All-electric concept aircraft powered by fuel cells, © Airbus Group.

Laser powder bed fusion for the sustainable aviation of tomorrow

How can aviation be made greener?

As the climate crisis worsens, the aviation sector is increasingly coming under the spotlight when it comes to reducing CO_2 emissions. As part of the aviation research program of the Federal Ministry of Economics and Climate Protection, the TIRIKA research initiative is addressing this issue. It is mainly focusing on developing materials and technologies necessary to make emission-free flight possible. The use of hydrogen as an energy source is a promising approach, but it places considerable strain on the components used, loads that can impair their durability, safety and functionality. The additive manufacturing process laser powder bed fusion (LPBF) can be used to process high-performance materials that can withstand hydrogen-rich environments. The initiative also intends to exploit the great geometric design freedom and the possibility of functional integration with LPBF.

The Fraunhofer ILT approach

Two TIRIKA work packages are being worked on in parallel at Fraunhofer ILT. In one, the institute is investigating the LPBF process for novel, high-strength aluminum alloys for use in hydrogen-rich environments. In the other, it is looking closely at sensor-based approaches for detecting component defects during the ongoing LPBF process. In this way, the functionality of the manufactured components can be ensured, and the effort of the usually lengthy and cost-intensive downstream quality control reduced by using LPBF process monitoring data.

This is shown by the first results

At Fraunhofer ILT, the LPBF process was qualified for processing the two high-strength aluminum alloys Custalloy and Scancromal®. A relative component density of 99.5 percent was achieved at a build-up rate of more than 100 cm³/h. Investigations into the mechanical properties of both materials and a heat treatment route will follow. The process sensors used detect defects relative to quality (e.g. inclusions of foreign particles with sizes of up to 400 µm) both in the powder bed and in the melting process.

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