PRESS RELEASE

Precise, smart, highly productive: Innovations for additive manufacturing from Fraunhofer ILT

Fraunhofer ILT at Formnext 2025 – from robust tungsten parts to intelligent sensor components

For more than 30 years, the Fraunhofer Institute for Laser Technology ILT has been shaping metallic additive manufacturing with groundbreaking system and process innovations. At Formnext from November 18 - 21, 2025, the laser institute will be presenting its comprehensive portfolio in Hall 11, Booth D31: developments that are geared toward key industry challenges. They reduce costs, save rework, and make components more robust. From high-strength tungsten components and multi-material approaches for extremely stressed components in fusion applications to highly productive simultaneous coating and finishing processes that save time and energy, to smart structures such as printed sensors that make metal components smart.

"Whether we develop a demonstrator or a production series, we focus our R&D at Fraunhofer ILT on making processes faster, more robust and ensuring high component quality," explains Dr. Tim Lantzsch, head of the Laser Powder Bed Fusion (LPBF) department at Fraunhofer ILT.
The exhibits at Formnext 2025 illustrate this approach along the entire process chain: an Al-Sc manifold housing for fuel cells, an LPBF-manufactured optical carrier for satellites, a 2 kW LCoS test setup for freely formable beam profiles, and LPBF structures with adjustable porosity.
In selective laser sintering (SLS), the institute focuses on developing processes for new materials. The flexible laboratory facilities at Fraunhofer ILT can already process even the smallest quantities of powder, for example, very soft thermoplastic polyurethanes (TPU) and shape memory polymers. It aims to control properties selectively and determine robust parameters for new applications and series production.
"We think about additive manufacturing from the perspective of component function, combining material, process, and data, reducing costs per part, and increasing quality and availability. We see ourselves as problem solvers and process developers, from the initial idea to stable production at our industrial partners," Lantzsch continues.

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Tungsten components for fusion energy

Plasma-exposed components in fusion reactors, such as the reinforcement of the reactor wall, must withstand cyclic heat loads of up to around 20 MW/m² and high radiation. Pure tungsten is practically the only material suitable for these extreme conditions. However, the material can only be made in simple geometrical shapes, which then must be joined in a complex manner. Different thermal expansion causes soldered joints to fail under thermal cycles, reducing service life and plant availability. This is where the DURABLE project comes in: Additive processes enable industry to manufacture monolithic or multi-material components of tungsten and copper alloy with a continuous heat path instead of a critical joint zone. Process control is crucial: New system technology and parameter windows in PBF-LB/M lead to virtually crack-free, high-density tungsten structures. This makes it possible to manufacture complex geometrical shapes with conformal cooling.
"The benefits lie in longer component life, less rework, and lower risk at joining points, which is a prerequisite for extending maintenance intervals and reducing costs per operating hour," says Niklas Prätzsch, group manager LPBF – Process & Systems Engineering at Fraunhofer ILT.

Optimizing surfaces in a single step

Viktor Glushych, group manager Coating LMD and Heat Treatment at Fraunhofer ILT, is pursuing a new groundbreaking approach for extreme high-speed laser cladding (EHLA). The process coats quickly and conserves resources, but in most cases, surfaces need to be post-machined. Simultaneous coating and roller burnishing (SCaRB) combines EHLA with roller burnishing in a single process step. While the applied layer is still warm, a roller tool runs over the resulting surface, plastically compacting it and smoothing out roughness peaks. This creates a dense, pressure-saturated surface layer with high surface quality and without needing ablation or any additional setup.
"This saves time, tools, and material," says Glushych, explaining the advantages. "At the same time, SCaRB can specifically influence the microstructure and internal stresses. This improves the wear and corrosion resistance and increases the fatigue strength of coated components." At Formnext, Fraunhofer ILT will be presenting an EHLA rolling demonstrator that allows visitors to comprehend how the combined process control works live.

PFAS-free multi-material coatings

In addition to pure metal layers, multi-layer coatings made of different materials can also be applied. Here, the EHLA process for metal layers is combined with the application of a PEEK layer to produce functional composite layers. PEEK is a fluorine-free high-performance polymer and an attractive alternative to PFAS coatings. "The innovation lies in using the residual heat from the EHLA process to melt a deposited PEEK layer in the immediately following step. A nozzle technology developed at Fraunhofer ILT is used for this purpose, which enables homogeneous application. This hybrid coating system combines the properties of two individually adjustable functional layers," explains Rebar Hama-Saleh Abdullah, research associate at Fraunhofer ILT.

The metallic EHLA layer can be used as a corrosion protection layer (e.g., for pistons), as an emergency running layer (e.g., in wind turbines), or as a thermally conductive intermediate layer. Depending on the additives used, the PEEK layer applied on top serves as a non-stick layer, a sliding layer, or additional corrosion protection. “The adhesive strength between metal and polymer is achieved by clamping the plastic to the rough surface specifically created using the EHLA process,” explains Dr. Christian Vedder, Head of the Surface Technology and Ablation Department at Fraunhofer ILT.

Printed sensors, smart components

Additive manufacturing creates components layer by layer, thereby making areas accessible that cannot be reached from the outside. The approach of incorporating sensors directly into metal parts builds on this, such as printed strain gauges in LPBF components. The sensor layers are created using inkjet, aerosol jet, or pad printing; the sensors can be applied during or after assembly and positioned with precision. The smart components manufactured in this way provide real-time data on load, deformation, or incipient crack formation, for example.
"These sensors are located exactly where data is most useful, even in areas that would be inaccessible with conventional manufacturing," summarizes Dr. Samuel Moritz Fink, group manager Thin Film Processing at Fraunhofer ILT. "This enables us to monitor conditions during operation, do predictive maintenance, and provide greater operational reliability. At the same time, system complexity is reduced because separate superstructures, cables, or external measuring points are no longer necessary. Target industries range from aerospace and energy to mechanical engineering."

Problem solver and process developer

Key challenges for companies in metal AM include high unit costs, complex application development, and qualification and certification of processes for series production. This is exactly where Fraunhofer ILT comes in. It identifies bottlenecks, develops stable processes, and quickly brings applications into production, from the first functional prototype to robust manufacturing at the customer's site.

"New materials are the key to leveraging the particular strengths of SLS, namely maximum design freedom and freedom from support structures, in more and more industries. With our modified machines, we can efficiently qualify these materials and thus overcome the chicken-and-egg problem of industrial plants," explains Vera Rothmund from the Application Development group at Fraunhofer ILT.
"At Fraunhofer ILT, we see ourselves as a partner to industry: we develop customized processes and technologies to solve key challenges in metal 3D printing – from productivity and quality assurance to cost-effectiveness – together with companies," says Dr. Thomas Schopphoven, head of Laser Material Deposition Department at Fraunhofer ILT.

Visit us from November 18 to 21 in Frankfurt am Main at the joint Fraunhofer booth D31 in Hall 11 and learn more about the comprehensive portfolio of Fraunhofer ILT.

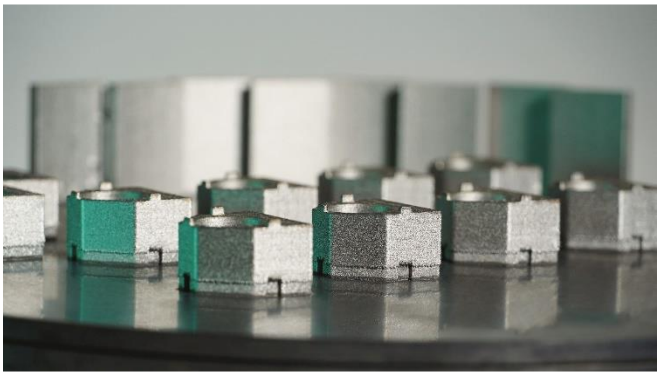

Image 1:
At Formnext 2025, Fraunhofer ILT will be demonstrating a W-CuCrZr divertor monoblock chain that illustrates the approach from powder to near-functional component.
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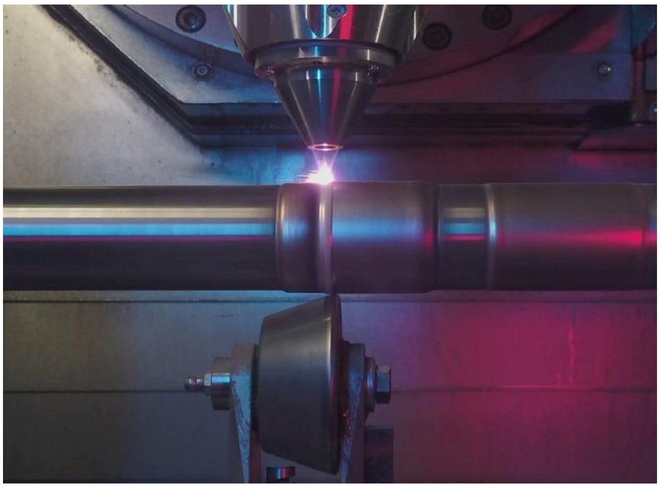

Image 2:
SCaRB combines EHLA with rolling in a single step. The result: coated components whose surfaces are significantly improved by plastic deformation during coating.
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Image 3:
A new laser combination process enables PFAS-free composite layers made of metal and the high-performance plastic PEEK for additional non-stick, anti-slip or anti-corrosion functions on metal components.
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Image 4a
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Image 4b:
How can components themselves be turned into sources of information? Fraunhofer ILT will demonstrate how strain gauges and other sensors can be integrated directly into metal components.
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Image 5:
SLS polymer parts: filigree lattices and functional samples for design, material, and process testing. Fraunhofer ILT's flexible lab systems support small powder batches and rapid material changeovers. The focus is on new materials such as very soft TPU and shape memory polymers.
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Since its founding as a nonprofit organization in 1949, Fraunhofer has held a unique position in the German research and innovation ecosystem. With nearly 32,000 employees across 75 institutes and legally independent research units in Germany, Fraunhofer operates with an annual budget of €3.6 billion, €3.1 billion of which is generated by contract research — Fraunhofer's core business model.