Surface structuring using fs-lasers for R&D and industrial applications

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EPHJ LE MONDE DE LA HAUTE PRÉCISION

Photonics 4 Masterpieces

SWISS PHOTONICS

LASEA LASER SOLUTIONS

Table of contents

Locations

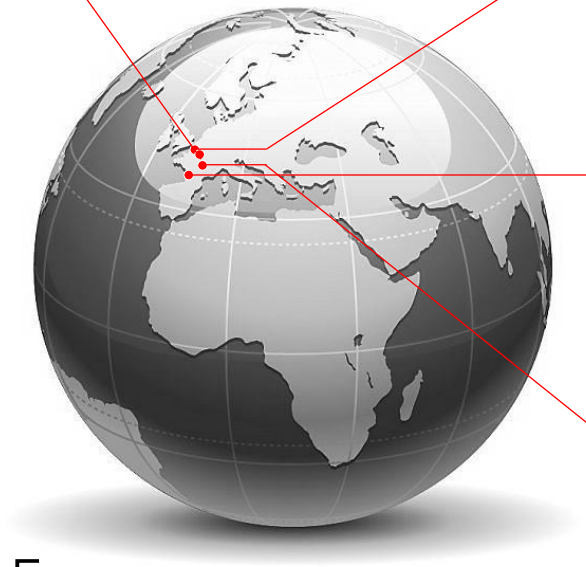
CohPros RBSystem EMPM Rainford Precision LAS Photonics

LASEA Belgium – Liège (Headquarters)

Optec - Mons

LASEA France - Bordeaux

LASEA Switzerland - Bienne



Europe

LASEA USA
Optec LLC – San Diego

America

BEAMS – Tokyo

Raymax – Sydney

Asia - Oceania

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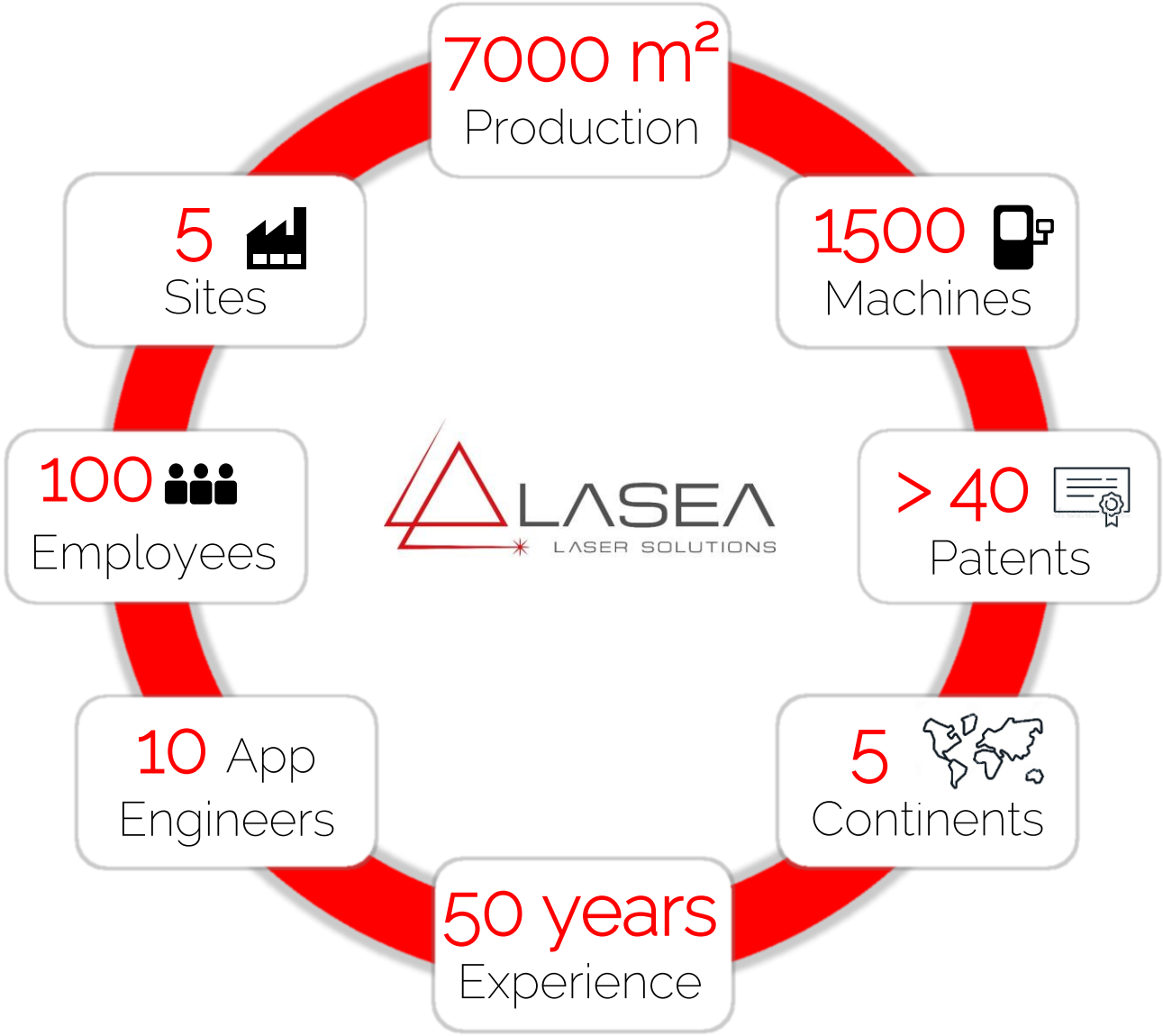
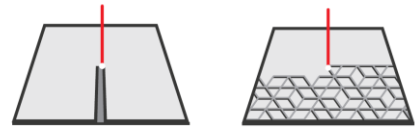
Facts & Figures

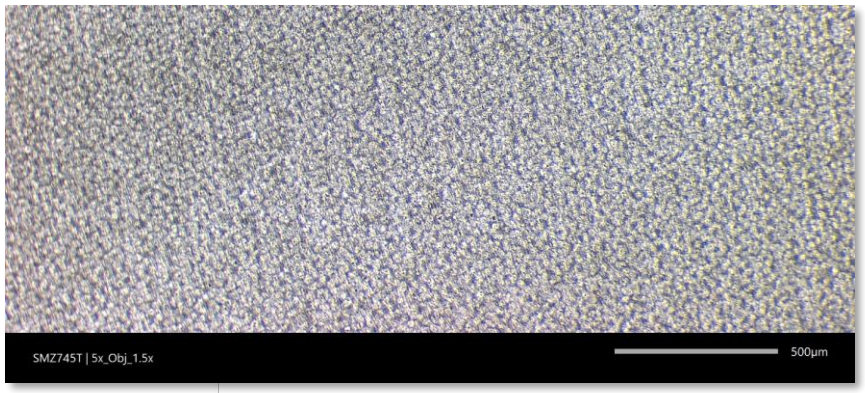


Surface texturing

- Change the appearance of a surface
- Change the characteristics of a surface
- Change the geometry of a surface

White engraving





Objectives :

- **Part** : Watch case back
- **Material** : Stainless steel 316L
- **Application** : White engraving
- **Tolerances** : 50 µm ± 10 µm

Results :

- **Engraving depth** : 52 µm
- **Cycle time** : According to the surface to engrave
- **Visual aspect** :
  - White
  - Shiny
  - Good surface finish

Eco-friendly : Replace the chemical etching (acid)

Talk from Andreas Oehler
"Photonics 4 Laser Micromachining" at 15.15-16.30

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Black marking

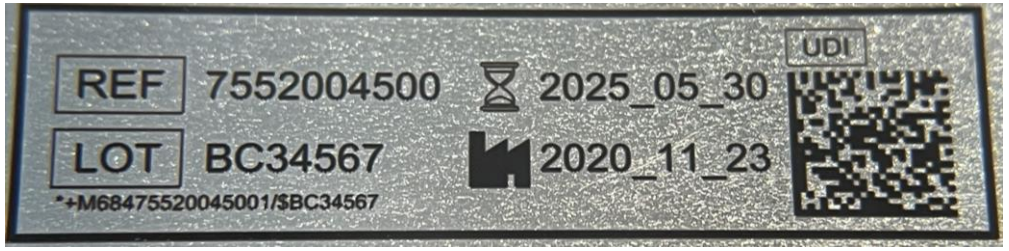
40mm

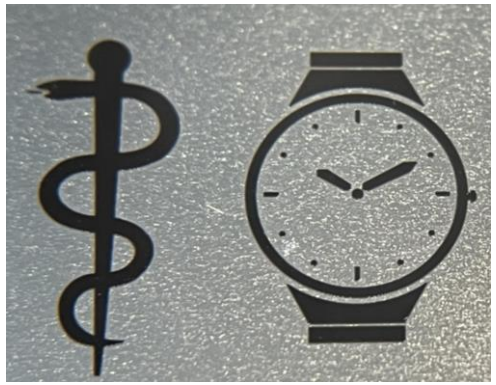
Objectives :

- **Part** : Demo part
- **Material** : Stainless steel 1.4301
- **Application** : Black marking for UDI-markings / traceability of surgical equipment

Results :

- **Cycle time** : According to the surface to mark
- **Visual aspect** :
  - Black color, high contrast
  - Independent of viewing angle
  - Independent of light incidence

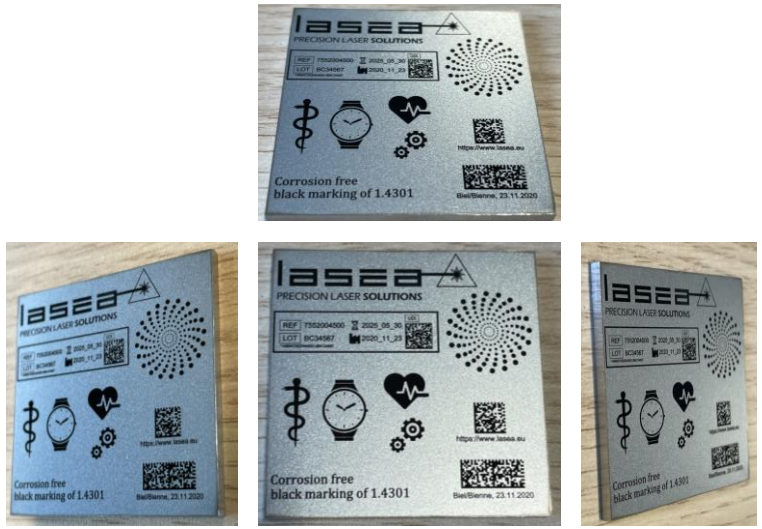




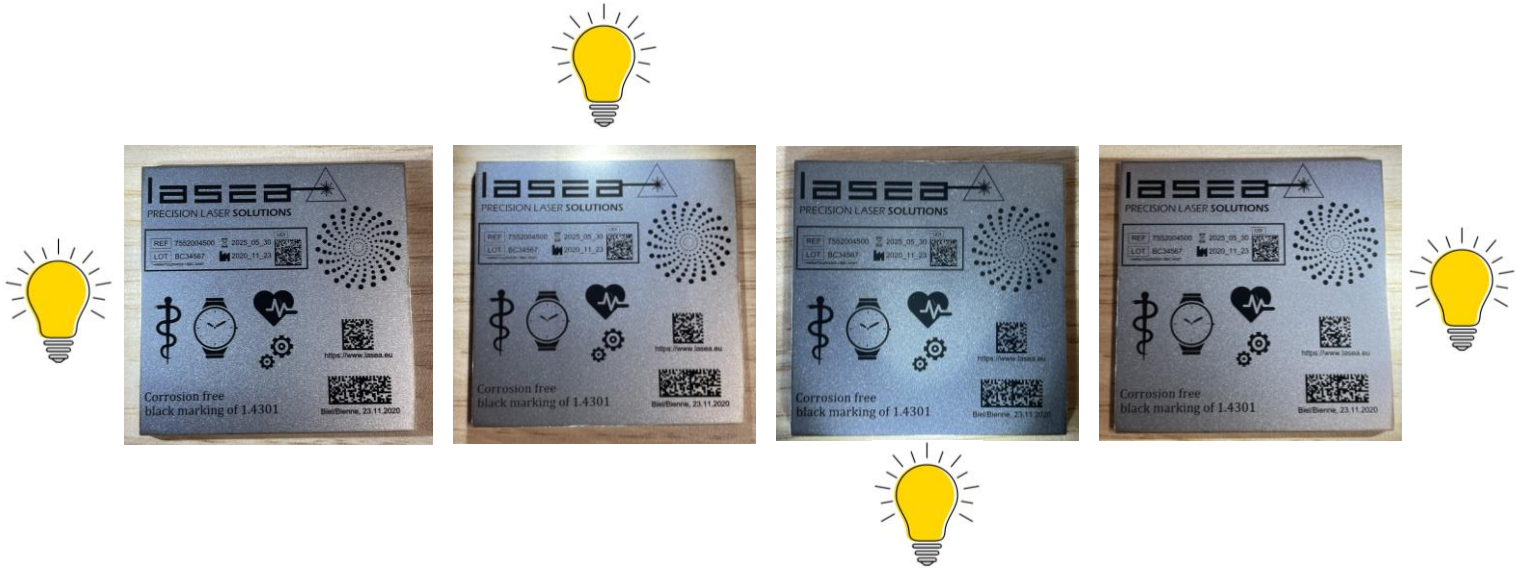
Black marking

MARKING

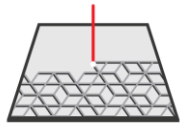
- Independent of viewing angle



- Independent of light incidence



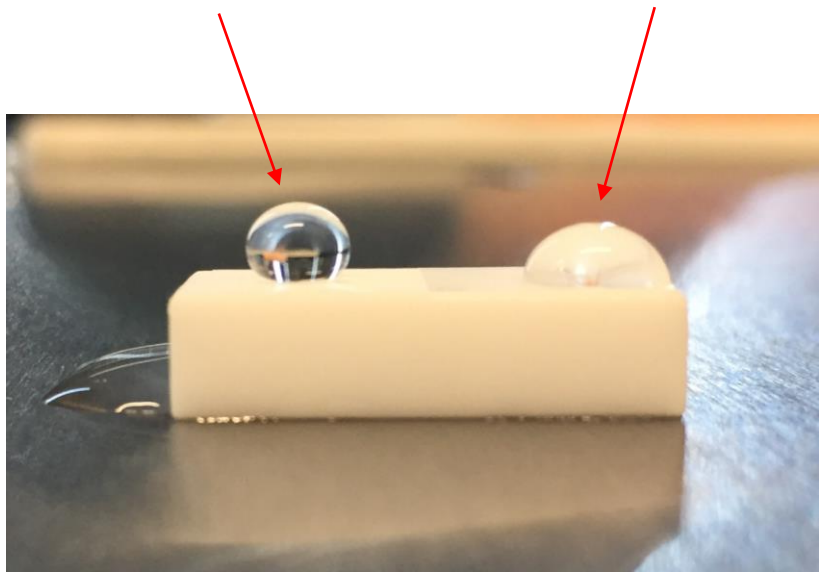
Hydrophobic surfaces



TEXTURING

Surface laser textured

untreated



Objectives :

- **Part** : Demo part
- **Material** : Teflon
- **Application** : Hydrophobic surface

Results :

- **Cycle time** : According to the surface to mark
- **Characteristic** :
  - Hydrophobic surface after laer treatment

Diffractive marking using LIPSS

Objectives :

- Part : Demo part
- Material : Stainless steel 1.4301
- Application : Diffractive marking

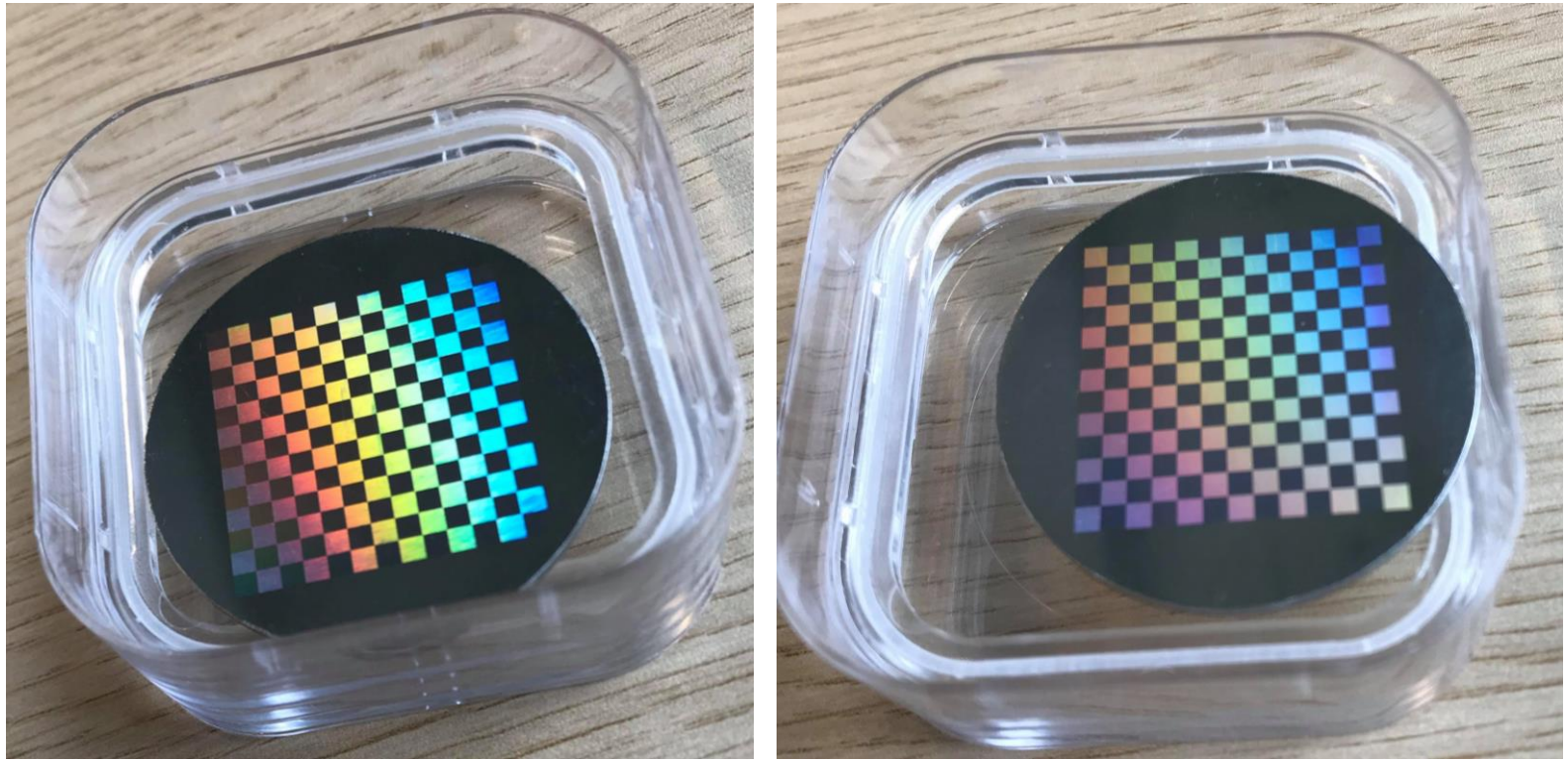
Results :

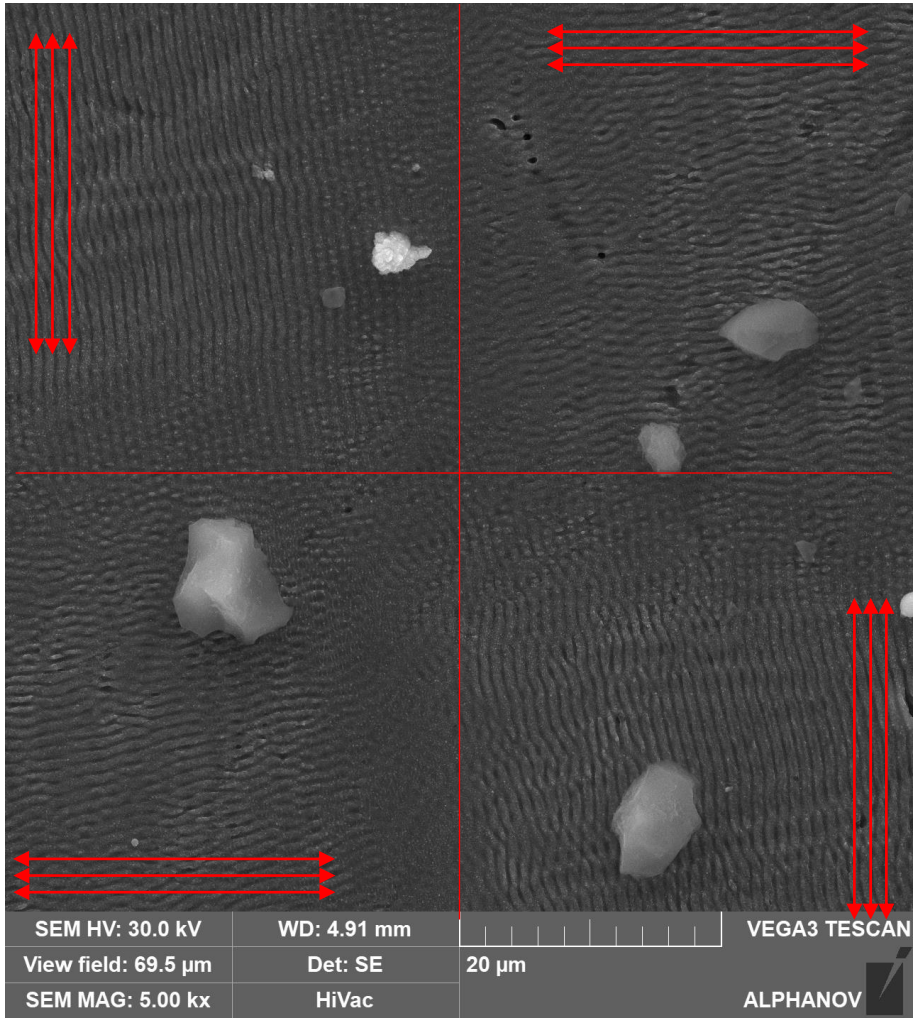
- Cycle time :
  - According to the surface to mark
- Visual aspect :
  - Rainbow effect
  - Angle-dependent
  - Bright colors
- Average Power :
  - Close to the threshold fluence

Diffractive marking using LIPSS

MARKING

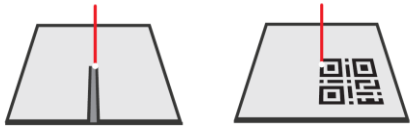
Sample rotation by 90°

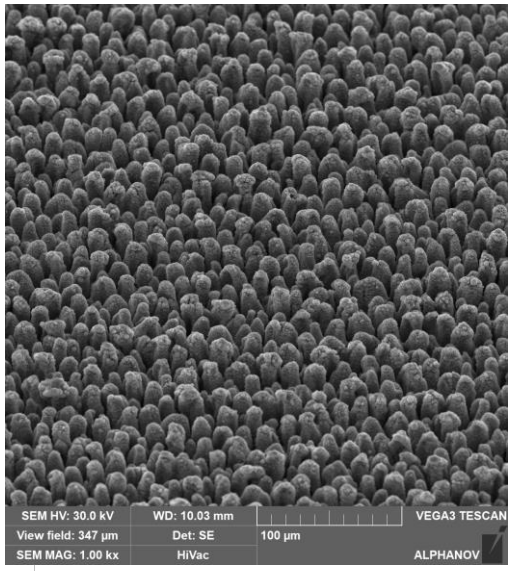




Change of the ripples-orientation by changing the linear polarisation from S to P

Deep Black





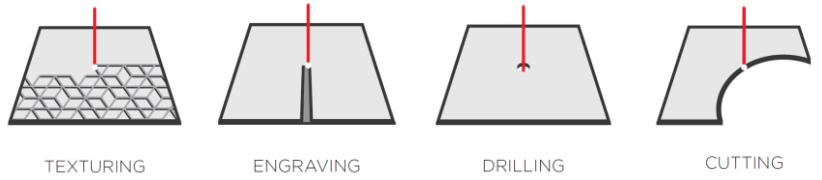
Objectives :

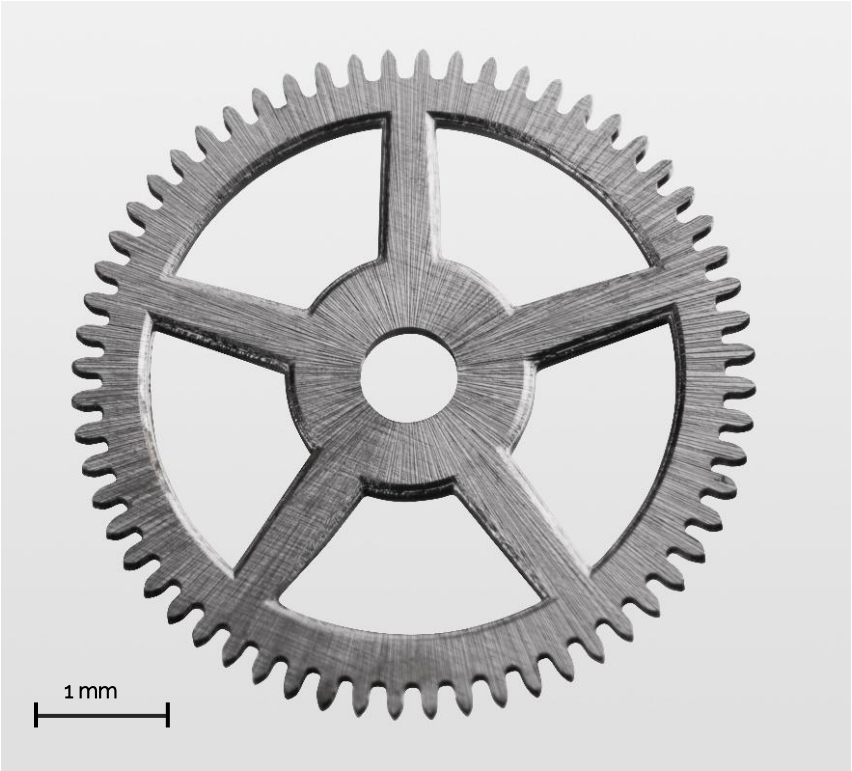
- **Part** : Demo part
- **Material** : Stainless steel 1.4301
- **Application** : Engraving deep black

Results :

- **Cycle time** : According to the surface to engrave
- **Visual aspect** :
  - From dark gray to deep black
  - Spikes

Cutting and texturing (decoration)





Objectives :

- **Part** : Watch movement part
- **Material** : Brass
- **Tickness** : 250 µm
- **Applications** :
  - Cutting
  - Drilling
  - Chamfering
  - Texturing

Results :

- **Visual aspect** :
  - Traditional soleillage aspect

Result from project Laser4Surf

- Surface texturing

Motivation & objectives : Surface functionalization by laser

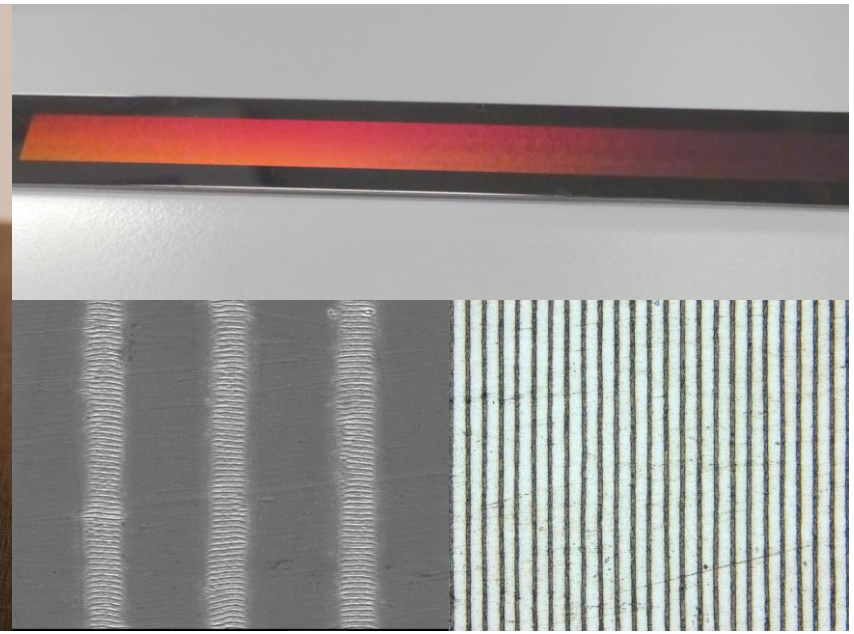
Energy sector

Batteries

Pharmaceutics

Medical implants

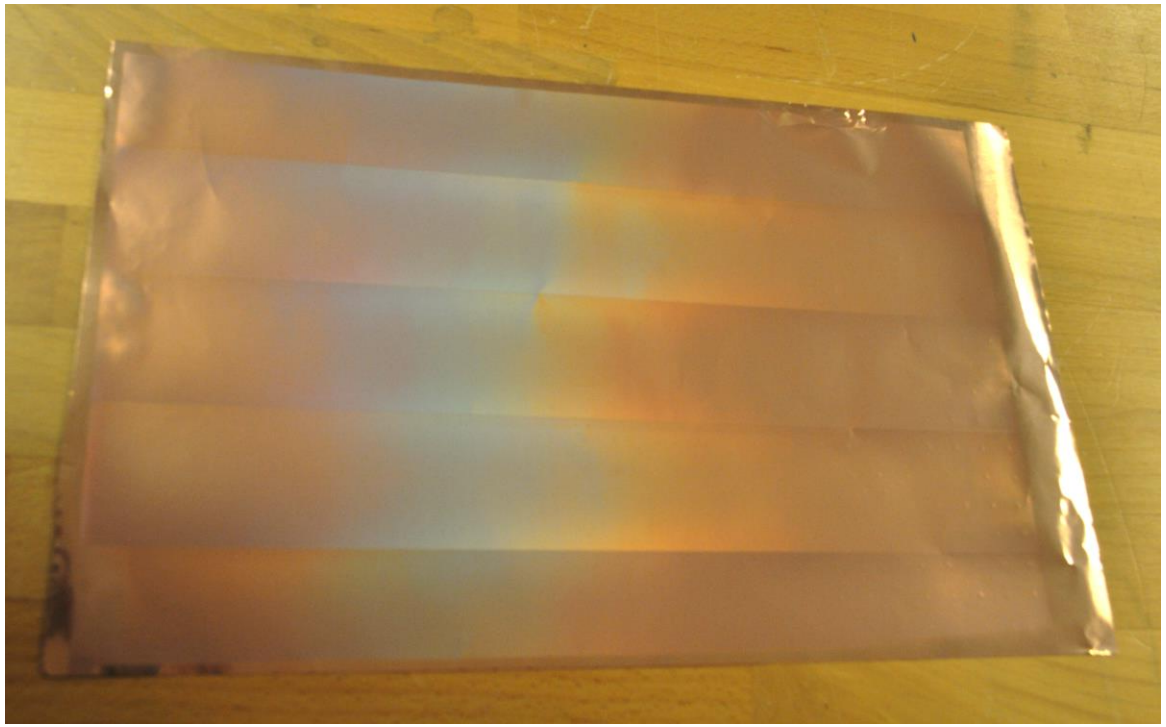
Metrology



Linear encoders

Batteries : Large surface texturing

Cu foil



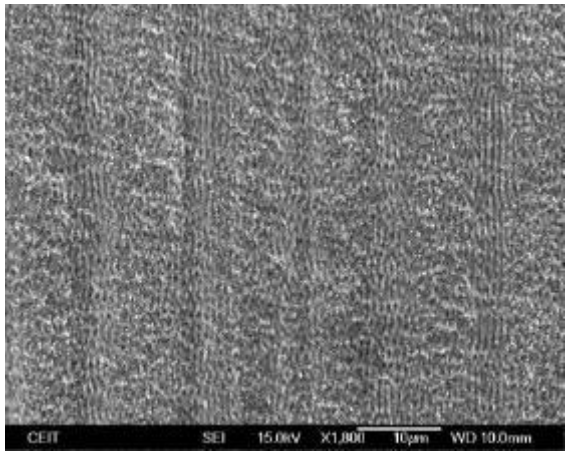
Al foil

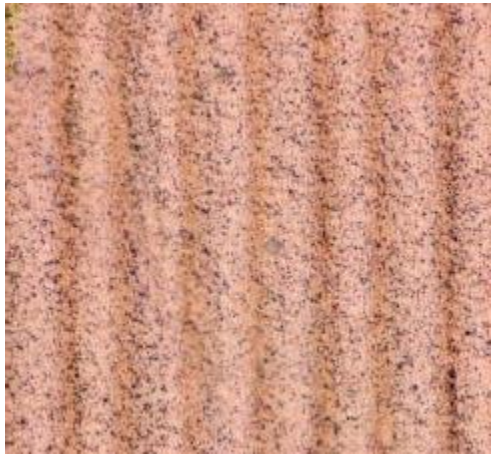
A4 homogenous large surface texturation (210 x 300 mm^2)

Batteries : Large surface texturing

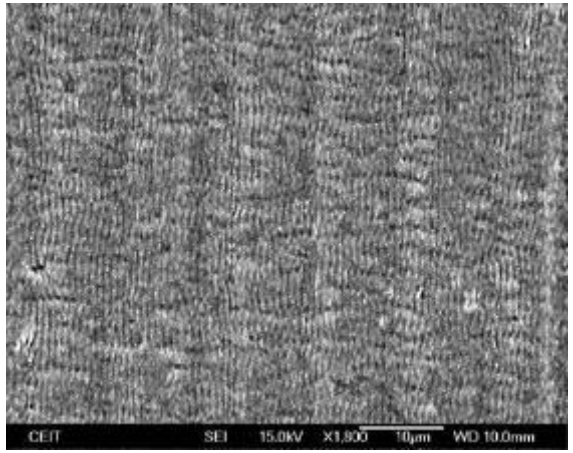
- Large area texturing: 210mm x 300mm
- Copper and Aluminum
- Parameters reproducibility proven

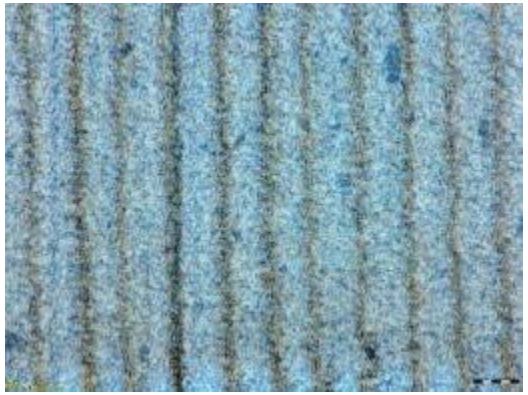
COPPER



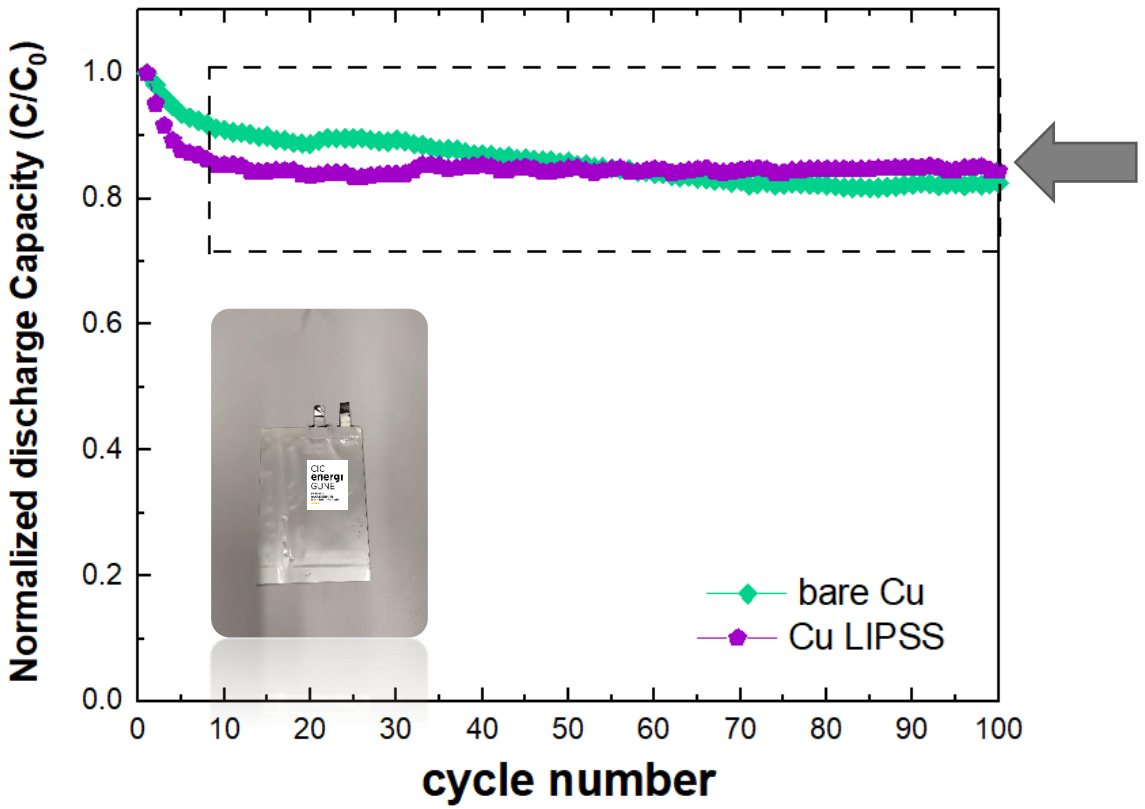


ALUMINUM

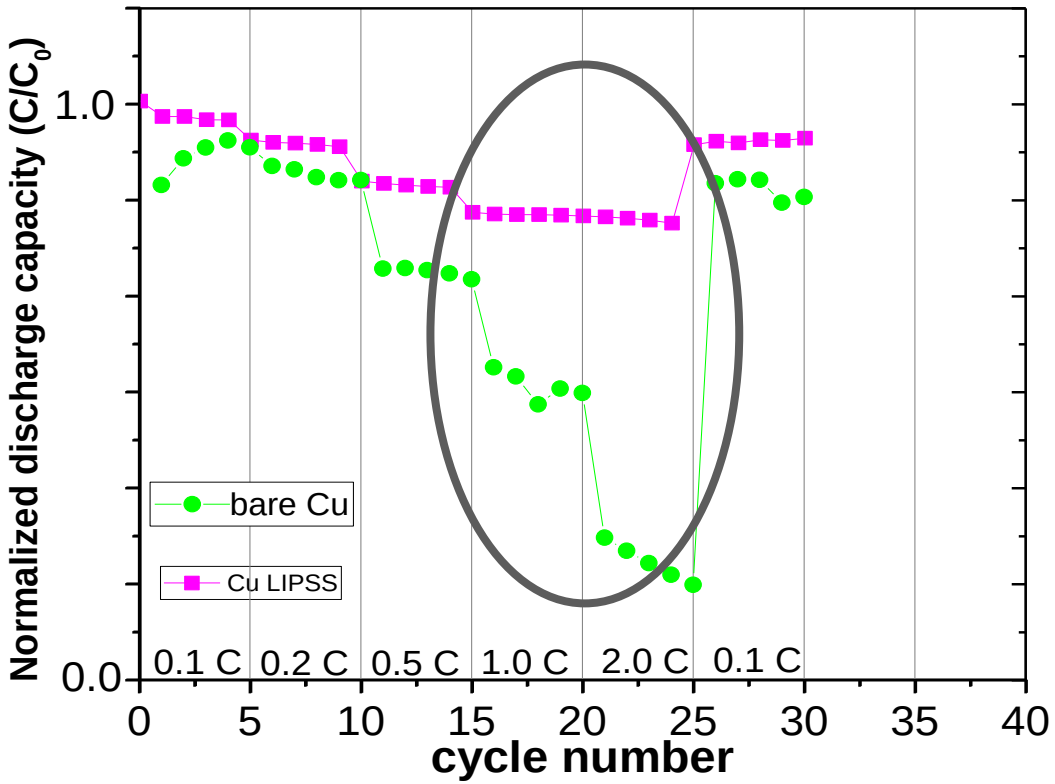




Batteries : Large surface texturing

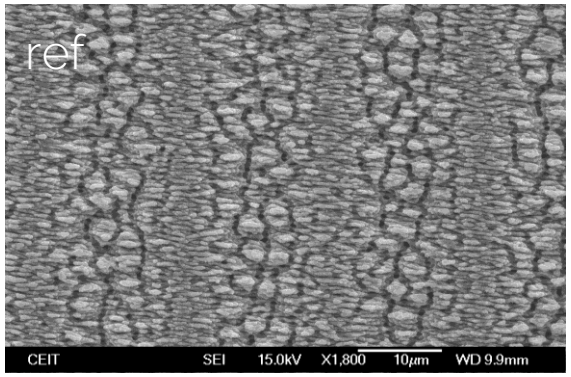


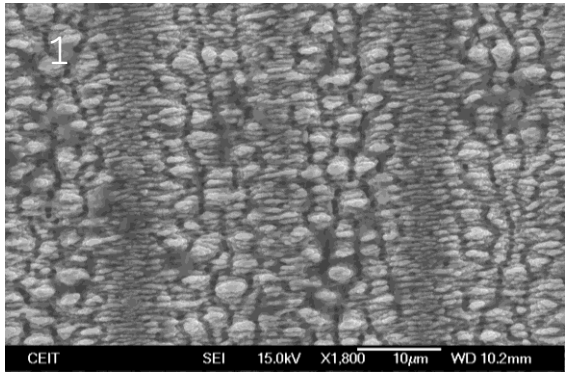
Better capacity retention of the Cu LIPSS pouch cells after 100 cycles at 1C -> better cycle life

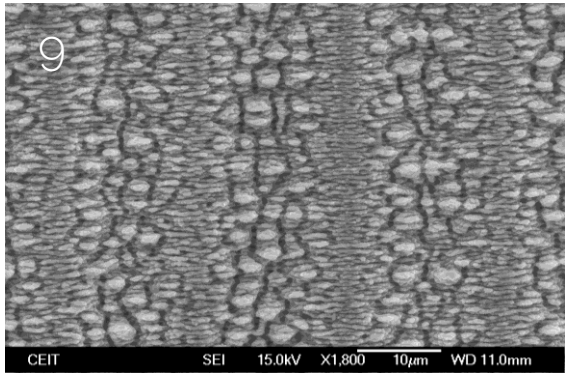


Better electrochemical performance at high C-rates for the Cu LIPSS pouch cells

Medical implants: 3D texturing





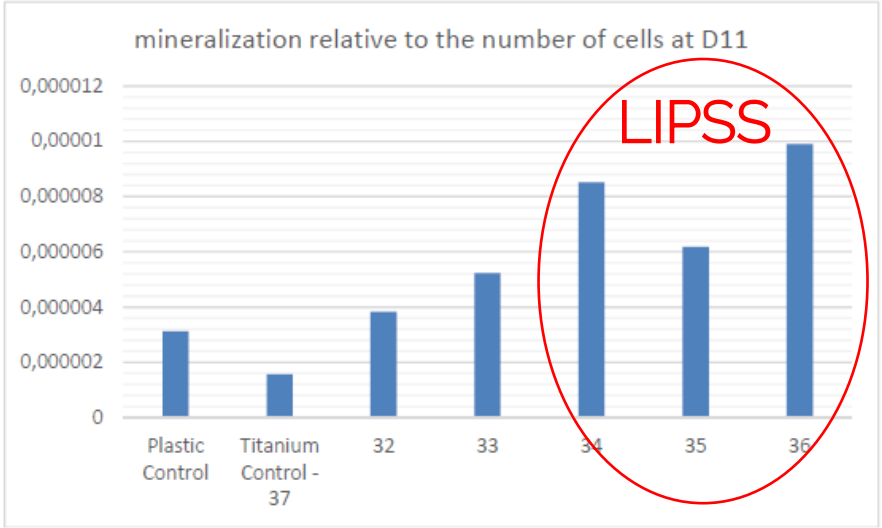


- Titanium screws texturing (Reproducibility)
- 7-axes technology
  - 5 mechanical axes
  - 2 optical axes (galvo scanner)

Medical implants: 3D texturing

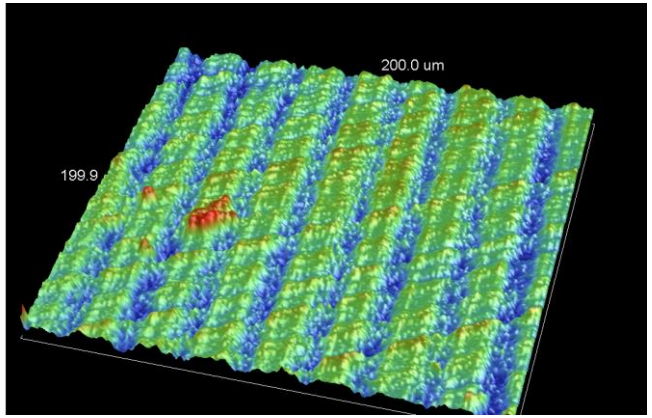
In vitro tests were performed:

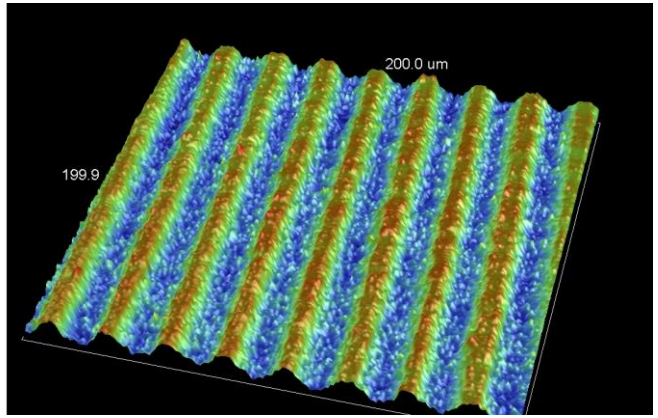
- Increase of the mineralization proves a better osteointegration



Laser texturing is a very promising method for surface treatment as:

- Possibility to fine-tune the surface parameters according to desired specifications
- Possibility of complex surface treatment from plates to screws
- No major chemical modification of the surface





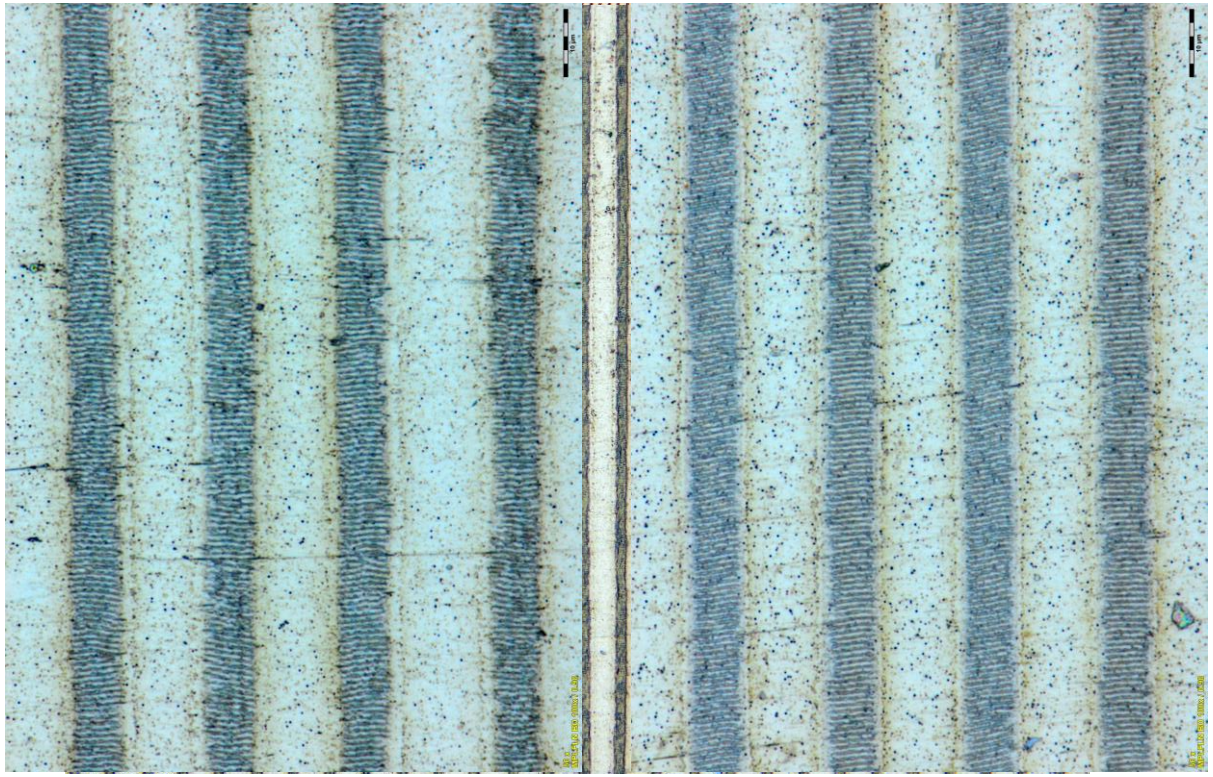
Encoders : 100x5mm surface texturing

Key features:

- Micron precision of line positionning with LS-Scan
- Micron precision of line width through laser process control and parameters conversion
- Sub-micron precision of LIPSS structures and orientation
- Improvemement of LIPSS homogeneity through the use of beam-shaping

Without DOE

With DOE



Gaussian beam

Square top-hat beam

Conclusions

- Change of the appearance
  - White surface of stainless steel
  - Black marking of stainless steel
  - Sunray brushing
- Modification of the surface characteristics
  - Hydrophobic surfaces
- Modification of the surface geometry (on sub-micron scale)
  - LIPSS for battery manufacturing
  - LIPSS for encoders

Thank you for your attention

- If you have further questions or like to discuss your laser application, please visit our booth G102

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