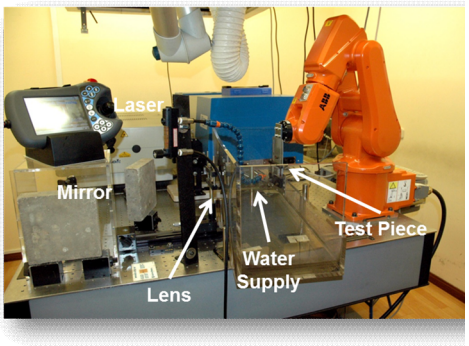
Research Group on Laser Engineering and Applications

The UPM Research Group on Laser Engineering and Applications (GRIAL) was founded in 1990 and has continuously progressed through an active involvement in a significant number of R&D projects (most of them of public competitive financing) in the fields of Laser Matter Interaction and Laser Materials Processing for Industrial Applications. Since then, the Group has promoted the implementation of relevant experimental facilities at its experimental site in the UPM Laser Centre, being the responsible for key technological achievements in cooperation with national Spanish and international industrial companies and providing the frame (MSc and PhD Programs on Laser Technology and Applications) for the completion of over 20 PhD Theses and 50 MSc Works. In an international context, the Group is well recognized in the field of Laser Shock Processing Technology, having hosted in Madrid the 4th International Conference on this discipline.

Facilities and infrastructures

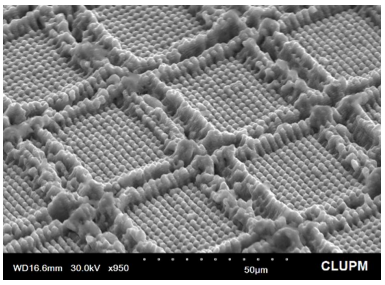
The Group has based its progress both in the development of calculational models for the predictive assessment of laser processing applications and in the pursuit of experimental investigations based on key equipment of the UPM Laser Centre. These experimental research facilities include:

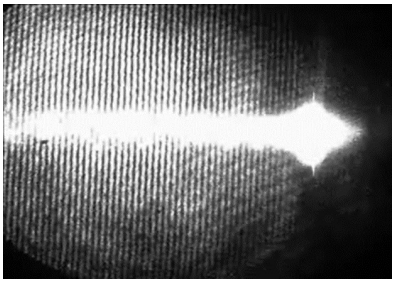
- Robotized Laser Processing Cell (6 DoF) including:
  - 3,3 CW fiber transmited Nd:YAG Laser.
  - 3,5 CW CO_2 (slab) optically transmitted.
  - Hybrid Laser-Arc welding + heat treatment / cladding equipment.
- Laser Shock Processing Cell including:
  - Pulsed (2,5 J, 10 ns, 10 Hz) Nd:YAG Laser.
  - 6 DoF Robotized positioning system.
  - Spectroscopic + fast camera Plasma analysis system.
- Laser microprocessing lab., including:
  - Microprocessing workstation OPTEC ML-100 equipped with KrF + Nd:YVO_4 (mW range) ns lasers.
  - Microprocessing workstation OPTEC AB-200 equipped with PULSEO (100 kHz, 25 ns, 10 W) and VANGUARD (80 MHz, 20 ps, 8 W) Nd:YVO_4 lasers.
- Mechanical testing laboratory equipped with MTS 100 kN system.
- Microscopy (SEM + confocal) and Surface Characterization (wear, corrosión, residual stresses) laboratories.
- For the development of models for the predictive assessment of laser processing applications, the Group operates a moderate range workstation based computational centre.

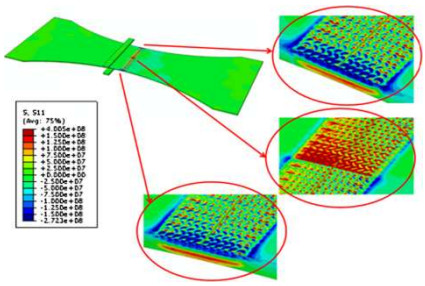


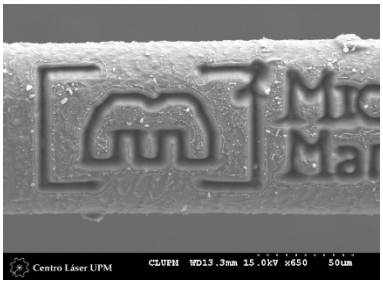
Research areas associated with Big Science

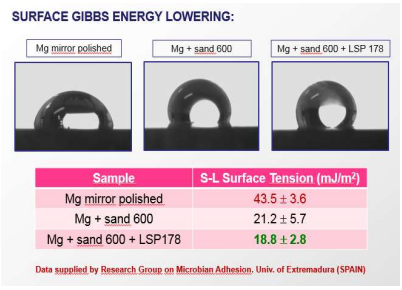
- *High Intensity Laser Materials Processing for Aerospace Applications (ESA, AIRBUS, ZAL).*
- *Surface Micro-/Nano-Structuring for Energy Efficiency and Carbon Capture.*
- *Development of Advanced Alloys and Surface Treatments for Healthcare.*
- *Numerical Simulation of High Intensity Laser Plasma Interaction (Mechanical and Advanced Energy Applications).*
- *Development of Advanced Material Behaviour Models for Extreme Conditions.*
- *Development of Models for Experience-Based Data Analysis and Process Control in Additive Manufacturing.*











Main projects in Big Science

- *Monitoring Laser Peening for Stress Corrosion Cracking and Fatigue Resistance Enhancement of Launchers External Structures (LASER EXPRO; ESA).*
- *European ESRs Network on Short Pulsed Laser Micro/Nanostructuring of Surfaces for Improved Functional Applications (LASER4FUN; EC).*
- *Mechanisms of residual stress generation in mechanical surface treatment: the role of cyclic plasticity and texture (MEDUSA; US-EOARD).*
- *Intelligent Manufacturing of Advanced Materials for Transport, Energy and Health Applications (MAT4.0-CM; CAM).*
- *LSP Treatment of Biodegradable-Resorbable Mg alloys for improved in-body mechanical performance (LSP-BIOMAG; AEI).*

Collaboration with Large European Scientific Facilities

- ***HiLASE, ZAL and ILL**: laser shock processing as a method for the induction of compressive residual stresses fields in metallic alloys.*
- ***ILL**: use of neutron diffractometry for the characterization of microstructural transformations following high rate deformation of Ti6Al4V by laser shock processing.*
- ***ILL**: analysis of the effect of pre-processing conditioning on the microstructural transformations following laser shock processing of Ti6Al4V.*

GRIAL-UPM

LASER ENGINEERING AND APPLICATIONS

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