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## REDUCTION OF SURFACE ROUGHNESS OF SLM COMPONENTS BY MEANS OF MODULATED LASER RADIATION

### Task

Before components made with SLM can be used in the industry, their surfaces usually require post-processing to reduce their roughness. The surface roughness depends not only on the SLM process itself, but also on the geometry of the component. The roughness of overhang areas is generally greater than of perpendicular constructed surfaces. For example, a surface roughness of  $R_a \approx 15 \mu\text{m}$  is reached on components made of Inconel 718 built in layer thicknesses of  $30 \mu\text{m}$  on vertical surfaces. In overhang areas, on the other hand, only a roughness of  $R_a \geq 30 \mu\text{m}$  can be achieved despite adjusted parameters (downskin).

In order to efficiently finish complex SLM components, they need to have a minimal and homogeneously distributed surface roughness. By using modulated laser radiation, Fraunhofer ILT has been able to significantly reduce the surface roughness of small components ( $\leq 10 \text{ mm}$ ) in the Micro-SLM process. The project aims to identify parameters for the SLM process with scanning laser systems, with which the surface roughness in all areas of macroscopic components can be reduced and homogenized.

### Method

The SLM process control to reduce the roughness is adjusted by means of scanning laser systems for areas near the surface of the component (contour and overhang areas). By discontinuous energy input, shape and size of the melt pool can be controlled and a significant reduction in surface roughness achieved. For the experiments, an SLM laboratory plant was used, which has a 400 W beam source, and the powder material Inconel® 718 in the particle fractions  $d_{100} = 15 - 45 \mu\text{m}$ .

### Result

Initial samples produced by modulated laser radiation show a significant reduction in roughness on surfaces that are mounted directly on the powder bed (incidence angle =  $90^\circ$ ). The  $R_a$  and  $R_z$  values are smaller by a factor of 2 when compared to the values of reference samples, which were made with cw laser radiation.

### Applications

Turbomachinery construction and medical technology, for example, are two sectors that require SLM components with a low surface roughness. If post-processing costs can be reduced through the adapted SLM process control examined here, the SLM process could gain greater acceptance, thus opening up new fields for this application.

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3 Demonstrator built out of Inconel® 718 using SLM and modulated laser radiation.