PRESS RELEASE

Additive manufacturing of carbide machining tools

Tungsten carbide-cobalt is an excellent material for cutting tools as it is extremely heat- and wear-resistant. In the new research project "Additive Manufacturing of Machining Tools out of WC-Co – AM of WC-Co", scientists from the Institute for Materials Applications in Mechanical Engineering IWM and the Laboratory for Machine Tools and Production Engineering WZL of RWTH Aachen University as well as from the Fraunhofer Institute for Laser Technology ILT are now investigating how Laser Powder Bed Fusion can be used to process this material. It aims to additively produce cutting tools that achieve longer tool life thanks to complex cooling geometries.

Until now, cutting tools made of tungsten carbide-cobalt (WC-Co) could only be manufactured using complex sintering processes. Since these materials are so strong, on the one hand, and since the sintering technology only offer restricted geometrical freedom, on the other, cutting tools can only be shaped to a limited extent. This makes introducing complex cooling structures into the tools very costly or simply impossible.

In contrast, additive manufacturing processes offer a high degree of design freedom and near-net-shape production. This minimizes finishing processes and also enables complex cooling structures to be generated within the cutting tool. Laser Powder Bed Fusion (LPBF) is particularly suitable for this purpose. In this additive manufacturing process, the workpiece is built up layer by layer from the powder bed using the laser. This allows undercuts to be made and complex cooling geometries to be generated. In turbine construction, significantly higher operating temperatures have already been achieved thanks to the use of additively manufactured parts.

The laser-based additive manufacturing processes require a careful selection of the material and the process parameters so they can generate components with strengths comparable to those from conventional processes. In the new funding project "AM of WC-Co", a group of Aachen research institutes will investigate this in more detail. The team includes Fraunhofer ILT, the Institute for Materials Applications in Mechanical Engineering IWM and the Laboratory for Machine Tools and Production Engineering WZL of RWTH Aachen University.

NIR emitter heats the component to over 800 degrees

A major problem in the LPBF process is the temperature distribution in the manufactured workpiece. The metal powder is melted in the laser spot and then quickly cools down. Conventional systems have a heated base plate to slow down the

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cooling process. However, this is not sufficient for refractory materials and large components in particular, as tensions and sometimes even cracks occur in the component.

The experts at Fraunhofer ILT have been working on this issue for several years and, in cooperation with the company adphos Innovative Technologies GmbH, have developed a system in which a near-infrared (NIR) emitter heats the component from above. With an output of up to 12 kW, the emitter can achieve temperatures of up to 800 °C in the component. In the "AM of WC-Co" project, this technology is to be used to process tungsten carbide-cobalt.

For this purpose, the partners will investigate the complete process route from the powder materials to the additive manufacturing process up to post-processing and testing. The scientists will qualify those materials and processes that can be used to replace conventional sintering processes. Tungsten carbide cutting tools produced in this way should have a comparable hardness, but a longer service life than conventionally made cutting tools due to the cooling structures introduced via LPBF.

This should pay off especially when demanding materials need to be machined, such as titanium alloys. In addition, the system with NIR emitters for powder bed heating can pave the way for the processing of further refractory alloy systems.

The project "AM of WC-Co" is funded by the "Otto von Guericke e.V." working group of industrial research associations. The project will last 30 months and began on October 1, 2019.

Fraunhofer ILT at formnext 2019

From November 19 to 22, the Fraunhofer ILT researchers will present the project "AM of WC-Co" at formnext 2019 in Frankfurt am Main: joint Fraunhofer booth D51 in hall 11.

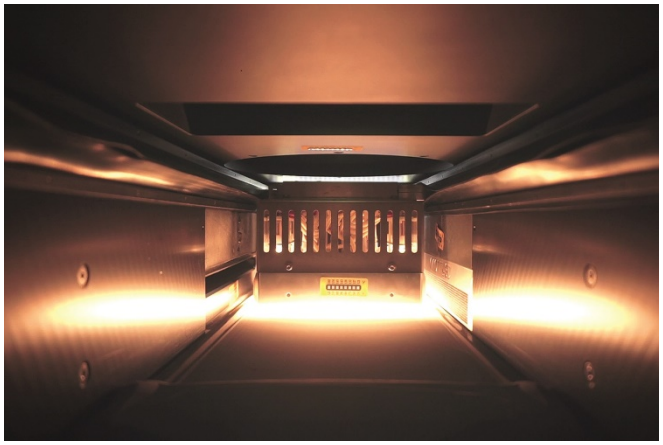

Image 1:
Preheating the machining plane with the NIR module significantly reduces stresses in the laser-manufactured component.
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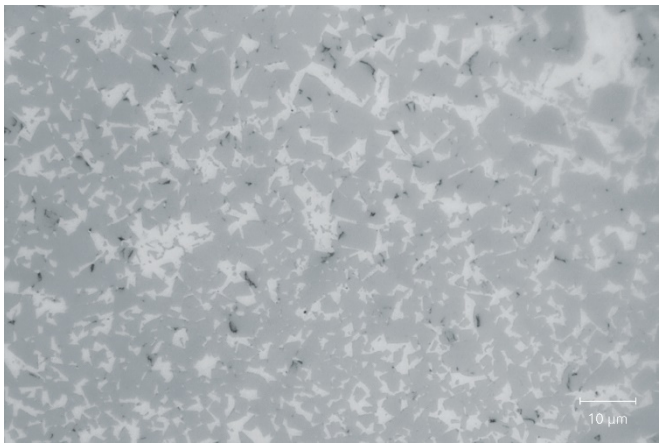

Image 2:
The process development aims to generate a homogeneous and almost dense structure of the WC-Co-composite, as shown here by means of a scanning electron microscopy measurement.
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