PRESS RELEASE

A new dimension: Makino and Fraunhofer ILT expand the possibilities of Additive Manufacturing

From laser material deposition to Additive Manufacturing: A research project has the potential to revolutionize material processing with EHLA3D

Makino and the Fraunhofer Institute for Laser Technology ILT are using EHLA and EHLA3D to redefine the boundaries of Additive Manufacturing. By integrating EHLA3D into a five-axis CNC platform, they have developed a process that can efficiently produce, coat or repair complex geometries with high-strength materials. Result of the collaboration: shorter production times and extended component life in critical industries, while laying the foundations for future innovation in the circular economy.

Laser technology plays a central role in manufacturing sector, especially in the field of Additive Manufacturing. In this context, the Fraunhofer Institute for Laser Technology ILT and Makino, a globally recognized manufacturer of machine tools headquartered in Japan, ventured an exciting technological advance: they wanted to transfer the extreme high-speed laser cladding EHLA to a five-axis CNC platform. To do this, however, kinematics had to be developed to enable fast and dynamic movement of the machining head for the EHLA process.

This would allow a wide range of geometrical shapes to be flexibly processed and components could be coated with an enormous range of materials. Initially, the project partners only thought about Additive Manufacturing, but the topic of repairs soon came up: "Repairs are extremely exciting," explains Min-Uh Ko, Group Leader for Additive Manufacturing and Repair LMD at Fraunhofer ILT. "Many expensive components have to be replaced, even for minor defects. A flexible system like the one from Makino with a rotary and tilting table actually offers good repair options, which saves costs for new production, avoids transport and delivery times and minimizes downtimes. Furthermore, the topic of repair is the basic prerequisite for a future circular economy."

Makino's task in the project was not only limited to the CNC hardware, but also to the process control, as this had to be completely redesigned. The challenge was to technically adapt the machine to high accelerations and to optimize the process control and machine kinematics in order to precisely control the interaction between the laser beam and the material.

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The machine tool developed by the Makino subsidiary in Singapore achieves an effective feed speed of up to 30 meters per minute, which is a significant increase compared to conventional systems. This speed is especially advantageous when machining large and complex components, as it significantly reduces production time. The technical improvements lead to a consistently high quality of the end products and improved efficiency of the production process, which is particularly important for high-quality components in the aerospace and toolmaking industries.

Makino's project manager Dr. Johannes Finger: "Makino is known worldwide for its high-precision CNC systems. The move into Additive Manufacturing, especially high-speed LMD, represents a strategic expansion of the Makino portfolio. The jointly developed five-axis CNC machine now enables us to quickly and precisely produce complex geometrical shapes with materials that are difficult to weld, such as high-strength steels or carbide. That is unique."

Joint optimization increases efficiency and precision

Fraunhofer ILT contributed its extensive expertise in the field of laser-based manufacturing processes and brought its comprehensive infrastructure and specialized laboratory facilities to the project. Thanks to its decades of experience in process and component development for LMD, the institute made a decisive contribution to optimizing the process parameters for processing various materials and ultimately transferring the new technology to the industrial pilot customer toolcraft AG. This included adjusting the laser parameters, fine-tuning the powder feed and optimizing the motion control of the CNC machine.

"Optimizing the heat input is a critical aspect of the EHLA3D process," explains renowned materials expert Min-Uh Ko. "The feed rate and powder gas jet play a crucial role in controlling the heat that is introduced into the material. By adjusting the feed rate and powder mass flows, we can precisely control the heat input, reduce the heat-affected zone and ensure uniform coating quality."

According to Johannes Finger, the high build-up rate is a significant advance. "By using high feed rates and an optimized powder feed, we can achieve a considerably improved efficiency of the material application at the same or even higher precision. The build-up rate with HS-LMD can thus be significantly increased, which enhances the overall efficiency of the production process."

Repair and coating of high-performance components

The repair and maintenance of high-quality tool and machine parts exposed to high loads during regular operation was one of the project objectives. The partners were able to achieve this with the adapted EHLA3D technology. In addition, the EHLA3D technology was successfully used to coat wear parts, which significantly improves the service life of these components. As it can now apply wear-resistant coatings precisely and efficiently, EHLA3D has become a cost-effective solution for extending the service life of components in various sectors, including mining and heavy industry.

The fact that Makino was able to implement the results so quickly in the new AML 500 processing machine shows, on the one hand, how flexible the machine manufacturer's CNC systems are. On the other, the practical applications also show that the EHLA3D technology is not just a theoretical concept, but an advanced, robust and industrially applicable technology that offers significant advantages in terms of cost, efficiency and performance. The collaboration between the industrial customer and Fraunhofer ILT has, thus, led to tangible improvements in manufacturing technology that go far beyond the laboratory environment.

A key aspect of future developments will be to identify and validate new areas of application for the EHLA3D process. Since the material systems that can be processed have become so flexible, this extended EHLA process can now be transferred to applications that could not normally be investigated since the LMD process has such limitations. This applies in particular to applications with multi-material systems and the printing of fine structures.

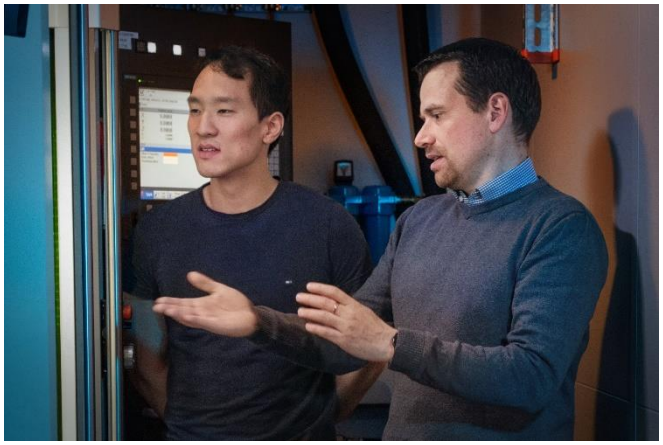

Image 1:
Min-Uh Ko from the Fraunhofer Institute for Laser Technology ILT (left) and Dr. Johannes Finger from Makino (right) lead the research cooperation in which the extreme high-speed laser material deposition EHLA was transferred to a five-axis CNC platform.
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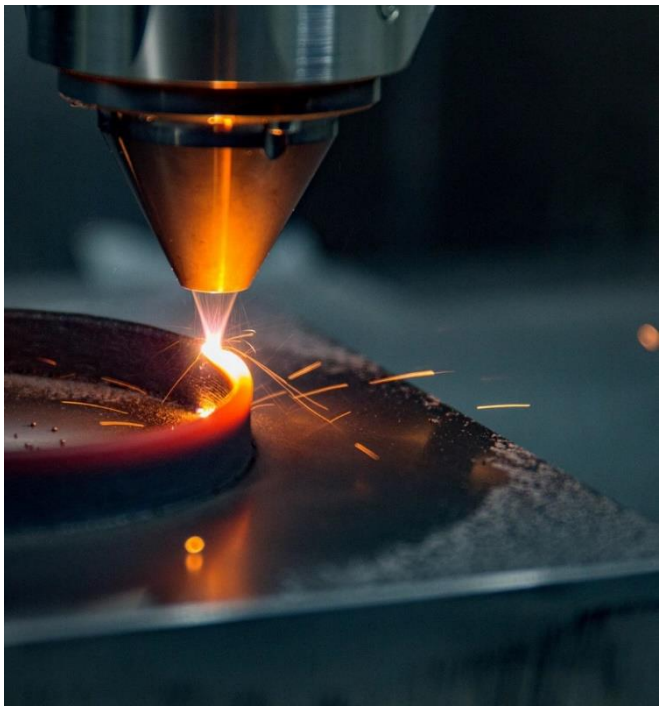

Image 2:
The new production process with EHLA3D technology makes it possible to efficiently produce, coat or repair complex geometries with high-strength materials.
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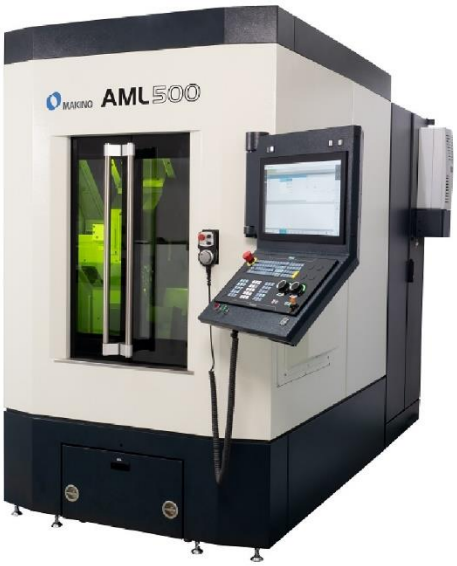

Image 3: .
Makino has implemented the joint project results in the new AML 500 processing machine. The flexible machine tool achieves an effective feed rate of up to 30 meters per minute.
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