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DISCO2030 1ST PRESS RELEASE

DISCO2030 | COMBINING DISSIMILAR MATERIALS INTO FUNCTIONAL LARGE-SCALE AND LIGHT-WEIGHT COMPONENTS AND STRUCTURES

CHALLENGES TO ADDRESS

The main motivation for scientists and industries around the globe to join multiple materials, including dissimilar materials, is achieving multi-functionality.

The multi-functionality requirements of modern devices keep challenging researchers and industrial designers every day, often creating dilemmas of conflicting objectives. For example, modern aerospace engines are multi-material devices, as they need to fulfil the function of being able to operate in harsh environments, and at the same time should be light enough to not negatively impact a plane's/spacecraft's payload.

State-of-the-art multi-material joining techniques such as brazing, solid-state welding or mechanical joining, force industrial designers to accept the process limitation of firstly machining the respective components (made of different materials), followed by joining with the respective technique in a second step.

This process limitation leads to suboptimal results, as it significantly reduces the design freedom of multi-material devices and creates "dead spaces" in areas where two dissimilar materials are joined, thus negatively impacting the part's weight. It also does not offer a viable pathway towards achieving the "holy grail" of materials science – the so called "graded" materials. The latter are materials in which the composition changes continuously over the volume, resulting in locally optimized material properties to fulfil specific functions.

An emerging alternative to remedy the above-mentioned limitations and provide a viable pathway towards graded materials is additive manufacturing (AM). AM offers a radically different approach to manufacturing by gradually depositing, joining, or solidifying materials to create 3-dimensional objects.

Thanks to the high design freedom offered by current AM technologies a "form follows function" approach is made possible.

However, in this area, AM is still in its infancy compared to material joining. Whilst first successes have been demonstrated at lab scale, AM is not yet able to offer reliable dissimilar material joining solutions that are mature enough to be widely taken up by the industry.

Two important "families" of AM technologies have emerged in recent years: Powder-bed fusion (PBF) and Direct Energy Deposition (DED). PBF is a promising AM technology for printing highly complex geometry parts and components with comparatively high accuracy. Its main drawback are the limited dimensions of parts that can be manufactured. DED is a very versatile technology, capable of processing metals or polymers in the form of powder or wire as feedstock.

The big advantage of DED is the technical possibility of in-situ joining of multi-materials. Its main disadvantage is the lower design freedom and lower accuracy compared to PBF. Both technology families will be further developed in the DISCO2030 project to make dissimilar material components with a "form and property follow function" approach a reality.

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AIM AND PROJECT OBJECTIVES

The overall aim of the project is to develop and demonstrate (TRL 6) two first-of-a-kind hybrid manufacturing methods for joining dissimilar metal-metal and metal-polymer materials, to manufacture lightweight, complex-geometry multifunctional devices that are at the same time able to operate in harsh environments - rocket engines, marine engines, and hydrogen fuel tanks.

For the metal-metal domain, the DISCO2030 project will develop a hybrid manufacturing method based on a combination of PBF and powder-directed energy deposition with either laser beam or plasma arc as energy source (P-DED/LB, P-DED/PA).

For the metal-polymer domain, the DISCO2030 project will develop a hybrid manufacturing method based on the combination of PBF, wire-directed energy deposition (W-DED) and polymer-directed energy deposition (POL-DED).

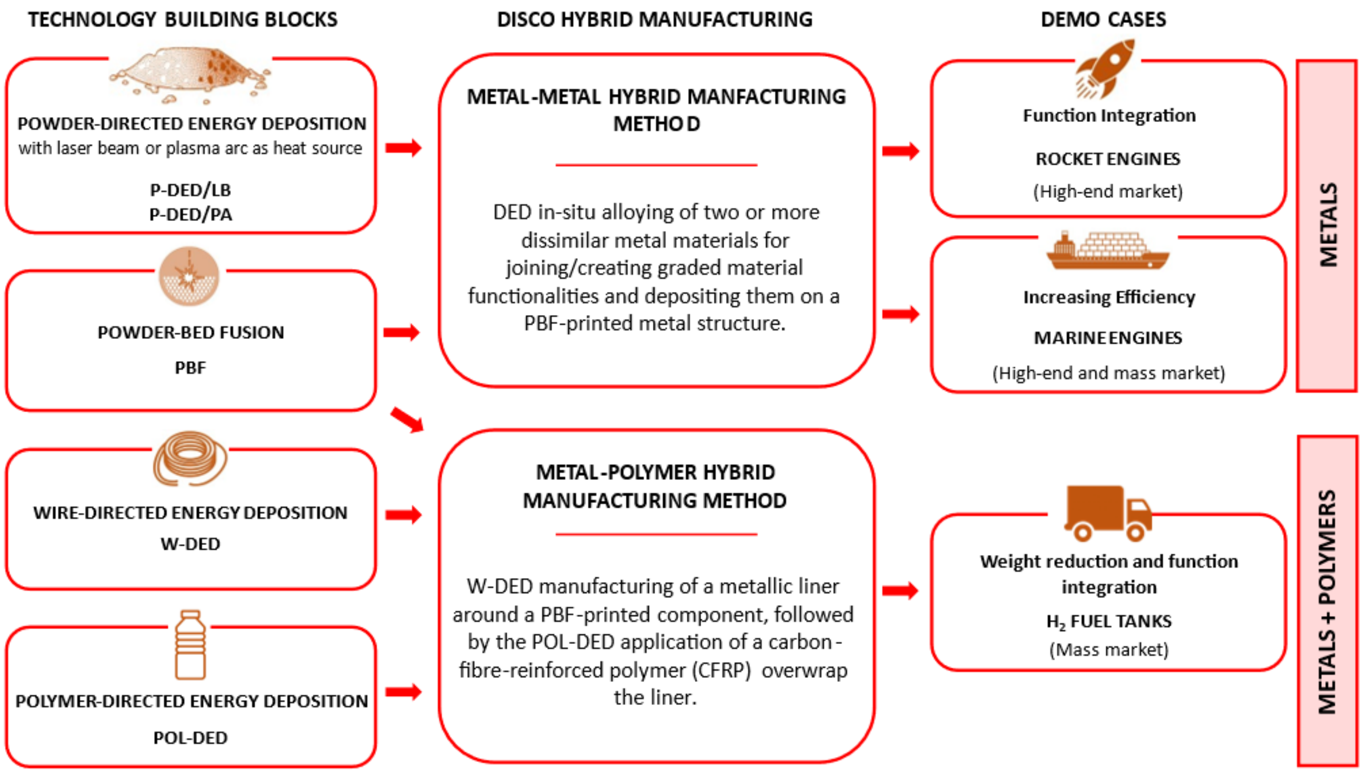

Figure 1 - DISCO2030 Project at a glance

The underlying vision is that within 5 to 8 years the novel combination of AM techniques developed in the DISCO2030 project will become a recognized and widely used manufacturing standard in various industries, replacing traditional methods such as die casting and mechanical assembly of multiple parts, making the EU's manufacturing sector more sustainable and efficient, but also increase its resilience by making it less reliant on non-EU supply chains.