

## PRESS RELEASE

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### **Innovative materials increase sustainability in the factory**

#### **Metal foam and PFAS substitution improve ecological footprint**

**Frankfurt am Main, 8. April 2025.** – This piece of metal is so light and airy that it even floats in milk. We are talking about metal foam. The innovative material is made of up to 90 per cent air and has amazing properties. In the factory it ensures greater sustainability and helps to improve the ecological footprint in industrial production.

Due to increasing regulatory requirements, production technology providers all over the world are confronted with the challenge of integrating efficient and environmentally friendly materials. The solutions already available can be seen at EMO Hanover 2025, the world's leading trade fair for production technology, which takes place from 22 to 26 September. The main focus is on metal foams and substitutes for per- and polyfluoroalkyl substances (PFAS).

Metal foams help to make machines more efficient, lighter and, at the same time, more stable. Similar to its natural role models bone or wood, the highly porous

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material has a cellular structure, which can absorb energy in the form of oscillations, impact or sound.

### **Like baking bread**

Aluminum foam can be manufactured in a process that in principle is similar to baking bread. Take some powder, a blowing agent and heat, and the finished product is aluminum foam. However, the manufacture of the high-tech material is, of course, somewhat more difficult. "For the manufacture of aluminum foams, an aluminum alloy and a blowing agent are mixed together, in most cases are pre-compacted by axial compression and then compressed into foamable sections by extrusion", explains Carsten Lies, Head of Department Functionally Integrated Lightweight Construction at the Fraunhofer Institute for Machine Tools and Forming Technology (IWU) in Chemnitz. "For the manufacture of aluminum foam sandwiches, customized, foamable aluminum sections are placed between two cover sheets positioned at a distance from each other", adds the engineer, describing the production process.

In the subsequent heat treatment the foamable aluminum expands many times over. The arising foam forms a solid bond with the two cover sheets to create a sandwich. After cooling the sandwich is cut to the final dimensions. "Metal foams, especially aluminum foams, are primarily used as core material in sandwiches", explains Lies. Their cover sheets are usually made of steel or aluminum. "The top layers support loads, the core prevents direct contact between the sheets", is how the Fraunhofer researcher explains the special properties of the high-tech material. The bond between top layers and core generally happens in the metallic adhesive bond.

### **Airy, light and rigid: sandwich with foam filling**

"Depending on their design, sandwiches have very high bending stiffness. This effect is used to make assemblies lighter and thus maintain or even improve the stiffness of the assembly", says Lies. They are replacing massive elements of the conventional assembly. According to the researcher, depending on the optimization criterion either significant weight savings with the same stiffness (up to around 30 per cent) or substantial increases in the stiffness with consistent weight can be achieved. The specific advantages when using metal foam in the machine in terms of efficiency and sustainability are, according to Lies, "significantly improved damping by the foam core and significant weight savings with the use of sandwiches".

The fact that metal foams can also be easily recycled has a positive effect on the ecological footprint. "As no adhesive is used for the sandwich production, the material can be used in existing cycles for the treatment of metal scrap comprising steel and aluminum", says the researcher from Chemnitz.

### **Custom-fit from the 3D printer**

Components made of metal foam – or more precisely components made from hybrid porous (HyPo) materials – can also be manufactured in 3D printing. Advantage of additively manufactured metal foam: The air chambers can be accurately positioned. Components produced in this manner can be further optimized for special applications because the graded adjustment of the pore structure inside the component allows more options than air blowing in metal as they are formed during foaming by gas. For instance, machine components can be formed in the 3D printer with custom-fit and precisely defined properties.

"A graded adjustment of pore structure and property profiles is very difficult or not even possible in a monolithically manufactured material as either the manufacturing

process or the further processing to the final component geometry do not match the final requirements of the use", explains Thomas Hassel from the Institute of Materials Science at the Leibniz University Hanover (LUH). The doctorate engineer highlights that additive manufacturing manages to enable "near-net-shape production" of components and, at the same time, "introduce the grading at the corresponding places in such a way that it is positioned precisely in the profile of requirements".

The research addresses specific applications in the machine tool industry and how the innovative material can help increase efficiency and sustainability in the factory. The focus is on components of a machine tool (tool changer, tool holder, spindle carrier) with regard to their stiffness, damping, thermoelastic behavior, imbalance, as well as their hardness and surface quality, explains Hassel. Through the implementation of the HyPo components, e.g. in a shaper, research is carried out on what advantages are achieved with the graded components. "The operating behavior during processing is to be analyzed as the milling process involves a wide range of different loading conditions", says Hassel. "This makes it possible to determine the influence of the HyPo component on the mechanical and thermal machine properties and significantly improve the performance of such machines."

### **Substitution for "forever chemicals"**

Greater sustainability through lightweight materials is one of many approaches adopted to improve the ecological footprint in industrial production. Meanwhile, more attention is turned to environmentally friendly alternatives for the so-called "forever chemicals". The focus is on environmentally harmful per- and polyfluoroalkyl substances (PFAS), which are used in production particularly where extreme conditions prevail: high temperatures, significant wear or aggressive chemical conditions. PFAS can be found in seals, pipes or fittings.

"There is no blanket answer to the question of whether a substitution of PFAS is possible, and an individual assessment must be carried out depending on the

application", says Frank Schönberger, Head of Synthesis and Formulation at the Fraunhofer Institute for Structural Durability and System Reliability LBF from Darmstadt. "A 1:1 replacement of fluoropolymers is generally not possible, but always depends on the individual requirements of the respective application."

There are situations where a fluoropolymer can be replaced with another high-performance polymer (such as PEEK, PEI or PPS) depending on requirements, for example, if temperature and media requirements are moderate or in the area of tribological compounds. "But there are also areas of applications where the complex requirements – nowadays – cannot be fulfilled by any other material", adds the researcher. "Fluoropolymers have to a great extent universal chemical resistance and have high temperature resistance. In applications where this is required such as in pumps or machines that have to withstand different media in varying conditions, up to now fluoropolymers do not need to be replaced", sums up Schönberger and adds: "There may be opportunities in applications where the full potential of the fluoropolymers is not required and in situations where, e.g., a redesign is possible."

### **PFAS substitution also relevant for the USA**

According to Schönberger, the PFAS substitution is also relevant for markets outside Europe, in particular the USA. In the USA there are also regulations, in part dependent on the respective federal state. This also shows that greater sustainability in production technology is a global challenge, to which a response must be provided in the factories in all industrial nations.

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Author: Daniel Schaubert, trade journalist, Mannheim

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### **Metal foam from the 3D printer**

Components made from hybrid porous (HyPo) materials can be manufactured in 3D printing. Researchers from WGP (Wissenschaftliche Gesellschaft für

Produktionstechnik, engl. The German Academic Association for Production Technology) has set themselves the goal of establishing an adaptable and robust manufacturing process for HyPo materials by 2027. The manufacture of metal foam using additive manufacturing is currently being researched in the collaborative research center: SFB/Transregio TRR375; title "Multifunctional High-Performance Components made of hybrid porous materials (HyPo)" with the participation of the University of Kaiserslautern-Landau RPTU and the Leibniz University Hanover in the first funding period. Two principal methods are integrated in the research program. A laser-based method (DED-LB – Laser Beam Direct Energy Deposition) and an arc-based method (WAAM – Wire Arc Additive Manufacturing) are used to manufacture graded porous structures and graded materials made from hybrids. The research focus is the graded property distribution of these materials, explains project leader Thomas Hassel from the Institute of Materials Science at Leibniz University Hanover (LUH). Further information is available online at <https://www.trrhypo.de/>

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**Background**

**EMO Hanover 2025 - the world's leading trade fair for production technology**

Under the motto *Innovate Manufacturing*, EMO will showcase the entire metalworking value chain from September 22 to 26, 2025. These are cutting and forming machine tools, manufacturing systems, precision tools, automated material flow, computer technology, industrial electronics and accessories. EMO takes place every two years in Hanover, Hanover, Milan and will celebrate its 50th anniversary in 2025. Most recently in 2023, more than 1,800 exhibitors attracted a good 92,000 visitors from all over the world to Hanover. As the most important platform for metalworking worldwide, the event stands for **innovation**; EMO is a source of inspiration and a global leader when it comes to new products, manufacturing solutions and services. **Internationality**: International market leaders from 45 countries exhibit at EMO. The trade visitors come from all major customer industries such as mechanical and plant engineering, the automotive industry and its suppliers, aerospace technology, precision mechanics and optics, shipbuilding, medical technology, tool and mold making, steel and lightweight construction, and from around 140 countries. **Inspiration**: No other trade fair presents the full breadth and depth of international manufacturing technology like EMO. Exhibitors and visitors with a high level

of expertise discuss the megatrends in manufacturing, exchange ideas with representatives of international production research and develop solutions to existing challenges. **The future of metalworking:** *Innovate Manufacturing* remains a constant challenge for the industry. EMO points the way to the limitless possibilities of industrial manufacturing.

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