Development of a CAM-based additive laser cladding process for adaptive manufacturing of multi-material systems for high-performance components

Results of the collaborative project M-ERA.NET-MatLaMeD

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Preface

Additive manufacturing processes, such as laser cladding, are used to produce products additively or to optimize them locally. Until now, laser cladding has focused a laser beam on the component surface and at the same time supplied a filler material - either as a powder or as a wire. This process is very interesting for tool and mold making, as it is ideal for applying flexible protective layers, repairing damaged areas or changing the geometry of tools shortly before production starts. But so far, up to 70 percent of the powder has been lost unused in powder-based laser cladding. This is uneconomical, especially with expensive powders. Wire, on the other hand, enables 100 percent material utilization. However, today's wires made from special alloys are only available to a limited extent or do not meet the desired criteria for a coating material.

The aim of the MatLaMeD research project was therefore to develop a hybrid process variant of laser cladding. Here, wire and at the same time the smallest quantities of powder were fed locally in order to provide application-optimized or novel material systems during the additive manufacturing of high-performance components e.g. with toughness and hardness enhancement. At the same time, special software was developed that enables the user to individually plan the process control depending on the desired material properties and to set the hybrid process exactly. For later use in industry, a manufacturing process for wire was further developed, with which high-performance, high-alloy special wires can be made available inexpensively on a large scale.

In order to achieve these goals, basic process studies on hybrid laser cladding using powder and wire were carried out and material-related process strategies were developed. These results served as the basis for corresponding algorithms that were integrated into CAM software. Finally, wire drawing tools with the hybrid laser cladding process were developed for wire drawing of high-alloy wire materials.

The interdisciplinary collaboration within the project across national borders with Belgian partners not only created an innovative additive manufacturing process and new material systems. It also strengthened the European competitiveness in economically important sectors, such as tool and mold making, through its knowledge advantage in the fields of laser material processing and materials science.

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