APPLICATION OF LASER SHOCK PEENING ON HIGH ELASTIC LIMIT STEELS FOR POWER TRANSMISSION COMPONENTS

CertBond
COST Action CA18120

Maxime Guerbois

Supervisors: Laurent Berthe & Véronique Favier

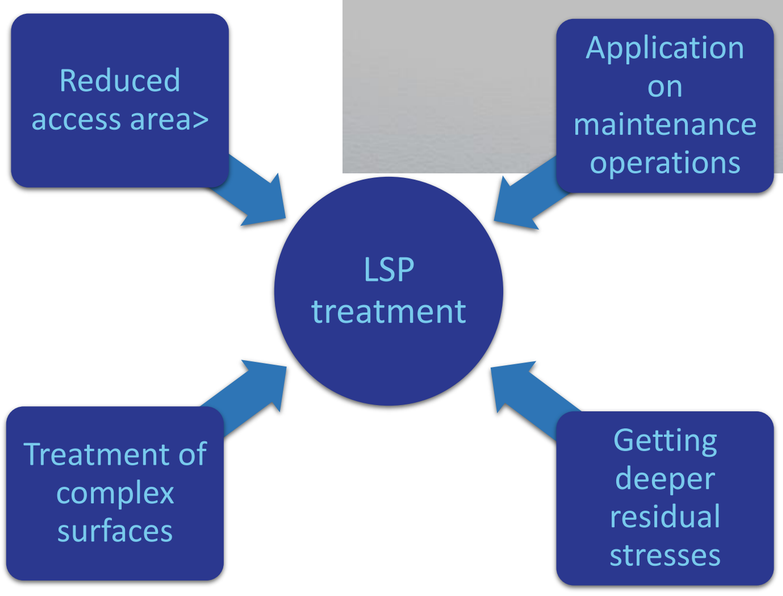
Context & Goals:

Objective: Improving the gears life cycle for naval and aeronautics industries

As the immobilisation of vehicles is an issue, dealing with the ageing of the gears, and being able to realise maintenance on the vehicle itself is one of the main concern of this project.

The treatment method needs to be applicable in production and in maintenance

- Laser Shock Peening (LSP) is used as a mean to improve fatigue life by introducing high level of residual stresses and improving the corrosion behaviour of treated pieces.[1,2]
- The transport of the beam by optical fiber is required to reach reduced access areas.



Laser Shock Peening process

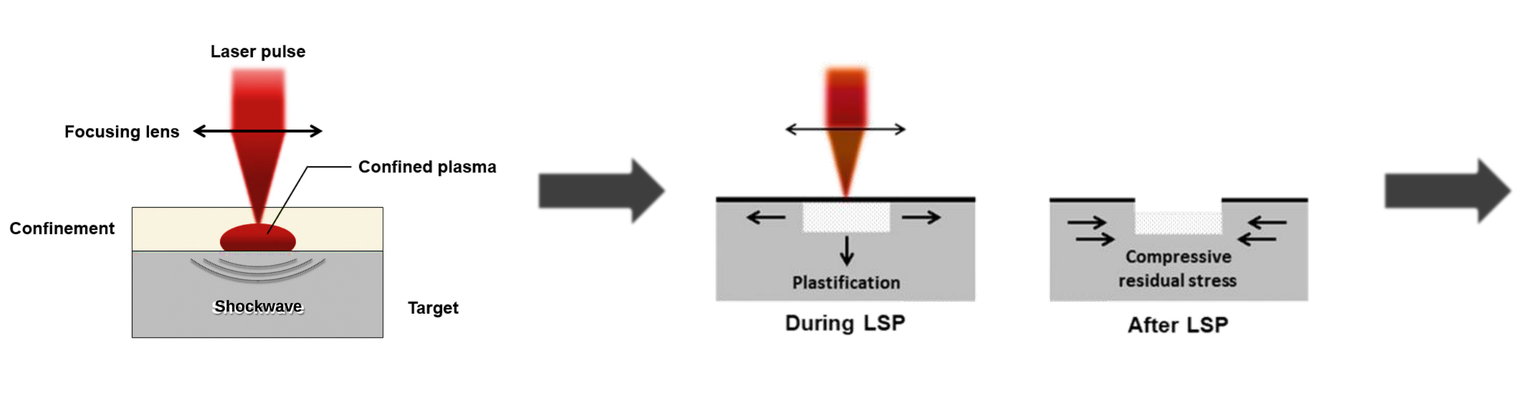
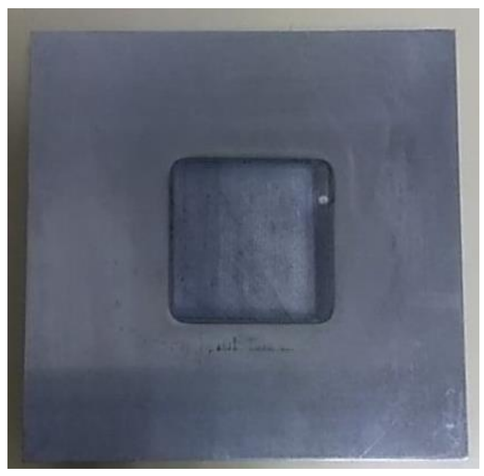


Figure taken from [2]

- The plasma produced on the surface by the impulsion produces a pressure over 1 GPa during its release.
- This impulsion leads to the introduction of deep and high compressive residual stress in the treated piece, compared to conventional peening.

- Prevents the cracks on the surface.
- Using low energy and small spot size, it is possible to transport the beam through optical fiber.

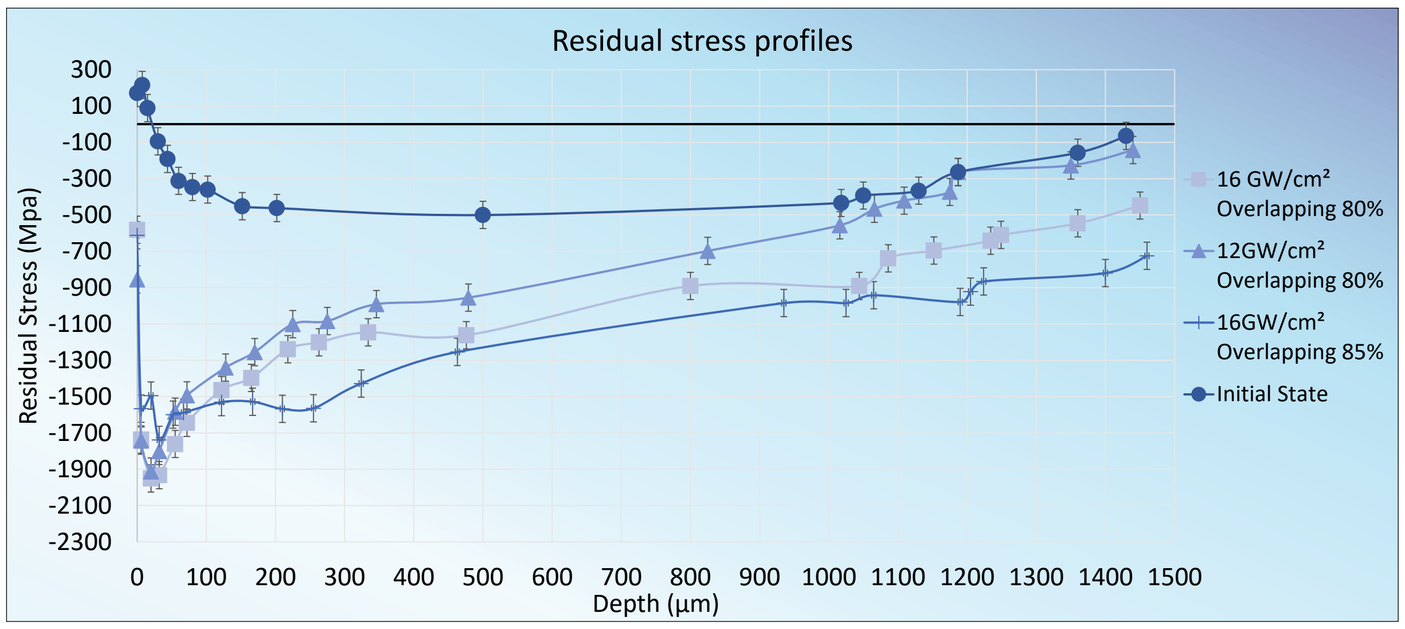


Sample after LSP treatment

LSP treatment parameters

All the LSP treatment were realised at the Héphaïstos facility at PIMM Laboratory.

- λ = 532 nm
- Spot size = 1 mm, (order of magnitude)
- Frequency : 2 Hz
- Pulse duration : 7 ns
- Overlapping : 80% - 85% (order of magnitude)
- Intensity : 12-16 GW/cm² (order of magnitude)
- Targets : 16NCD13 blocks (60x60x20 mm)
- Surface treated : 20x20 mm²



Results

- The highest compression is obtained for a 20 µm depth, with 2GPa.
- The higher the overlap is, the higher the compressive residual stress is.
- Residual stress can be observed over more than 1 mm below the surface.
- The Average Roughness is 1.4 µm on the treated specimen. This is 0.9 µm higher than before LSP.
- The surface ablation of 25 µm is a real issue for now, as it is radically changing the geometry of the specimen.

Funded by the Horizon 2020 Framework Programme of the European Union

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

References

[1] Yuji Sano, Koichi Akita, Kiyotaka Masaki, Yasuo Ochi, Igor Altenberger, and Berthold Scholtes. Laser peening without coating as a surface enhancement technology. Pulse, 100 (40):250mJ, 2006.

[2] Fabbro, R., et al. "Physics and applications of laser-shock processing." *Journal of laser applications* 10.6 (1998): 265-279.