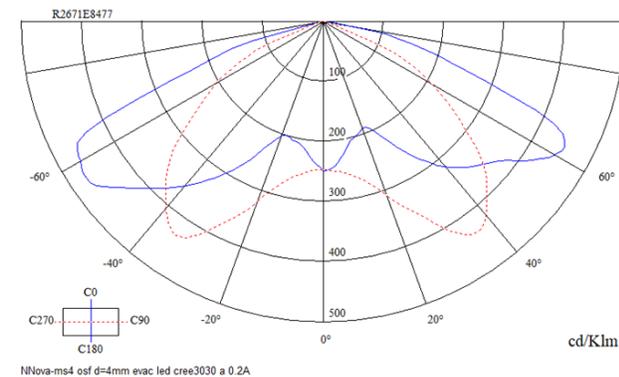
Customer: Daisalux



Simulated value

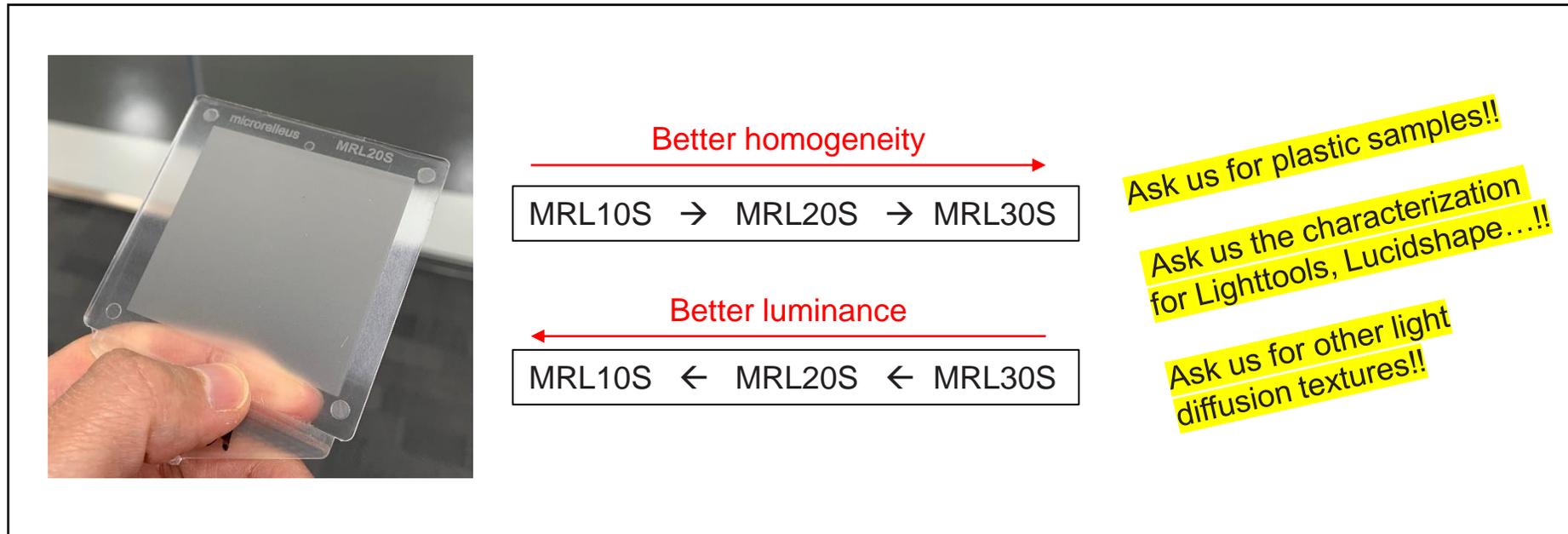


Measured value

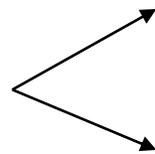


Mould texturing – functional texturing

Development of textures on mould for **light diffusion purposes using femtosecond laser** (MRL10S, MRL20S, MRL30S)



Important points we took into consideration for the design of the textures



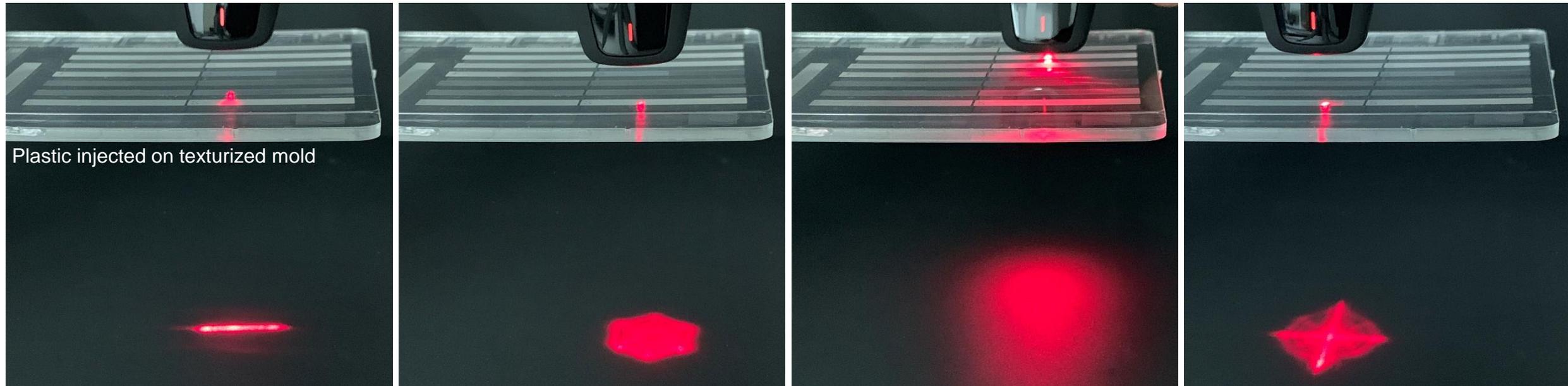
Diffusion quality and luminance

Repeatability and stability of the texture (that's why we use femtosecond laser)

- **Burr is not having any influence on the diffusion.**
- **Very controlled process and textures over any material or conditions.**

Mould texturing – functional texturing

FUNCTIONAL TEXTURING → LIGHT DIRECTION 1D & LIGHT DIRECTION 2D

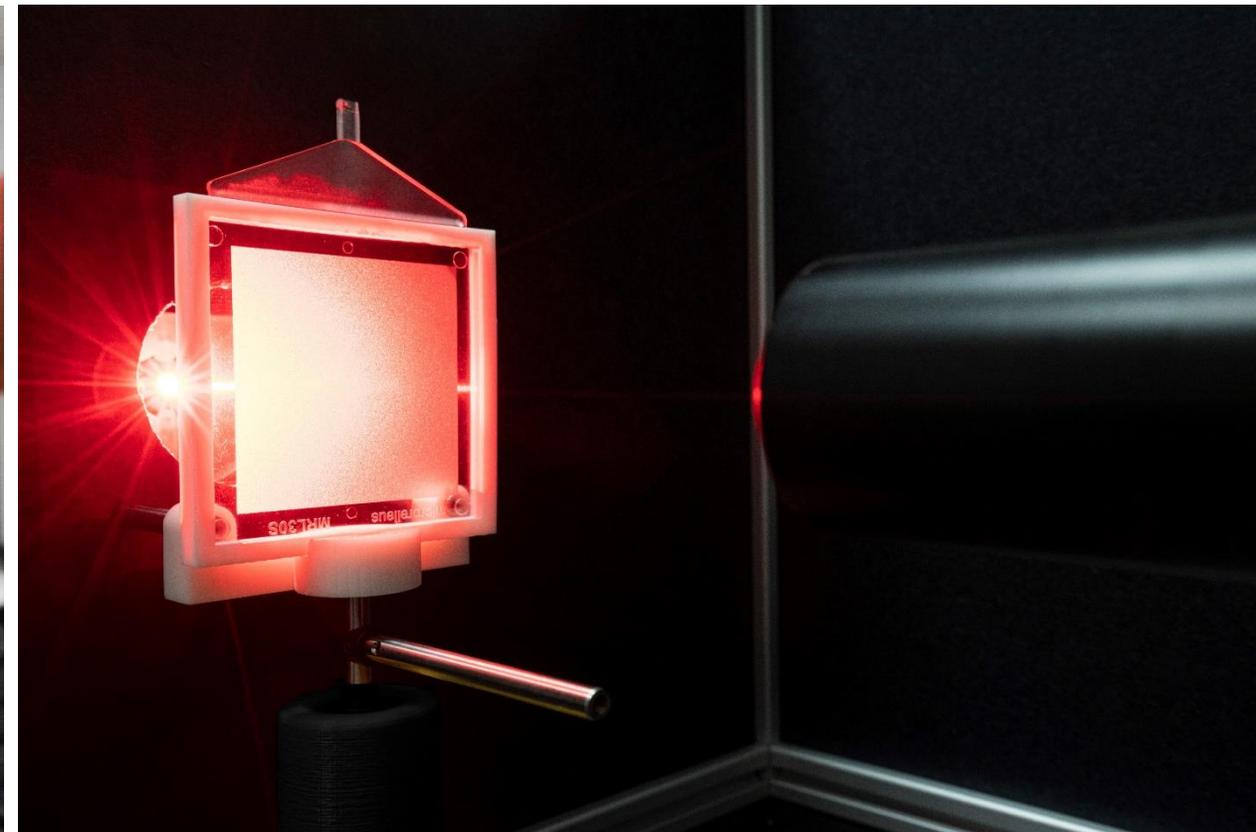
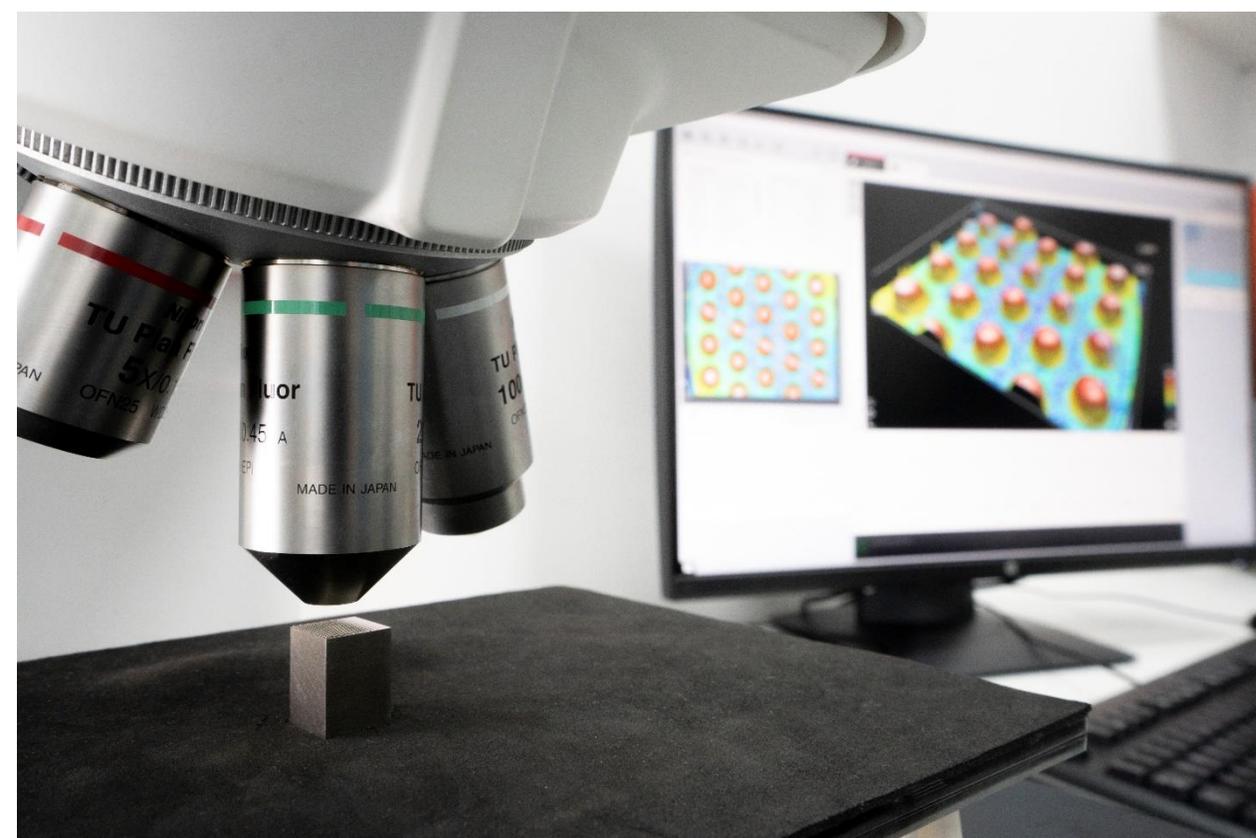


Pina-Estany, J., García-Granada, A. A., & Corull-Massana, E. (2018). Injection moulding of plastic parts with laser textured surfaces with optical applications. *Optical Materials*, 79, 372-380.
Textures: Microrelleus

Quality control & measurement

We use confocal and focus variation microscope to measure the microstructures and textures.

We have our own photometry laboratory to obtain basic measurements that help us to know the quality and the homogeneity of our textures and microstructures.



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 have our own mould to engrave your proposals and we can inject to offer customized injected samples. Ask us!
- We collaborate with Tecnology Centers and Universities to offer complete solutions to our customers: texture or microstructuring design for functionality, test on laboratory, prototypes, etc.
- Our customers: OEM's, Tier 1, Tier 2, final product manufacturers, mold-makers, plastic injectors, etc.

microrelleus

Laser microstructuring
Laser texturing
Industrial engraving

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