ATHANASSIOS KALIUDIS

Reaching for the sky – LMD in Aerospace

The future looks bright for the aviation sector, with the International Air Transport Association (IATA) predicting that global passenger numbers will double over the next 20 years. The increase in demand for aircraft therefore looks set to continue. What's equally clear is that the race for orders will only be won by aircraft manufacturers that supply airlines with efficient, fuel-saving aircraft models. This has prompted the industry to embark on a feverish hunt for ways to reduce component weight, transfer new designs into production and manufacture aircraft more economically, all with an eye to gaining a crucial competitive edge. The UK is one of the biggest players in this sector. Britain has the third biggest aviation industry in the world – and the government innovation agency Innovate UK is keen to ensure it maintains this dominant position. To this end, it is supporting a raft of measures designed to put new manufacturing methods to the test. One of these is the Open Architecture Additive Manufacturing (OAAM) project, which aims to convince companies to invest in additive manufacturing technologies.

Carl Hauser from TWI aims to make LMD applicable for big components.
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Benefits of 3D printing in aerospace are obvious

The best place to find out more about this project is Rotherham in South Yorkshire, not far from Sheffield, the former heart of Britain’s steel industry. This is where TWI runs a research center. The globally renowned institute specializes in welding and joining technologies and is the lead partner on the OAAM project, which also involves various universities as well as companies including Airbus. Carl Hauser can hardly wait to get started on the project. The scientist manages a team of 16 researchers who specialize in laser manufacturing processes, and he is very clear about the benefits of producing parts using 3D printing: “Lasers can create geometries that you could never get with a milling machine. What’s more, 3D printing caters to a wide range of materials and only uses the amount of material that is absolutely necessary.” The difference can be striking: a typical material removal process might require 40 kilograms of raw material to produce a component that weighs no more than one kilo. With aircraft manufacturers dependent on expensive materials such as aluminum and titanium, the cost of raw materials can be substantial.

» **LMD technology will play a key role in the future. All we need to do now is scale up AM production to cater to larger components.**

Carl Hauser, laser expert at TWI

Carl Hauser from TWI wants to find out, what is possible with LMD in aerospace.
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Obviously AM processes are nothing new in the aerospace sector. In fact, this was one of the first industries to start reaping the benefits of 3D printing. Processes such as nozzle-based laser metal deposition, or LMD, have been a popular choice for many years. A good example is 3D printed turbine components. Yet these parts have typically tended to be on the small side. The OAAM project aims to make the leap to larger components, scaling up from multi-centimeter to multi-meter sizes. The team believes the LMD process could be used to manufacture major aircraft components, including, for example, engine casings.

Finding the right machine

Hauser is convinced lasers can get the job done – but finding the right machine poses a bigger challenge: “Right now, there are quite simply no suitable systems that offer a reliable means of producing larger components." Fortunately, Hauser already has a potential solution in his sights. He and his team will soon be ready to run the first tests on a TruLaser Cell 7040. "We've been using a TRUMPF machine for 15 years, but now we need something bigger to meet the goals of the OAAM project," he says.

TRUMPF engineers tailored the TruLaser Cell 7040 to TWI's requirements. The next two years will
show just how much potential the LMD process still has to offer
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How to avoid oxidation in LMF?

The team needs more than just a bigger machine, however. Using AM to create parts requires a stable and reliable process – and that's the second sticking point: "A stable protective atmosphere is crucial when you're working with sensitive materials such as titanium and aluminum, because you have to protect them against oxidation," Hauser explains. LMD applications therefore use shielding gases such as argon to keep oxygen away from the parts being built. Modern chamber designs offer a simple and versatile solution for smaller parts, but what about larger ones? "That's where things get a lot more complicated," says Hauser. Using full chamber shielding for the entire system would be far too costly and time consuming. Some alternatives could be trailing shrouds with diffusers to supply an enlarged area of controlled laminar flow of inert gas, and/or novel gas mixtures. "The next step is to join forces with our industry partners to work out what additional components we need to solve this problem," says Hauser. Ultimately, the goal is to enable aircraft manufacturers to integrate LMD technology in their everyday production processes.

Where do the limits lie?

If Hauser and his team succeed, aircraft manufacturers will be able to start thinking in entirely new dimensions and create geometries with new kinds of materials that were previously inaccessible. "Today's manufacturing processes limit engineers' creativity, but the laser has the power to break down those boundaries," says Hauser enthusiastically. But doesn't the LMD process also come with certain limitations, at least in regard to component size? "The truth is we just don't know. But I'm confident we can apply it to far bigger components than we previously thought." The OAAM project is set to run for another two years. Who knows what new options it might eventually open up for the aviation industry?

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