aerospace & advanced composites

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HTMnext²

An FFG supported project together with SBI GmbH and RHP Technology as project leader.

ABSTRACT

In order to reduce the consumption of aircraft engines, it is necessary to increase the efficiency of the engines and this requires higher temperatures in the turbines.

Materials are required which can easily withstand these higher temperatures. The aim of the project is to develop and evaluate new material concepts for high-temperature applications in combination with efficient manufacturing using additive manufacturing technologies. Plasma Metal Deposition (PMDR) is used, a technology that feeds wire or powder into a plasma arc and where components are built up layer by layer.

In order to be able to produce high-temperature materials with an appropriate quality, it is necessary to modify or expand the technology of existing additive manufacturing systems. The focus is on the use of the PMDR process for the production of high-temperature alloys such as intermetallic materials (titanium aluminide), composite materials based on nickel superalloys and high-entropy alloys, which are characterized above all by excellent high-temperature properties at operating temperatures > 1,000 ° C.

To manufacture these materials in a safe process, further development of the system technology used is also required. This includes the temperature control of the substrates, improvements in the plasma torch systems to achieve higher deposition rates or higher precision or the development of multiple wire feeding systems, which also enables the production of complex alloys. These developed components are also integrated into the systems to allow a reproducible production of components.

There is currently no high-temperature material data available for materials manufactured using the PMDR process. For this reason, it is also necessary to determine the corresponding characteristic material properties using methods such as high-temperature tensile tests, fatigue tests or creep tests. One of the challenges is that material testing at high temperatures is very time-consuming. Solutions are also being developed for this area to accelerate the testing of samples at high temperatures.

The individual building blocks from modification of the systems, development of the processes for the high temperature materials and the results from the determination of the mechanical characteristics are used to demonstrate the developed technologies for the production of two functional samples / components from an aircraft engine. To consortium will be supported in the selection of components as well as in the evaluation and assessment of material properties from the company Rolls Royce. The superalloys market will be approximately $ 8 billion in 2023, with aviation accounting for approximately 50%. In addition to the applications in aircraft engines, the high-temperature materials represent also a solution for industrial gas turbines, which is also an interesting market for additive manufactured high temperature components.

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