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Ultrashort pulsed lasers for surface texturing of implants

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- Technological centre created in 1982 by the Engineering School of the University of Navarra
- Member of *Basque Research and Technology Alliance*
- Service to society and industry through non-profit research
 - through research projects (TRL4-TRL7)
 - training young researchers
 - disseminating knowledge



Light technology for precision in manufacturing

We use ultrashort pulse lasers (femtosecond pulses) to develop manufacturing processes with high precision for industrial applications.

Modification of injection moulds

Decorative elements

Micro/nano diffusion patterns

Microfluidic structures

Micrometric diffractive gratings

Complex optic elements

Modification of transparent materials

Light barriers

Decorative elements

Light Diffusers

Structured current collectors for pouch & coin-type Li-ion batteries

Superhydrophobic metallic surfaces with hierarchical structure

Decorative applications

Structural coloring of surfaces

Selective decoating of metallic thin layers

Surface treatment to enhance osseointegration

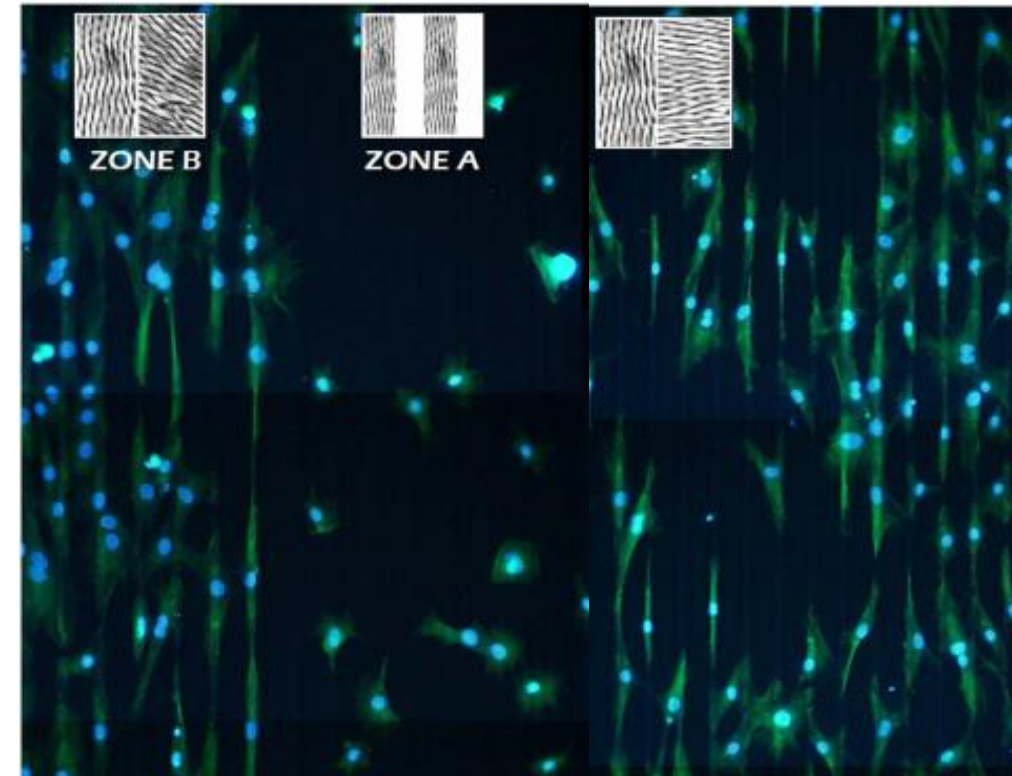
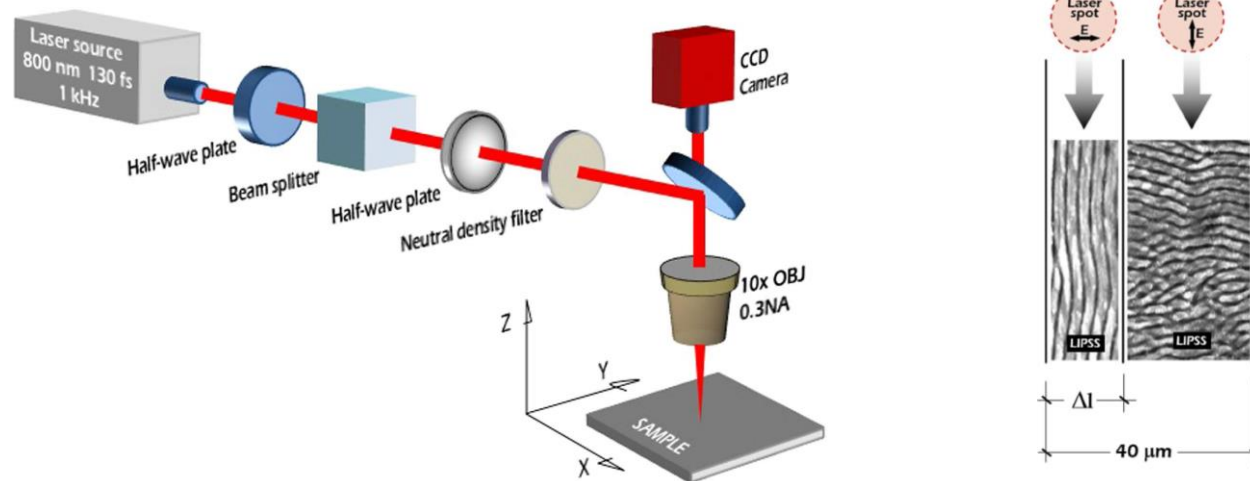
Surface texturing and edge treatment of cutting tools

Broadband omnidirectional antireflective surfaces

Surface treatment for control of cell migration

First step: Demonstrate Functionality

- Laser Induced Periodic Surface Structures (LIPSS) to pattern stainless steel
- human Mesenchymal Stem Cells (hMSCs) tend to attach and preferentially align to the LIPSS nanopatterns oriented in a longitudinal direction
- No noticeable change in chemical composition.



Martínez-Calderon, M., Manso-Silván, M., Rodríguez, A. *et al.* Surface micro- and nano-texturing of stainless steel by femtosecond laser for the control of cell migration. *Sci Rep* **6**, 36296 (2016). <https://doi.org/10.1038/srep36296>

Laser4Surf – LIPSS for mass production of functional surfaces



Second step: Demonstrate Industrial Application

- Technical specifications for Laser textured implants:
 - Have a good **biocompatibility**
 - Improve **osseointegration** with pre-defined topographic features
 - **Technique:**
 - Be clean and environment friendly
 - Be fast and cost effective
 - Be applicable on small and complex shape
 - **Meet regulatory standard** : No metal modification, no geometrical feature changes
 - Not to release adverse components
 - Have good mechanical properties



Laser4Surf – LIPSS for mass production of functional surfaces

Second step: Demonstrate Industrial Application

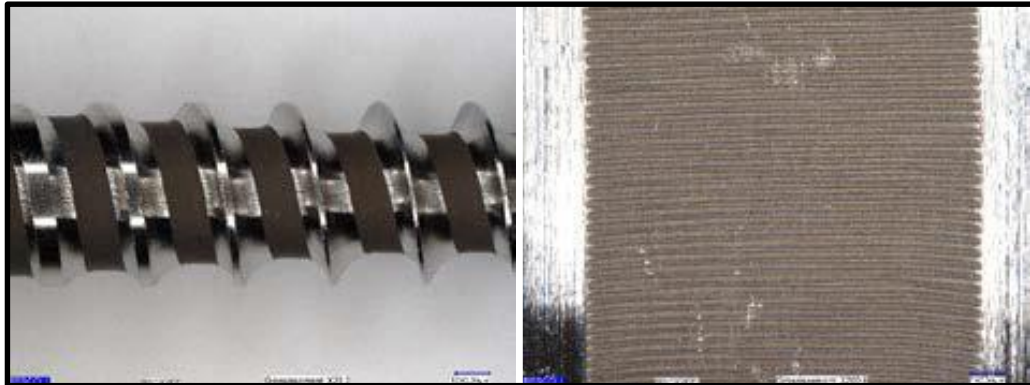
○ Technical specifications for Laser textured implants:

• **Technique:**

- Be clean and environment friendly
- Be fast and cost effective
- Be applicable on small and complex shape

} **Laser Process**

Dental screw



Cervical plate



Laser4Surf – LIPSS for mass production of functional surfaces

Second step: Demonstrate Industrial Application

- Technical specifications for Laser textured implants:
 - **Meet regulatory standard** : No metal modification, no geometrical feature changes
 - Not to release adverse components
 - Some leaching of Al, Fe and V; all values are well below the acceptable limit (0,6µg/implant)
 - Have good mechanical properties
 - Mechanical tests were performed
 - No significant difference in maximum insertion/removal torque or axial pull-out strength

Laser4surf

RESCOLL

LASEA
LASER SOLUTIONS

Implants can be successfully textured using femtosecond laser processes

Cell migration can be controlled and osseointegration improved

Industrial scalability has been demonstrated

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***Researching today,
Creating the future***

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