Reducing CO_2 Emissions for Titanium Components

Gefördert durch:

Bundesministerium für Wirtschaft und Klimaschutz

aufgrund eines Beschlusses des Deutschen Bundestages

The Federal Ministry for Economic Affairs and Climate Action is funding the AMAvia, IKARUS and Greenhorn projects.

The project sponsor is the German Aerospace Centre (DLR e.V.).

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The use of titanium as a raw material already contributes to the high CO_2 footprint of aviation during production. Conventional production methods also waste considerable quantities of the material through machining. In view of rising material costs, strict environmental requirements and increasing supply bottlenecks, the relevance of an optimised buy-to-fly ratio is increasing.

In three research projects, Fraunhofer IAPT is developing processes that significantly reduce resource and energy consumption in the production of titanium components. The experts at the Fraunhofer Research Institution for Directed Energy Deposition (DED) are researching and optimizing processes in combination with conventional production steps. The hybrid process chains generate significant savings in titanium and energy.

AMAvia

The project involves the further development of DED-Arc combined with laser-assisted DED-Arc for Ti-6Al-4V with machining processes to improve material properties and surface quality. A multi-robot production cell with the latest generation of control systems enables automated and flexible production.

The new pilot line at Fraunhofer IAPT enables DED production and subsequent post-processing in a single clamping operation. For large titanium structures in particular, this approach results in high cost and material savings.

Project partners:

- FOOKE
- Fraunhofer IAPT
- Heggemann
- racontec
- TU Hamburg
- Siemens

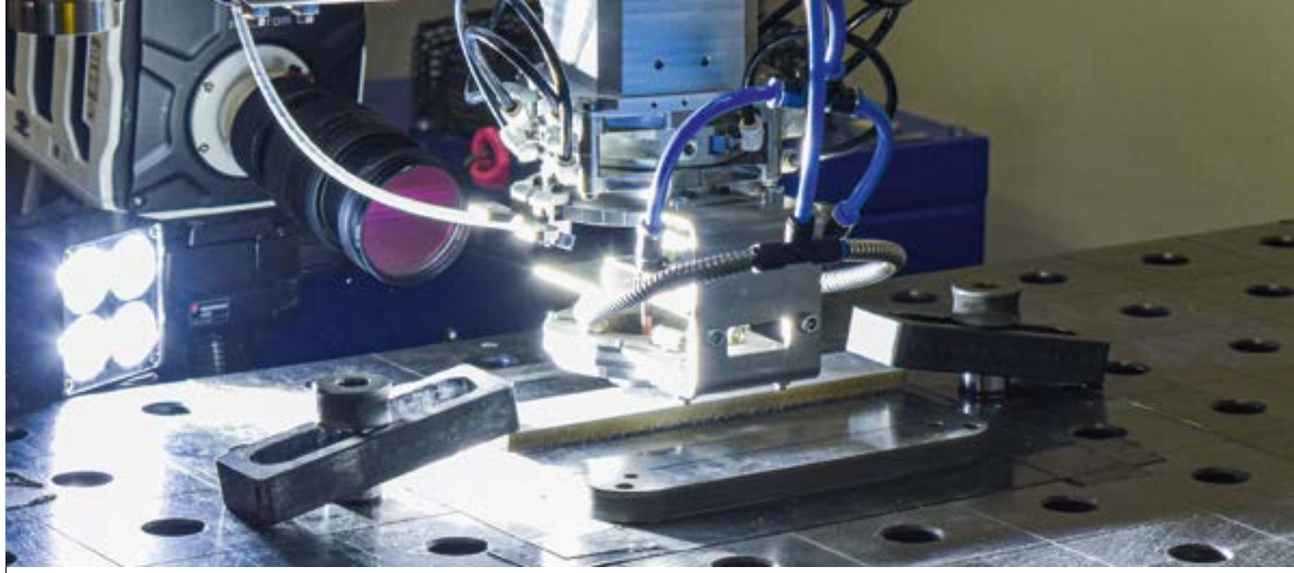
IKARUS

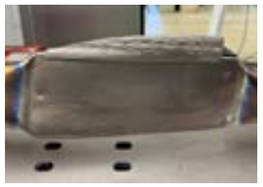
For thin-walled forged blanks that require localized reinforcement, Fraunhofer IAPT has tested the use of laser powder DED for Ti-6Al-4V. This enabled a 65 percent reduction in the amount of material required for the final component compared to conventional machining (target application: metal leading edge).

Fraunhofer IAPT has also optimized DED processes so that a local shielding method and a local gas nozzle replace the usual global shielding chamber. This means that the process requires less inert gas, especially for large components, and is more cost-efficient. Samples produced with the nozzle show an increase in elongation at break to 13 percent, which fulfils aviation-specific requirements.

Project partners:

- Access
- Fraunhofer IAPT
- Leistritz





Reinforcement applied using DED (top), prototype of a reworked leading edge (bottom)

Greenhorn

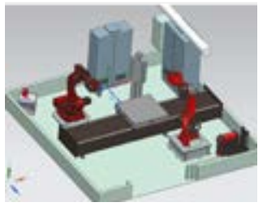
Fraunhofer IAPT qualifies the DED-Arc process for beta titanium alloys in order to generate near-net-shape blanks for downstream molding processes. Compared to the machining of preforms, this results in material savings of at least 50 percent.

The integration of in-process monitoring solutions also provides important approaches for comprehensive data availability and quality assurance. Data is recorded and analyzed in a spatially resolved manner. Anomalies can thus be localized directly on the manufactured component and the effort required for subsequent inspection steps is reduced.

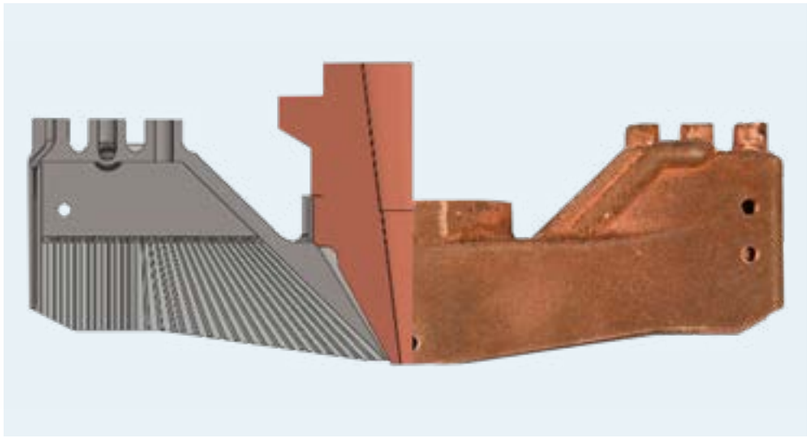
Project partners:

- BCT
- Fraunhofer IAPT
- Winkelmann

The direct transfer of findings from the projects is carried out by the aviation partners involved. These collaborations not only strengthen innovation in the industry, but also contribute to more sustainable production.



Robot-based machining (top) Hybrid production cell with DED-Arc (bottom)



Local shielding gas nozzle for laser powder DED process