

# Press Release

Aachen,  
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## **Laser beam repairs engine components – major market potential for aircraft construction and mechanical engineering**

**As part of a long-term collaboration with the Original Equipment Manufacturer (OEM) Rolls-Royce Deutschland (RRD) in Oberursel, the Fraunhofer Institute for Laser Technology ILT, working together with the Chair for Laser Technology LLT at the RWTH Aachen, has developed an innovative and cost-efficient repair technique for engine components.**

Ensuring flight safety is regarded as the number one priority in civil aviation. One of the key strategies to achieve this is by maintaining reliable engine performance, which is why engines undergo regular, thorough inspections in which they are completely disassembled and comprehensively serviced. The components of the engine that are made from titanium and nickel-based alloys (superalloys) are subject to heavy wear due to extreme fluctuations in pressure and temperature. In addition, they are frequently damaged by foreign bodies that are sucked into the engine during take-off and landing. Until recently, it was not a feasible option to carry out the kind of special repairs that involved having to replace sections of worn materials. Components that could not be repaired therefore had to be replaced in their entirety. As well as being extremely expensive, these replacement components were often difficult to get hold of due to material availability problems in the global market.

Researchers from the Fraunhofer ILT and the LLT have now succeeded in surmounting these difficulties by using a laser cladding technique that enables these defective engine components to be repaired. "What is so innovative is the fact that we can take oxidation-sensitive titanium materials and components that have a tendency to distort and weld them in a precise and reproducible manner without any distortion," explains Dr. Andres Gasser, project manager at the Fraunhofer ILT. "A local gas atmosphere is used to prevent the molten weld pool generated in the cladding process

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from reacting with the surrounding atmosphere. With this method we can avoid the need to use a costly processing gas chamber." The Aachen-based research institute is able to take on responsibility for handling the entire project, ranging from process development and certification to installation of a system for laser cladding at the site of the industrial project partner.

Using this new technique, a local weld pool is generated by the laser beam on the surface of the component. A specially designed powder feed nozzle then introduces a metal powder composed of a similar material. The resulting layer possesses similar mechanical properties to those of the component. "One of the keys to this technique is a newly developed system of powder feed nozzles, which increases the efficiency of powder use while preventing oxidation of the layers," explains Gerhard Backes, project manager for nozzle development at the LLT. Thanks to the special nozzles' modular configuration and compact design, the range of possible applications is virtually unlimited. A further advantage of laser cladding in comparison to conventional welding is the fact that the low thermal load helps to minimize component distortion while ensuring that the weld is free from defects and smoothly contoured to the shape of the component.

In parallel to developing the process, the Fraunhofer ILT supplied a modified laser cladding machine produced by the company TRUMPF, which has now been up and running at Rolls-Royce Deutschland for around one year, where it has been producing superb results. Martin Spallek, responsible for component repair at RRD, sums up the developments so far: "By deploying this repair technique we have managed to reduce the time required for general overhauls of the engines by approximately one third while simultaneously cutting costs. That has made a huge contribution towards boosting our competitive advantage."

The innovation cluster "Integrative production technology for energy-efficient turbomachinery – TurPro" set up by the Fraunhofer-Gesellschaft is further enhancing this repair technique for turbomachinery components. This will mean that

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the technology can also be applied to land-based turbines, opening up new potential for general types of engine technologies and – over the long term – for the entire field of mechanical engineering. An impressive way of making a lasting contribution towards securing Germany's status as a high-wage location.

**Caption:**

Fig 1: TRUMPF laser cladding machine, equipped with a flash-lamp excited Nd:YAG-laser.

Picture source: Rolls-Royce Deutschland, Oberursel.

Fig. 2: Repair process of an engine component.

Picture source: Fraunhofer Institute for Laser Technology ILT, Aachen.

Fig. 3: Front drum with powder and gas feed nozzles.

Picture source: Fraunhofer Institute for Laser Technology ILT, Aachen.

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