IDONIAL
CENTRO TECNOLÓGICO

SPEEDTECH-FORUMS
17th March 2023 – Leioa, Spain

ADVANCED STRUCTURES BY L-PBF TECHNOLOGY FOR ENHANCED APPLICATIONS

MULTI-FUN

IDONiAL
CENTRO TECNOLÓGICO

SPEEDTECH-FORUMS
17th March 2023 – Leioa, Spain

ADVANCED STRUCTURES BY L-PBF TECHNOLOGY FOR ENHANCED APPLICATIONS

Luis Ignacio Suárez

Manufacturing engineer

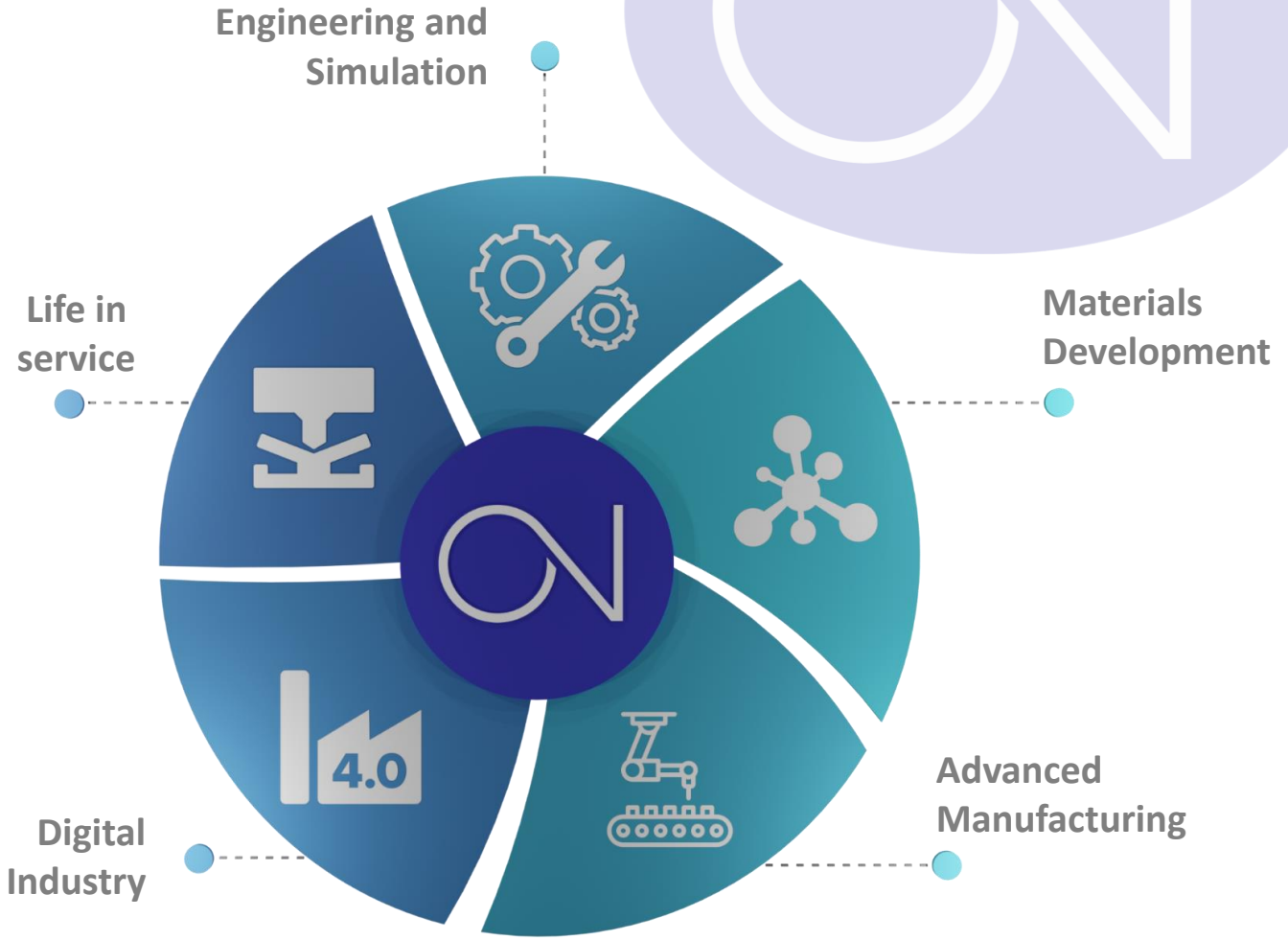
Strategy and business development in

IDONIAL Technology Centre

MULTI-FUN

IDONIAL GENERAL PRESENTATION

- ✓ Private, independent, non-profit and multisector technology center (RTO). Result of merging process between former RTOs PRODINTEC and ITMA. Contributes to the promotion and development of the business fabric in its areas of technological specialization offering integral R&D&I solutions in the entire value chain, from materials to manufacturing processes and products.
- ✓ 155 employees (19% PhDs).
- ✓ Headquarters Located in Asturias (northern region of Spain): Avilés, Gijón and Oviedo. Also, commercial office in Madrid

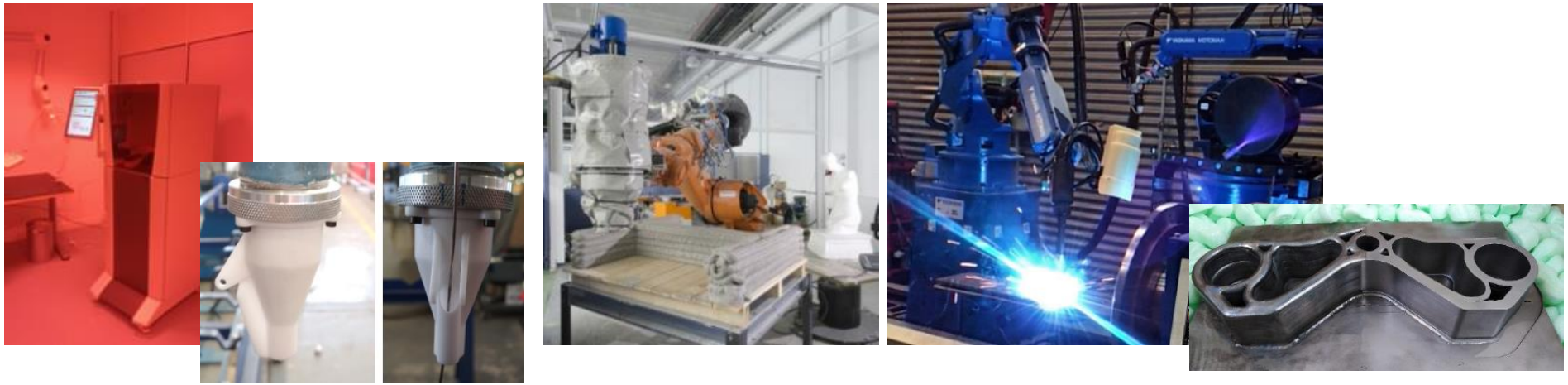


IDONIAL CENTRO TECNOLÓGICO

SPEEDTECH-FORUMS 17th March 2023 – Leioa, Spain

IDONIAL IN ADDITIVE MANUFACTURING

- ✓ PRODINTEC has been working with additive manufacturing for more than 15 years.
- ✓ Highly specialized staff in 3D design and AM process engineering.
- ✓ Technological resources in a wide range of commercial AM technologies:
- ✓ Custom made 3D printers for wide range of applications: construction, bioprinting..

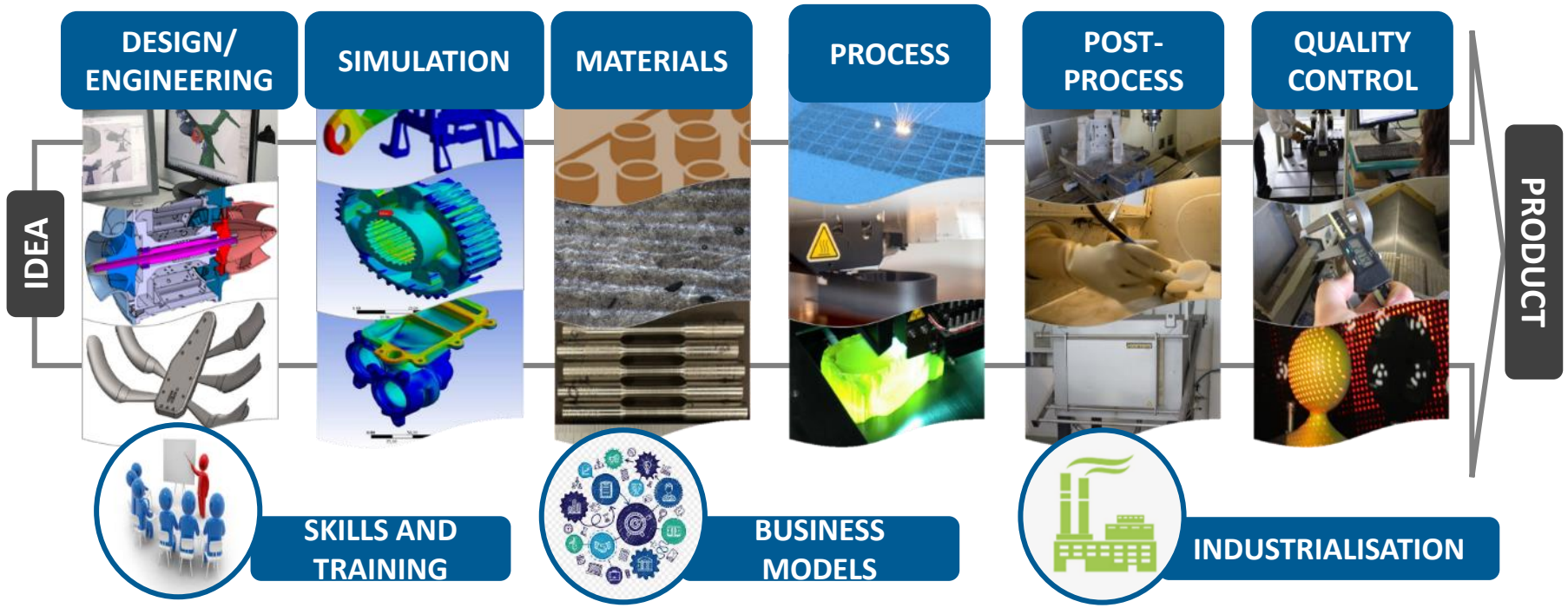


IDONIAL
CENTRO TECNOLÓGICO

SPEEDTECH-FORUMS
17th March 2023 – Leioa, Spain

IDONIAL IN ADDITIVE MANUFACTURING

Covering the whole AM process chain:

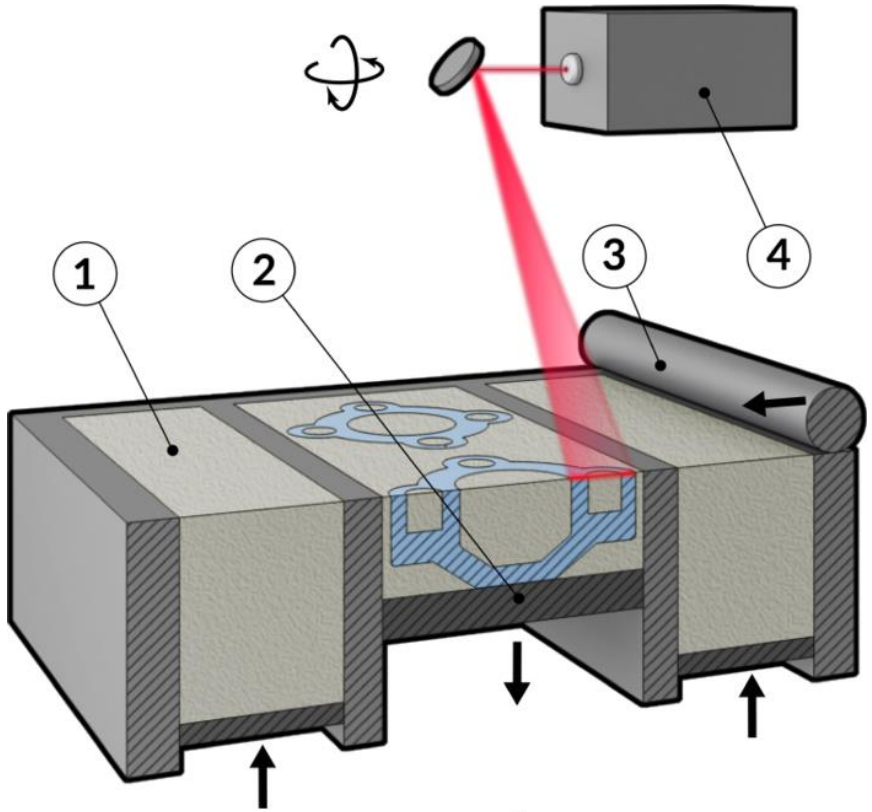


IDONIAL
CENTRO TECNOLÓGICO

SPEEDTECH-FORUMS
17th March 2023 – Leioa, Spain

L-PBF technology

AM technology, laser-based for the processing of raw materials in powder (steel alloys, aluminium, titanium, etc.)



MANUFACTURINGGUIDE

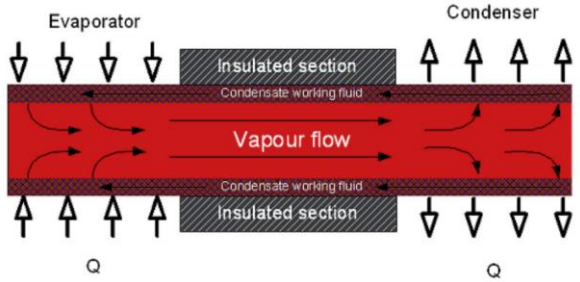
ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

- ***PRODUCTION OF HEAT PIPES FOR ENERGY APPLICATIONS***
- ***PRODUCTION OF AUXETIC STRUCTURES FOR DEFENCE APPLICATIONS***

ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

➢ *PRODUCTION OF HEAT PIPES FOR ENERGY APPLICATIONS*

Heat pipes are passive thermal exchange devices very common in advanced applications due to their high efficiency. A heat pipe is a structure with high thermal conductivity that enables the transportation of heat whilst maintaining almost uniform temperature along its heated and cooled sections.



madridspace

Relevant application of these devices can be found in many sectors:

- For low temperature applications: Pharmaceutical, food processing, biotechnology, chemical and medical industries, mainly for preserving purposes.

- For high temperature applications: Solar, nuclear, Aerospace. Interesting because of their high thermal conductivity and isothermal behaviour.

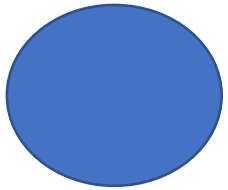
IDONIAL CENTRO TECNOLÓGICO

SPEEDTECH-FORUMS 17th March 2023 – Leioa, Spain

ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

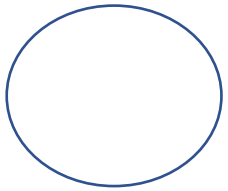
➢ *PRODUCTION OF HEAT PIPES FOR ENERGY APPLICATIONS*

Porosity is something intrinsic to LPBF process. Pores are discontinuities within the material structure and are considered a defect which compromises part's integrity in terms of mechanical performance.



There are two main sources for porosities in L-PBF printed parts:

- Low packing density of the print material: mainly due to raw material shape and size.



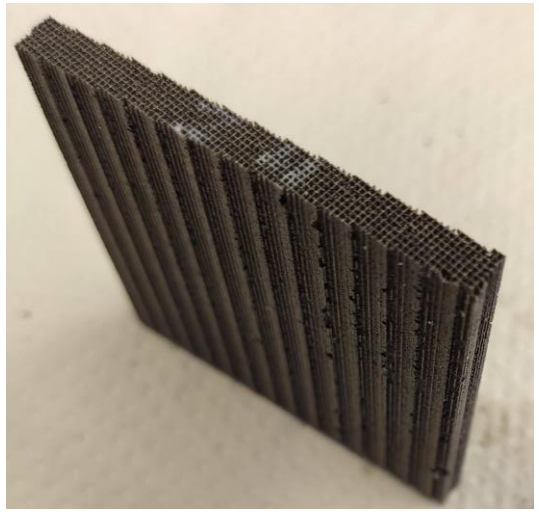
- Trapping of gas particles during the fusion and rapid cooling process: the high energy used in the process favours solubility of the gas inside the molten metal.

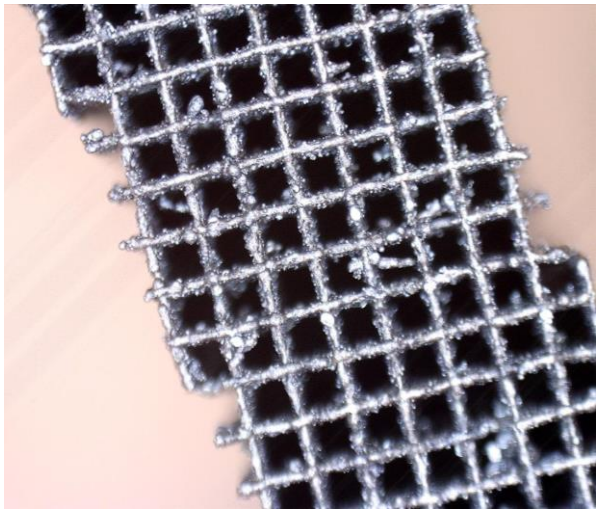
ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

➢ *PRODUCTION OF HEAT PIPES FOR ENERGY APPLICATIONS*

The goal of the development is to intentionally incorporate controlled grades of porosities (and potentially, gradients if the equipment allows to) within printed part, WITHOUT influence of design stage.

This is a way of incorporating internal structures “via process” as opposed to the design route, which is faster and features much less computational cost.





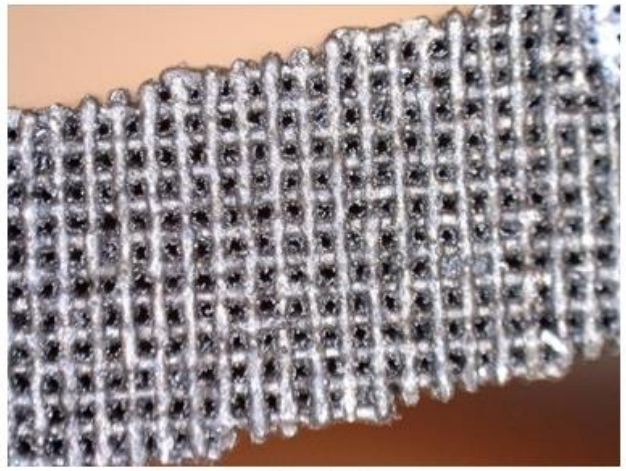
ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

➢ *PRODUCTION OF HEAT PIPES FOR ENERGY APPLICATIONS*

Different kinds of porosity design or void structures are explored, depending on the process operative parameters to be tuned.

The kind of parameter produces a different type of internal structure:

Sintered



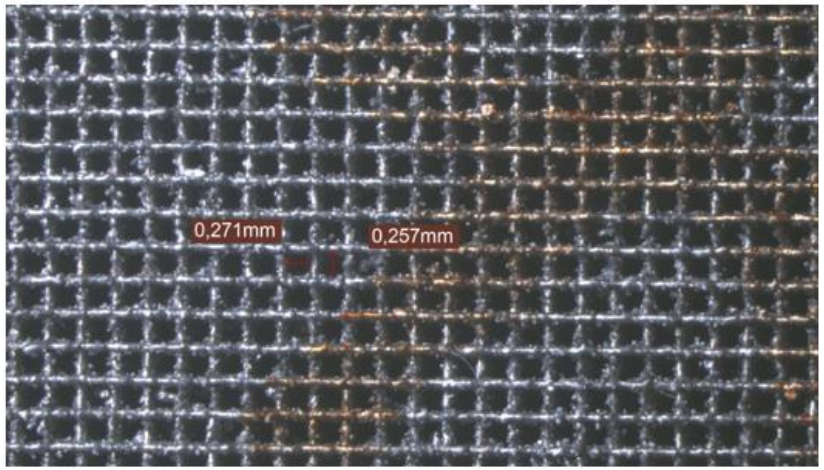
Reticular

Laminar

ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

➢ *PRODUCTION OF HEAT PIPES FOR ENERGY APPLICATIONS*

Perform geometric and dimensional validation by microscopy analysis and mechanical validation by standard test parts with the structure embedded.



Microscopy validation of the lattice cell size

Mechanical test bar

Issues troubleshooting/next steps:

- Solving issues with trapped loose powder inside the structure.
- Aiming towards implementation on actual components
- Bring the development to other niches of application (light weight structures is the most obvious, pending mechanical properties results analysis)

IDONIAL
CENTRO TECNOLÓGICO

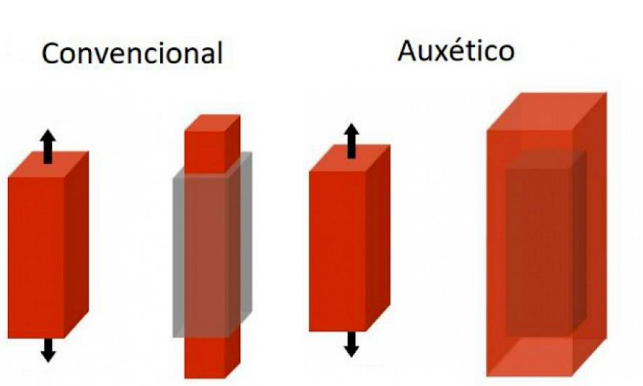
SPEEDTECH-FORUMS
17th March 2023 – Leioa, Spain

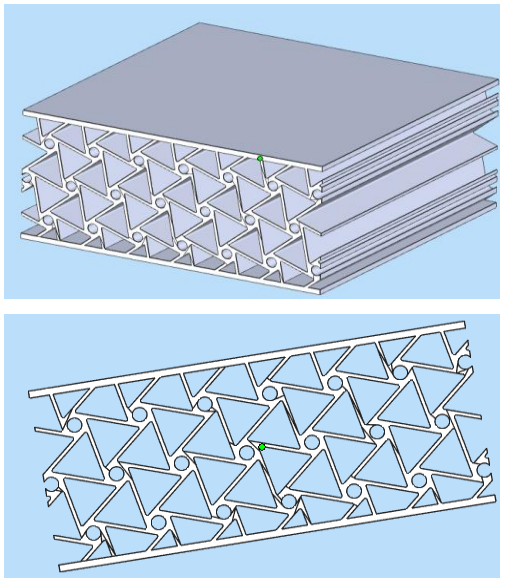
ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

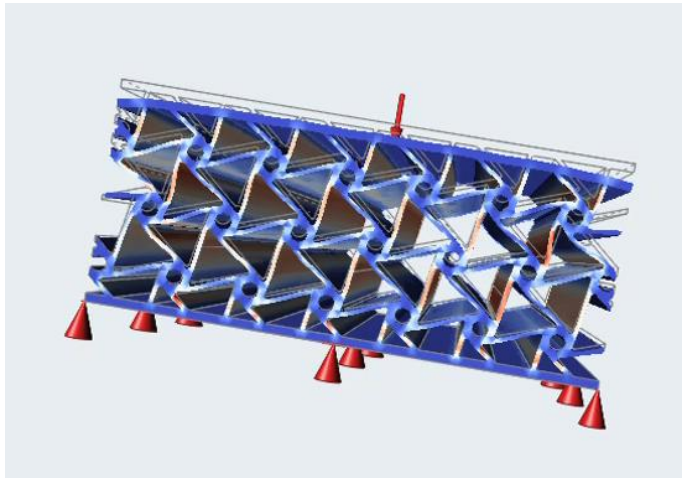
➢ *PRODUCTION OF AUXETIC STRUCTURES FOR DEFENCE APPLICATIONS*

Results shown belong to project ***"IMPACT"*** in national COINCIDENTE call, coordinated by IDONIAL and managed by General subdivision of Planification, technology and Innovation (SDG PLATIN). Ministry of defence is co proprietary of the project results.

WHAT IS AUXETIC MATERIAL??







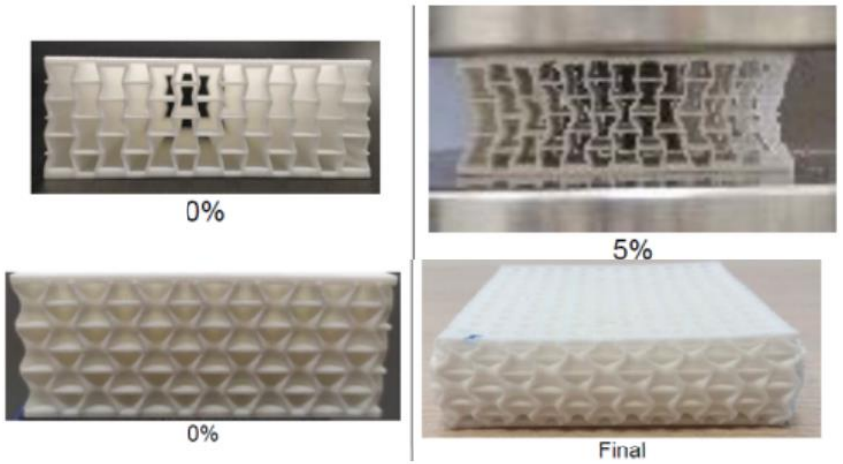
IDONIAL
CENTRO TECNOLÓGICO

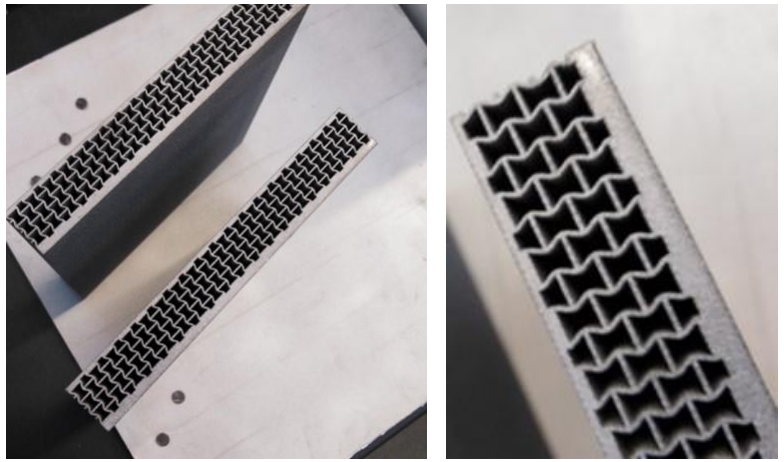
SPEEDTECH-FORUMS
17th March 2023 – Leioa, Spain

ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

➢ *PRODUCTION OF AUXETIC STRUCTURES FOR DEFENCE APPLICATIONS*

Empirical testing of auxetic structures designs (material PA made by SLS)



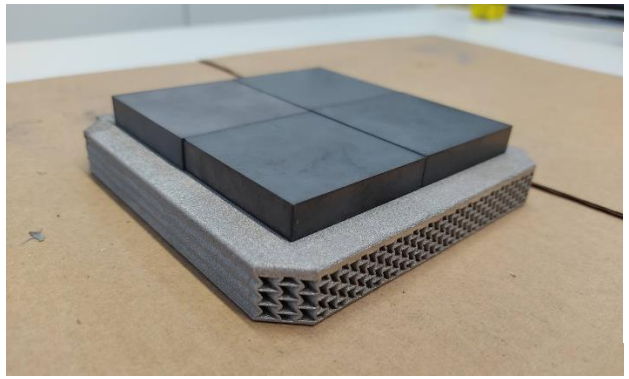


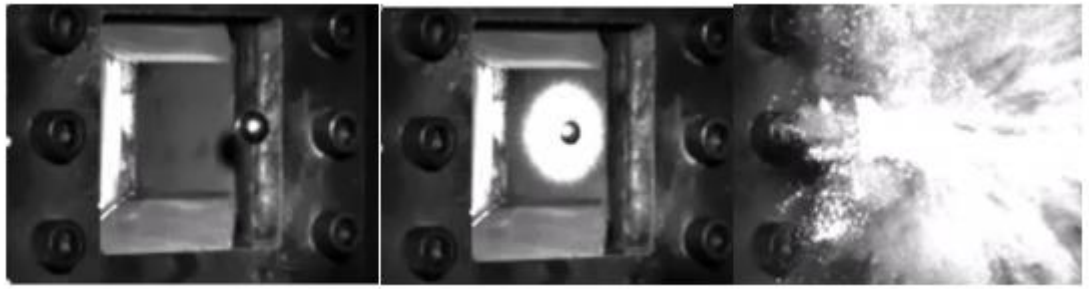
Those which showed appropriate performance in mechanical testing were printed by L-PBF in aluminium and titanium (weight constrain)

ADVANCED APPLICATIONS OF L-PBF TECHNOLOGY:

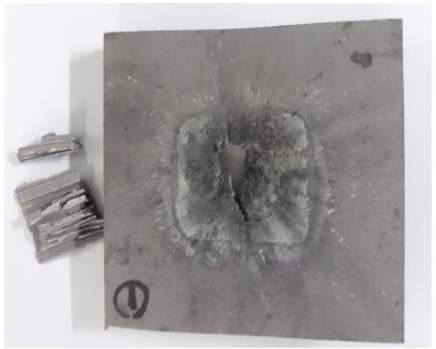
➢ *PRODUCTION OF AUXETIC STRUCTURES FOR DEFENCE APPLICATIONS*

Functional testing: human armour system was assembled with the novel L-PBF printed plate and the ceramic shell (carbon nitride)





The system was tested, firstly with steel bearings under controlled lab conditions, and with real ammunition:



IDONIAL
CENTRO TECNOLÓGICO

SPEEDTECH-FORUMS
17th March 2023 – Leioa, Spain

ADVANCED STRUCTURES BY L-PBF TECHNOLOGY FOR ENHANCED APPLICATIONS

THANKS FOR YOUR ATTENTION!

MULTI-FUN