



DIRECT POWDER BED PREHEATING USING NIR MODULES FOR LPBF

Task

In the laser powder bed fusion (LPBF) process, preheating systems can be used to reduce thermally induced residual stresses; thanks to preheating, LPBF can manufacture components with less distortion or can process materials susceptible to cracking. Conventional preheating systems, however, only heat the building platform itself. Since LPBF manufactures in layers and since the distance increases between the building platform and the processing plane, the temperature in the processing plane decreases during the process. To solve these drawbacks, current research is focusing on systems that directly preheat the processing plane. As part of a bilateral industrial project with the company AdPhos Innovative Technologies GmbH, Fraunhofer ILT has developed a preheating system based on adphosNIR® technology to address this issue.

Method

The core of the preheating system developed here consists of emitters that emit a wavelength spectrum in the near infrared (NIR) range with a maximum at 800 nm. The adphosNIR® module used can hold six such emitters with a total power of up to 12 kW. By mounting the module on the powder application unit of an LPBF system, Fraunhofer has been able to preheat the plane directly above the powder bed. Compared to other approaches for direct preheating of the processing plane, scattered radiation can be minimized and preheating concentrated on the powder bed. However, the powder bed is only preheated cyclically during the powder application process.

Results

With cyclical preheating, an almost constant temperature of 500 °C can be set when processing Inconel® 718 before remelting and independent of the overall height. The process-induced residual stresses have been reduced, as confirmed by distortion measurements on cantilevers. Trials with the high speed steel HS6-5-3-8 show that this preheating system makes it possible to build test specimens with an overall height of 50 mm without cracks. This is not possible when using a conventional, commercial system that only preheats the building platform. Furthermore, NIR preheating can be applied to achieve a much more homogeneous microstructure.

Applications

Thanks to the preheating developed here, almost constant temperatures can be maintained during the LPBF process on the machining plane, independent of component height. There are various applications that can profit from this, especially when processing materials difficult to weld, such as high speed steels or hard materials. In the »AM of WC-Co« project, Fraunhofer ILT is investigating how NIR preheating can be used in LPBF to process WC-Co, together with the Institute for Material Applications in Mechanical Engineering IWM and the Machine Tool Laboratory WZL at RWTH Aachen University.

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- 2 Significant reduction of distortion when using NIR preheating.
- 3 Preheating of the machining plane by an adphos®-NIR module.