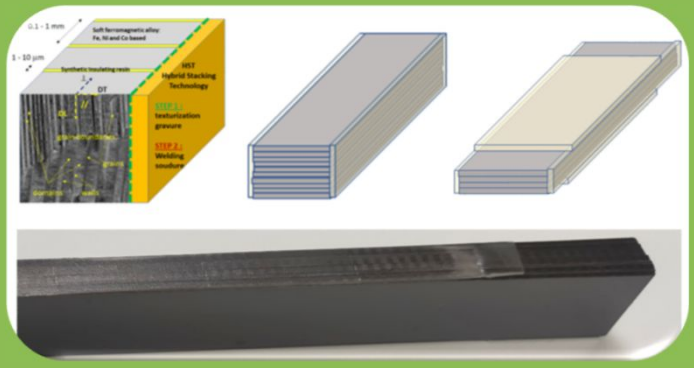
HYBRID STACKING TECHNOLOGY (HST)



CONTEXT

Most magnetic circuits used in electrical and magnetic components are made of electrical steel sheets or strips that must be insulated from each other and from other electrical parts (coils, yokes, housings …), put together to form stacks. The latter must also be put together to form the magnetic core or total magnetic circuit in the final component, with various geometries. Nowadays, Joining- Assembling / disassembling solutions are of three main types: the welding metal to metal, the crimping with two versions (with holes and insulated cross bars or with rods at the edges) and the strapping with two versions also (surrounding strapping with a metal thin tape or with an insulating tape).

INNOVATIONS

The HST is a new method for assembling and disassembling an arrangement of one or more substrates, and arrangement of one or more substrates. It is based on the hybrid joining technology using a first USPL (Ultra-Short-Pulsed-Laser) texturization step and then a second thermal annealing step to join the two substrates (electrical steels in a stack + insulator at the edges). The process provides the best-known quality regarding the following criteria: Insulation between laminations without short circuit neither nor at the edges, limitation of vibrations and delamination, insulation between the stacks and the other electrical parts, no damage of magnetic properties (losses and permeability), no barrier to the thermal dissipation of heat, automated disassembling and recycling of materials.

OUTCOMES

Energy savings : This process makes it possible to decrease either the iron losses up to 10% mainly thanks to the USPL texturization step of the process.

Control of vibrations : the flexibility of the assembling process makes it possible to optimize the stack design in order to minimize the vibrations, noise and delamination risks.

LCA assembling + disassembling : The HST process provides a partial eco-friendly design which facilitates both the assembling and disassembling process while separating easily the different materials without emitting pollutants.

LCA de-coating and re-use : metal sheets recovered after the disassembling process can be submitted to a de-coating process with no magnetic damage and re-use possibilities.

LCC reduction of global cost : Energy savings and the LCA lead to the reduction of global cost with ROI < 5 years.

LCC	DC choke	1 phase AC choke	3 phases AC choke
working rate	75 %	75 %	75 %
power saved	**10 W**	**20 W**	**30 W**
energy saved	**66 kWh/year**	**132 kWh/year**	**197 kWh/year**
cost saved	10 €/year	20 €/year	30 €/year
surface ratio	50 % of edges (17°600 mm²)	50 % of edges (46°800 mm²)	50 % of edges (122°400 mm²)
process energy	**1,05 kWh**	**2,8 kWh**	**7,3 kWh**
process time	**1,4 h**	**3,75 h**	**9,8 h**
process cost 3*8	**18 €**	**50 €**	**130 €**
ROI (months)	**22 months**	**30 months**	**53 months**

APPLICATIONS

Magnetic Components: choke inductors, current and voltage transformers / Electrical Machines: motors and generators / Magnetic cores, yokes and circuits / Assembling and Disassembling processes / Any kind of Stack of metallic sheets surrounded by an insulator part.

MARKET

The market of electrical steels shows a growth of 8% per year in the world. The global market for Laser Processing estimated at US$13.9 Billion in the year 2022, is projected to reach a revised size of US$24.1 Billion by 2030, with a growth rate of 7%.

Source : https://www.researchandmarkets.com/

INTELECTUAL PROPERTIES

European patent PAT2609572EP00

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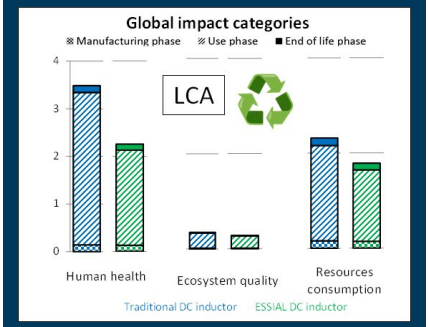
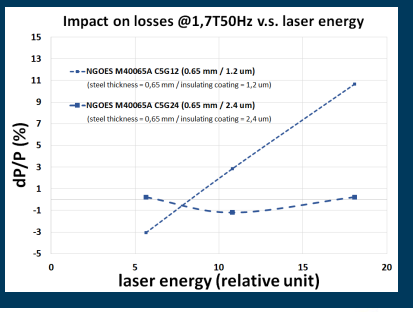
PARTERNSHIP

End-Users manufacturing magnetic products and interested in the Eco-Friendly design of magnetic stacks, cores, yokes and circuits.

Life Cycle Analysis (LCA):



QUALITY CONTROL AFTER DECOATING:



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