



ADDITIVE MANUFACTURING OF MICROSTRUCTURES WITH SLM

Task

If the range of applications of SLM as a manufacturing process is to expand, it has to undergo constant further development. Within the scope of the joint project »MikroGen«, funded by the German Ministry of Education and Research, SLM should be developed for the manufacture of micro-technical components with structural sizes smaller than 100 μm . The structural sizes producible and the surface quality attainable depend primarily upon the layer thicknesses and the size of the focused laser beam, as well as upon the grain fraction of the powder material and its safe and reliable application. With SLM, surface roughness values (S_a approx. 10 - 30 μm) result, which limit the attainable detail resolution. These aspects make a new process strategy necessary, which should enable the surface quality to be improved and, thus, the detail resolution as well.

Method

In order to reach the goal of manufacturing micro-structures, a process strategy was applied with discontinuous energy input. Thanks to this pulsed laser power modulation, the melt can solidify in between pulses. Thus, in turn, the fluctuation of the molten pool size is reduced, which also reduces the surface roughness. In addition, the amount of powder particles adhering to the surface of the component part is also reduced.

1 Radial compressor, manufactured with continuous (cw) energy input.

2 Radial compressor, manufactured with discontinuous (pulsed) energy input.

Result

Due to the discontinuous energy input, the surface roughness can be improved and thus also the detail resolution as well as the dimensional accuracy of micro-scaled SLM components (S_a approx. 1 - 2 μm). Thanks to this process strategy, micro-components, as well as those with local microstructures, can be built, the latter of which have structure sizes less than 100 μm , with corresponding detail resolution, form/contour accuracy and improved surface quality.

Applications

As the process has been expanded to create structural sizes $\leq 100 \mu\text{m}$, the potential applications for SLM have been enlarged. This way, new fields of application can be opened up for SLM in various branches, including medical technology, electronic engineering and optical technologies, among others, for use in micro-channel heat sinks.

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