FLASH

Flexible Laser-Based Manufacturing

NEWSLETTER #4 December 2025

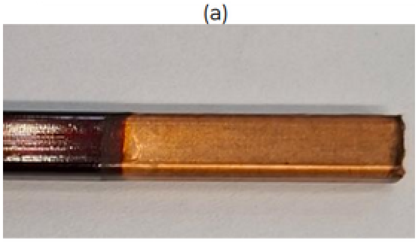
Experimental laser process development

The **FLASH laser system** integrates three laser sources and three beam delivery methods into a single machine platform. Potentially offering exceptional flexibility and cost reductions in accomplishing laser machining, joining, and surfacing processes. During the initial **experimental laser process development phase** of the FLASH project, the **Manufacturing Technology Centre (MTC), UK**, have collaborated with the project end-users to develop the fundamentals of numerous discrete laser manufacturing processes necessary to demonstrate and validate the FLASH system against ambitious end-user's targets in the latter stages of the project.

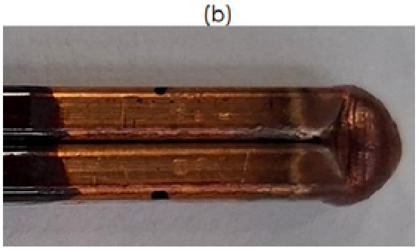
Motor hairpin joint preparation and joining

IMA Automation ATOP, Italy, who have a long history of using lasers in its assembly systems, aims to deploy laser cutting, cleaning and joining processes for the preparation and manufacture of copper hairpins for motor assemblies. The FLASH project team have developed discrete laser processes that embody the multi-laser, multi-delivery capability of the intended FLASH system in cutting, stripping, cleaning and joining copper hairpin joints. The wire ends can then be cleaned with short-pulsed lasers to remove any residual insulating material and contaminants before welding.

(a)



(b)



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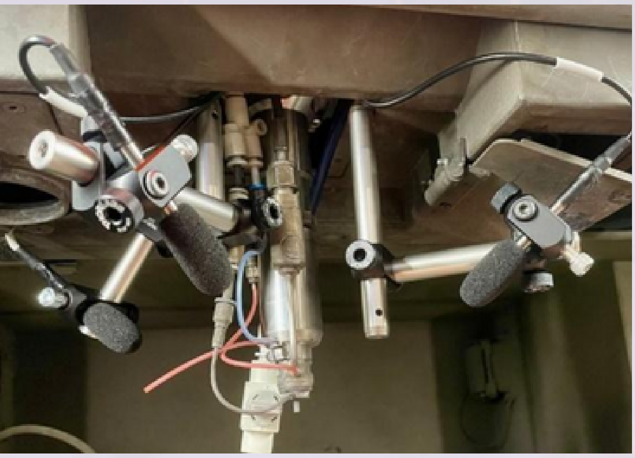

Process Monitoring

This phase of the project aims to advance the **state-of-the-art (SOTA)** in laser process monitoring by expanding the range of processes addressed within the FLASH project. The **SOTA** will be pushed further by introducing an automated control step that evaluates whether the process is running correctly and determines if any corrective actions are needed. This improvement is enabled through sensor fusion of optical and acoustic signals.

Acoustic monitoring in laser processing is currently widespread, but it remains unreliable due to the complexity of the acoustic emissions generated during lasermaterial interaction. Signal quality is also highly dependent on sensor placement.

Optical monitoring, by contrast, is well-established for conventional laser processes such as welding and surface texturing. For **waterjet-guided laser (WJGL)** processing, **Synova** has developed a patented monitoring system capable of automatic breakthrough detection based on plasma intensity

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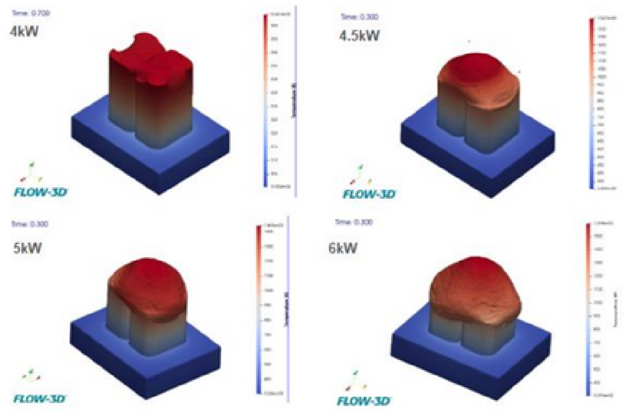
Modelling and simulation

Within the **MTC**, a key group alongside those from Laser processing is the modelling and simulation team. In FLASH, we are building capability by simulating the three laser processes occurring within the combined head, with an objective of integrating design models based on these that reduce the time and cost of new product development compared to typical design cycles by at least half.

These models are laser welding with a case study on hairpin welding with an 8 kW continuous wave laser, laser drilling with a 20-kW millisecond pulsed laser and laser processing with a 400 W nanosecond Water jet guided laser. By simulating these processes, we can estimate the topology (the shape) of each workpiece as it is processed with specific machine settings. After validation against an equivalent physical experiment, this provides data to **COSMOS Thrace** describing the input-output sensitivity of the laser processing.



Laser Welding

Laser welding is one of the most advanced joining techniques in modern manufacturing, but it's also one of the most complex. We are using high-fidelity modelling to understand this process and make it more predictable. This in turn supports industry cut development time and reduce waste.

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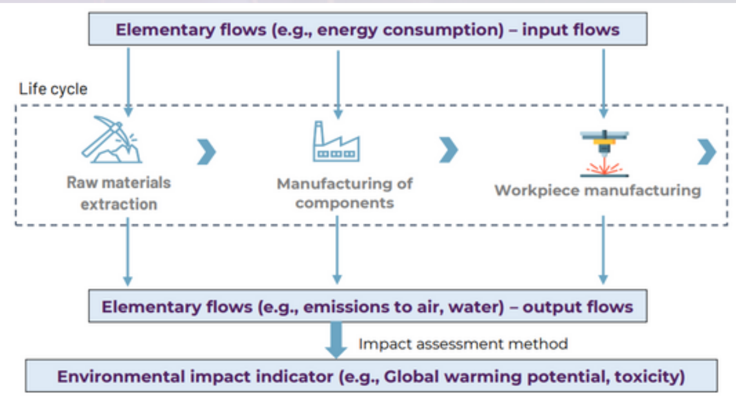

Environmental impacts of the FLASH laser system

One of the key objectives of the FLASH project is to replace conventional mechanical and chemical manufacturing processes, reducing energy consumption, material waste, and reliance on consumables.

As part of these goals, **3DRIVERS**' challenge is to assess the environmental benefits of the FLASH system, when compared to conventional manufacturing practices. To do that, 3DRIVERS is applying Life Cycle Assessment.

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Partners

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Co-funded by the European Union

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