

Press Release

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From components that switch in milliseconds to those that think for themselves: Fraunhofer ILT presents new approaches to more cost-effective AM at Formnext

Faster, more porous, smarter: Fraunhofer ILT innovations for additive manufacturing

What if additive manufacturing could tailor make complex components for the hydrogen sector? How can powder flow be switched on and off as quickly as a light? How can a tool determine for itself how much load it is currently carrying? At Formnext in Frankfurt am Main from November 17 to 20, 2026, Fraunhofer ILT will be presenting three smart answers at the joint Fraunhofer booth D31 in Hall 11.0, solutions that make additive manufacturing considerably more cost-effective.

Whether a filter structure, powder switch or sensor: Functions that previously required a separate component, an external assembly or an additional manufacturing step are increasingly being integrated directly into the additive process or the manufactured structure. Fraunhofer Institute for Laser Technology ILT is consistently pursuing this form of integration.

"We look at additive manufacturing not only in terms of the component, but also of the entire process chain. Wherever our processes can eliminate an additional component, manufacturing step or maintenance task, that is where we focus our efforts," says Dr. Tim Lantzsch, head of Department Laser Powder Bed Fusion (LPBF) at Fraunhofer ILT. "Our goal is to make AM more cost-effective and more competitive. And we are succeeding!"

Powder on, powder off: switching in milliseconds

Metal powder is one of the biggest cost drivers in laser material deposition (LMD). Until now, a significant share passes through the system unused, for example, when the laser briefly pauses while following a complex toolpath, but the powder continues to flow. The result is not only costly powder loss, contamination of components and handling systems, but also risks to equipment and occupational safety.

Existing solutions switch the powder flow mechanically, take more than a second and subject moving parts to wear. That is too slow and too costly for highly dynamic LMD and EHLA processes that require frequent, brief switching.

The Fluidic Powder Switch developed at Fraunhofer ILT instead switches the powder flow directly at the nozzle, where the powder enters the process. It works on the Venturi principle: A

control-gas flow creates negative pressure at a cross-section constriction, drawing the powder into a collection container rather than directing it into the process zone. Since there are no mechanically moving parts in the powder path, the patented system operates with virtually no wear and requires almost no maintenance. In addition to simply switching the powder on and off, it can switch between several materials and adjust the powder mass flow in stages.

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The economic benefit is substantial: Compared with mechanical systems, switching time is reduced by more than one order of magnitude. At the same time, the operating cost of the control gas is more than three orders of magnitude lower than the cost of the powder saved.

“Every gram of powder that does not pass through the system unused saves money, protects the component and conserves resources,” explains Viktor Glushych, group leader of LMD Coating and Heat Treatment at Fraunhofer ILT. Glushych played a key role in developing the innovative Fluidic Powder Switch. “We are particularly pleased that the switch not only works in the lab, but is already being used in series production by our first customers. That was exactly what we set out to achieve: a robust, cost-effective solution suitable for industrial use.”

Tailored porous structures

To create permeability in metal components, manufacturers have generally relied on separately produced metal foams, meshes or sintered filters that must subsequently be joined to the component. This takes time, restricts design freedom and increases thermal and electrical resistance at every joint.

Researchers at Fraunhofer ILT use laser powder bed fusion (PBF-LB/M) to create controlled porosity rather than avoid it. Dense and permeable zones can be produced in a single monolithic component, with either sharp or gradual transitions and without needing any post-processing.

In LPBFCells, a project funded by the German Federal Ministry for Economic Affairs and Energy (BMWE), Fraunhofer ILT is using this approach to produce the porous transport layer (PTL) of an electrolyzer cell as a single component rather than from stacked sintered layers. The result is lower contact resistance, an integrated flow field and support structure, and much faster iteration of new cell geometries. At Formnext 2026, Fraunhofer ILT will be demonstrating the technology with an electrolyzer cell featuring a graded PTL made of pure titanium.

“By treating porosity as a design feature, we can tailor dense and permeable structures specifically to the component’s function,” says Alexander Neuke, research associate at Fraunhofer ILT. “This is particularly interesting for hydrogen applications such as electrolyzers and fuel cells, where different levels of porosity are needed across the component thickness. But I also see considerable potential for filters and turbomachinery.”

Components that tell their own story

Additive manufacturing builds components layer by layer, providing access to areas that can no longer be reached once a component is complete. Dr. Samuel Fink, group manager of Thin Film Processing at Fraunhofer ILT, takes advantage of this by integrating sensors directly into LPBF components, including printed strain gauges. The sensor layers are applied by inkjet, aerosol jet or pad printing and can be deposited during or after the build and positioned

precisely where needed. The resulting smart components can provide real-time data on loads, deformation or the onset of cracking, for example.

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At Formnext, the institute will be demonstrating the approach with a functional prototype: a wrench with an integrated, in-situ printed strain gauge. Under load, the embedded sensor provides real-time data on deformation and stress distribution directly within the component, while remaining protected from mechanical abrasion and thermal loads. This enables condition monitoring, predictive maintenance and greater operational safety in critical applications. At the same time, eliminating external wiring and measurement points reduces system complexity.

“Everyone is looking for additive sensor solutions, but robust, efficient processes and suitable materials are still lacking,” explains Samuel Fink. “With the Smart Wrench, we are showing what is already possible: The sensors provide data exactly where it matters most, inside the component. This is an important step toward additive sensor solutions that are genuinely ready for series production.”

Info on Formnext

Visit the Fraunhofer ILT team at Formnext in Frankfurt am Main from November 17 to 20, 2026, at the joint Fraunhofer booth D31 in Hall 11.0, and discover these and other smart solutions for additive manufacturing.

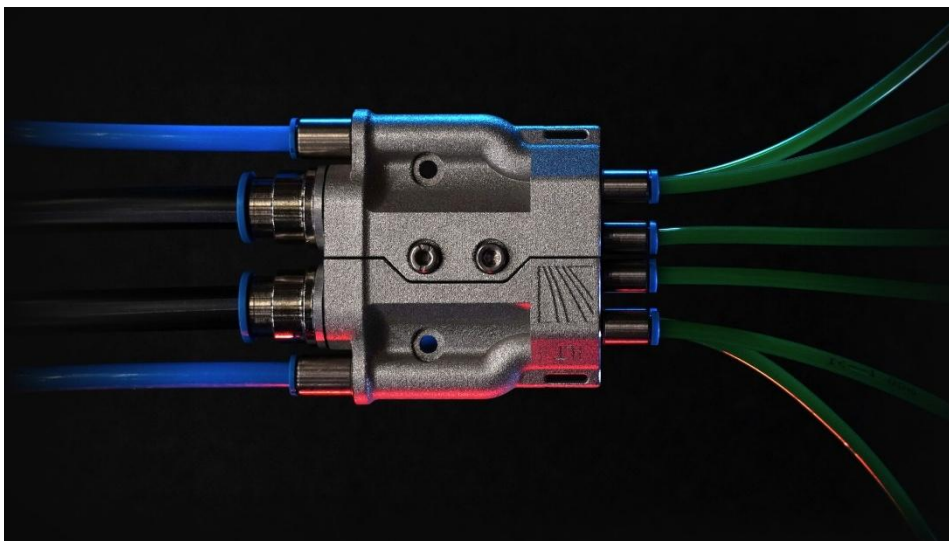


Figure 1:
The Fluidic Powder Switch developed at Fraunhofer ILT stops the powder flow directly at the nozzle within milliseconds, without wear or moving parts.
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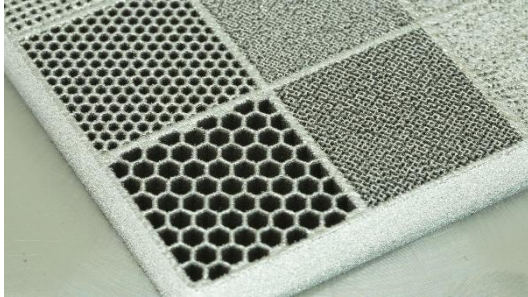


Figure 2:

As a demonstrator, Fraunhofer ILT is presenting an electrolyzer cell with a graded porous transport layer made of pure titanium and produced using PBF-LB/M.

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Figure 3:

Integrated strain gauge in an additively manufactured wrench: The in-situ printed sensor measures deformation and stress directly in the component.

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