# New manufacturing process helps metals lose weight

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A pioneering manufacturing process that can turn titanium, stainless steel and many other metals into a new breed of engineering components could have a big impact across industry.

Unlike conventional solid-metal components, the new parts have a tiny lattice-like structure, similar to scaffolding but with poles twice the diameter of a human hair, making them ultra-light. Because loads are channelled along the poles, the parts can comprise up to 70% air while remaining strong enough to perform correctly.

The components could replace solid metal in integrated circuits, automotive applications and many other fields of engineering. Aircraft parts, for example, could be produced that are over 50% lighter than conventional alternatives. The reduction in aircraft weight would cut fuel requirements, bringing down the cost of air travel and reducing the emissions produced by the combustion of aviation fuels that are a major contributor to climate change.

The world's first commercial-scale system for the rapid manufacture of these new-generation metal components is now being developed by engineers at the University of Liverpool, in collaboration with MCP (Mining and Chemical Products) Ltd and funded by the Engineering and Physical Sciences Research Council (EPSRC).

Harnessing a technique known as selective laser melting (SLM), this fully automated system builds up components, layer by layer, from fine metal powders using an infra-red laser beam to melt the powders into the required structure. Layers can be as thin as 25 microns, making it possible to produce complex parts in which thermal, impact-absorption and many other properties can be distributed in specific places to meet the requirements of particular applications. This is not possible with conventionally manufactured 'solid' metals.

For instance, the system can manufacture components designed for use wherever heat is generated and needs to be removed quickly. Such parts might include the heat sinks that cool the processor chips in personal computers. The lattice in these heat sinks can be designed to facilitate heat flow and deliver increased cooling rates, resulting in improved chip reliability and fewer PC crashes.

Although other ways of making some types of latticed metals exist, they do not enable the features of the lattice to be precisely 'designed in' to meet customised requirements. The metals they produce are also limited in their usefulness because they have to be machined into the final required shape, rather than 'built for purpose' step by step. A typical example is the manufacture of composite components used in motor sport.

The new system's versatility means it could manufacture better-performing components of this type, as well as products for the healthcare and chemicals sectors. For instance, it is possible to imagine miniaturised chemical reactors being built using SLM and replacing large chemical plants at some point in the future, with substantial benefits in terms of production, flexibility and safety.

The project is building on previous EPSRC-funded work carried out over the last six years by the University of Liverpool team, which is led by Dr Chris Sutcliffe. Dr Sutcliffe says: "There is worldwide interest in developing a standard rapid manufacturing process based on SLM. Our system will produce optimised engineering components that can’t be made in any other way and will give the industry that has supported us a significant advantage in future markets.”

The new manufacturing system, which represents a highly innovative approach to the production of metal components, is due to be in full commercial use next year. The team is already working on a larger version which should be ready for commissioning in around 18 months.

Source: Engineering and Physical Sciences Research Council