LASER ENGINEERING SURFACE STRUCTURES (LESS) IN PARTICLES ACCELARATOR ENVIRONMENT.

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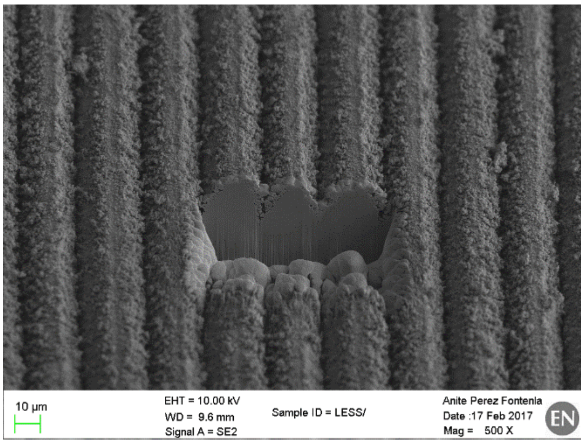

SEM top view of a FIB cross section in a LESS.

- Mitigation of the electron multi-pacting in particles accelerators
- Morphological analysis of the surface
- Mechanical characterization of the surface
- Multi-scale 3D modelling
- Electro-magneto thermo mechanical simulations

Abstract:

Electron multipacting and the electron cloud have been identified as being major limiting factors for the beam quality of high-intensity accelerators of positive particles.
Conditioning operational mitigation technics are already used and engineering surface solutions like amorphous carbon coating or surface structuration are investigated to decrease the SEY (Secondary Electron Yield) of the surfaces. Laser engineered surface structures (LESS) offer a promising alternative to treat the beam screens in situ and on atmospheric pressure.
Tests undertaken at CERN have shown that the modification of the surface morphology by creating roughness at different scales induces a decrease of the SEY by geometrical effects. Nevertheless, major characteristics of the treated surface, i.e. mechanical strength and dust generation rate have not been addressed yet.
During the thesis, a quantitative analysis of the multi-scale distribution of the surface morphology is carried out. Microstrutural analysis, scanning and transmission electron microscopies are used to investigate metallographic structures, composition and phase transformation at the surface of the laser-processed material. Three-dimensional analysis of the surface, based on results from electron nanotomography by FIB-SEM are applied to go into the topographical characterization at the nanoscale. These analysis are assisted by image processing consisting in stereological/morphological operations.
Electro-magneto thermal mechanical simulations based on a representative 3D surface model are expected to assess the solicitations during a magnet quench, a fast magnetic field decay and local damage/crack propagation leading to possible dust generation.