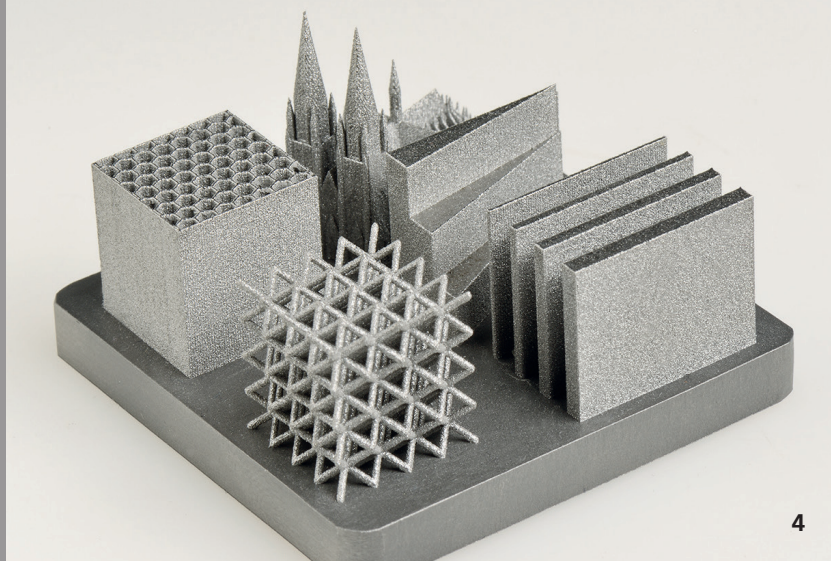
3



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GEOMETRY-ADAPTED PROCESS CONTROL FOR LPBF

Task

Laser powder bed fusion (LPBF) can be used to manufacture highly complex components by melting powdered starting material layer by layer. After a powder layer has been applied, the laser is moved over the areas of the powder layer and melts it using a pre-defined processing strategy consisting of scan sequences and process parameters. Currently, when selecting a processing strategy, the industry takes the component's geometric characteristics into account only to a limited extent. In most cases, it defines one strategy for the entire component, which means that very different areas – filigree and solid – are processed in exactly the same way. The results, however, are form deviations, component distortion and restrictions in surface quality and productivity.

Method

Within the Fraunhofer lighthouse project futureAM, Fraunhofer ILT is investigating how the LPBF processing strategy can be better adapted to the component's geometry. To enable the LPBF process parameters to be adjusted down to the level of individual scan vectors, the institute is modifying the system and control technology correspondingly. In addition, it is developing software for component analysis in order to assign the process parameters specific to a geometrical form. The novel processing strategies are developed by the production and evaluation of test specimens, which are representative for critical component areas. These include, for example, overhangs or filigree structures. The process is monitored in relevant component areas with the help of a thermographic camera to investigate the temperature distribution and cooling behavior of the test specimens.

Results

Thanks to the novel processing strategies, the dimensional deviations within a component layer can be reduced by more than 30 percent for Ti6Al4V. In addition, components can be manufactured with an overhang angle of up to 80°, which is not only an increase of 35° compared to the state of the art, but also significantly reduces the amount of support structures required. The software tools developed enable users to automatically parameterize the components to be manufactured and selectively control the LPBF system during the exposure process.

Applications

The results of the project can be applied across all sectors for the production of any components using LPBF and transferred to other materials. When the process limits are extended further, new applications for the LPBF method will also be opened up.

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3 Overhang structures made of Ti6Al4V manufactured with LPBF.

4 Components made of Ti6Al4V using controlled energy input.