Electrical Steel Structuring, Insulating and Assembling by means of the Laser Technologies

ESSIAL

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www.essial.eu

ESSIAL in a nutshell

ESSIAL is a research project funded by the European Commission “Factory of the Future” programme. The ambition of the project is to use laser surface texturizing (laser scribing, irradiation, texturizing, ...) on soft ferromagnetic materials, such as usual electrical steels and special alloys, in order to improve the performance and functionalities of laminated magnetic circuits.

These soft magnetic circuits, made from stack of steel sheets separated by an insulating layer, are becoming crucial in almost all industrial sectors, as they are key elements of industrial electrical machines (such as transformers, sensors, actuators, motors, generators ...). Experts estimate that the market growth rate of soft magnetic materials should increase by 7.8% annually in the coming years!

The ESSIAL consortium, consisting of research centers and companies covering the entire value chain of soft magnetic materials, develops innovative laser-based manufacturing processes to improve the functionality of materials. Several prototypes have been produced to confirm the benefits of ESSIAL’s solutions before possible mass production.

Legal Disclaimer

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A collaborative EU-funded project

ESSIAL is supported by the European Union's research and innovation programme. The project is funded by the "Factory of the Future" programme, under the specific topic "New product functionalities through advanced surface manufacturing processes for mass production" (FOF-06-2017).
The consortium is coordinated by UniLaSalle and implemented by a total of 13 partners from 4 EU member countries

Duration

4,5

years

From November 2017 to July 2022

EU contribution

5

millions €

The ESSIAL consortium:

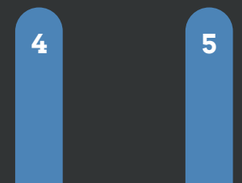
13 partners

5 research centres

4 private companies

3 universities and engineering school

1 competitiveness cluster



France

Université de Picardie Jules Verne
euronovia
jeumont electric groupe altawest
UniLaSalle Amiens
IRT M2P
EuraMaterials

Belgium

LASEA LASER SOLUTIONS
Multitel INNOVATION CENTRE
CRM GROUP
EREA TRANSFORMERS
erea · energy · engineering

Germany

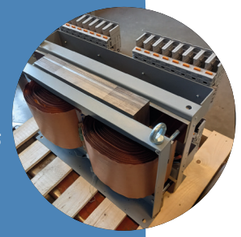
Fraunhofer IPT

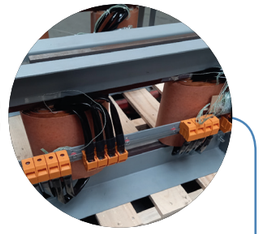
Spain

andaltec
uc3m | Universidad Carlos III de Madrid

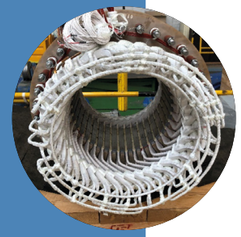
DC and AC chokes

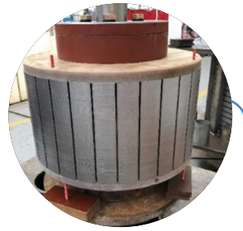
Voltage transformers



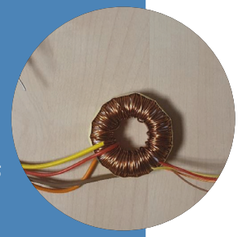


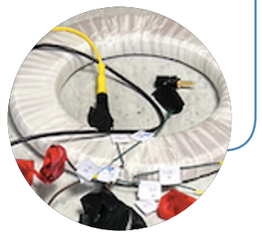
DC and AC Rotating Electrical machines





Current sensors and transformers

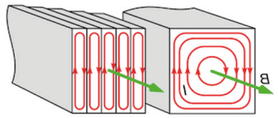




Context & Goals

Context: materials and machines

The soft magnetic materials, made from stack of steel sheets separated by an insulating layer, are becoming crucial in almost all industrial sectors, as they are key elements of industrial electrical machines such as transformers, sensors, actuators, motors, and generators.



Laminated stack of electrical steel sheets

Goals : energy efficiency

ESSIAL use laser surface texturizing in order to improve the performance and functionalities of laminated magnetic circuits, while preserving a high mechanical and thermal resistance.

The main objectives of the project are to:

- **Decrease iron losses** due to magnetic reversal processes by 20% (namely the excess magnetic losses),
- Control and decrease **mechanical vibrations** and **acoustic noise** by 20%,
- Make the diassembling/separation/cleaning of magnetic and insulating materials easier for **sustainable manufacturing process** chains
- Integrate **new laser processes** with maximum 10% price increase or even decrease the global cost by 20%

Overall cost

Recycling

Noise Pollution

Energy Efficiency

The project concept and innovations

Surface laser treatments on soft ferromagnetic materials

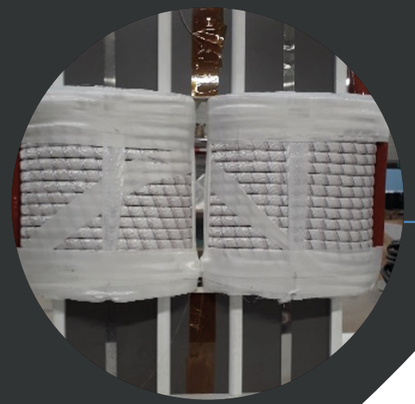
- For magnetic domains refinement
- For surface preparation dedicated to assembling / disassembling processes
- For eco-friendly surface cleaning of materials

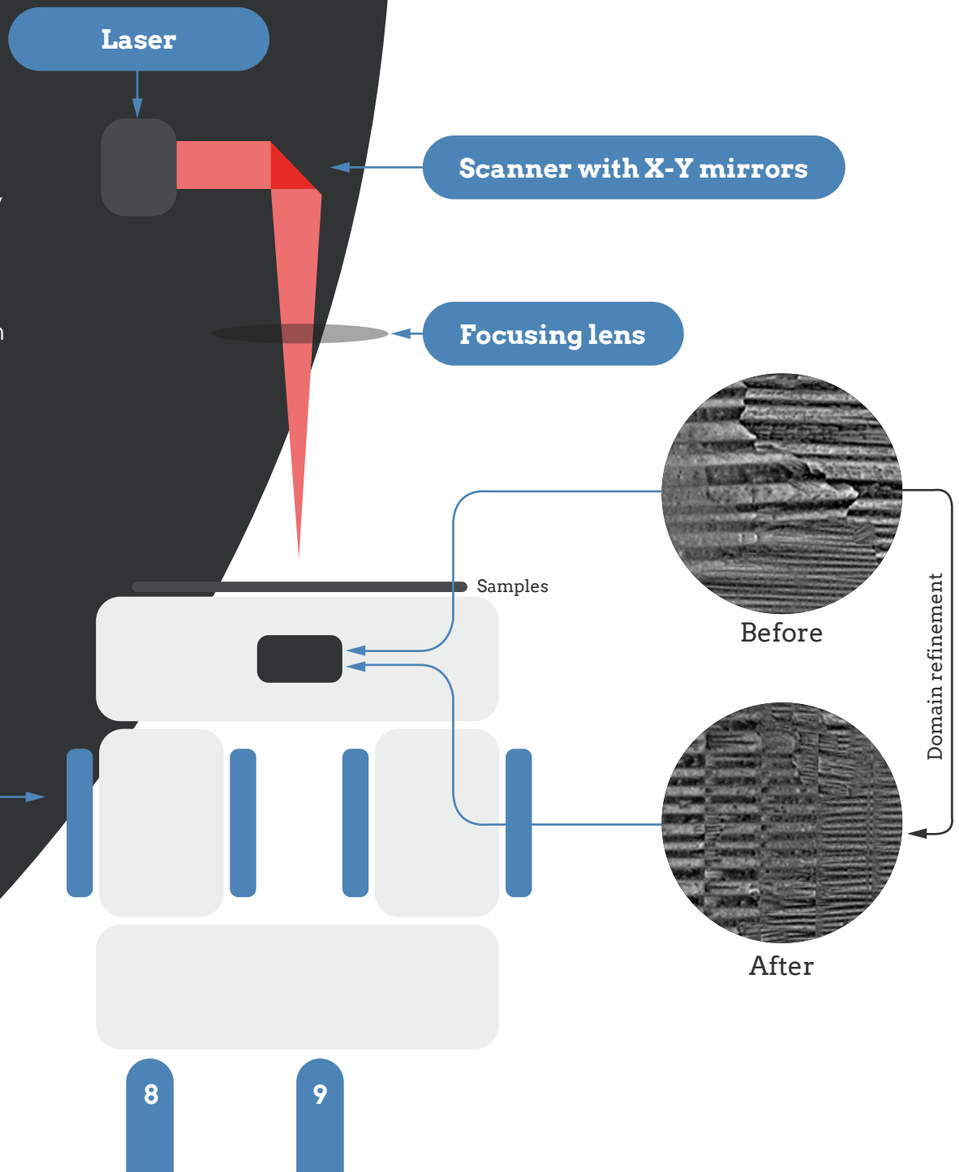
- Or contribute to the eco-friendly design of electrical components made of electrical steels in order to ease the separation / re-use and recycling of materials, which also leads to the reduction of global cost.

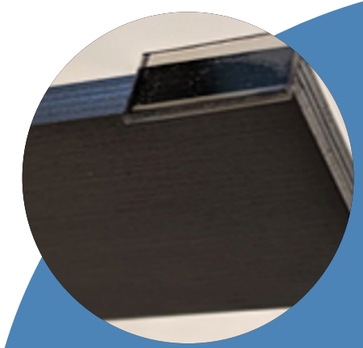
The challenge for laser-based manufacturing processes

Surface laser treatments performed on usual electrical steels or special alloys can effectively:

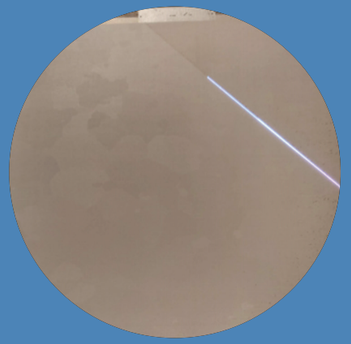
- Either increase the performance and functionalities of laminated magnetic circuits, reduce their losses and vibrations and thus limiting their global costs.







Assembling/ disassembling



Decoating/ cleaning

Project workplan

Work packages, Goals and Interactions

WP2 : Manufacturing Processes

WP2a: Metals

WP2b: Laser process

WP2c: Insulator & welding

- Laser treatment of hundreds of samples at the lab scale
- Laser treatment and thermal annealing of thousands of strips for the prototypes
- Definition and test of metallurgical routes for the whole process with recrystallization

Specifications

Samples

Samples

WP3 : Physical studies Specifications for the laser structuring patterns

WP3a: Magnetic

WP3b: Vibro-Acoustic

WP3c: Insulator

- Modelling the physical impacts of the laser processes. onto the material and its properties
- Modelling the macroscopic behaviour laws and couplings with the magnetic structure.
- Observation of the changes in the magnetic structure due to the laser processes.
- Measurement of the changes in the physical properties

Parameters Patterns

Meas. data

WP6 : Upscaling

WP6b: Upscaling for mass production

WP6a: Off-Line and In-Line Monitoring

- Upscaling of laser speed and power for mass production
- Definition of in-line monitoring and upscaling strategies for mass production
- Design and manufacturing of the in-line monitoring tools for the production process

Specifications

Reduced prototype

Speed quality

WP4 : Proof of concept - Manufacturing lab. Scale

- Upscaling of the laser treatment at high speed for the industries
- Dozens of optimized samples for prototypes
- Manufacturing of more than 25 ring core testers with special alloys,
- Manufacturing of more than 3 demonstrators with Grain Oriented steels,
- Manufacturing of more than and 10 prototypes at the lab. Scale.

WP5 : Prototypes - Manufacturing at the industrial scale

More than 3 prototypes, close to commercial products, have been manufactured and tested:

- 1 lasered rotating electrical electrical machine (in progress)
- 2 lasered voltage transformers (goal of 20% loss reduction achieved)
- Goal of 20% losses & 50% vibrations reduction achieved for AC inductors at the lab. scale.
- 1 DC choke for an AC/DC LVPS charger assembled with the ESSIAL technology

ESSIAL

Contact

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