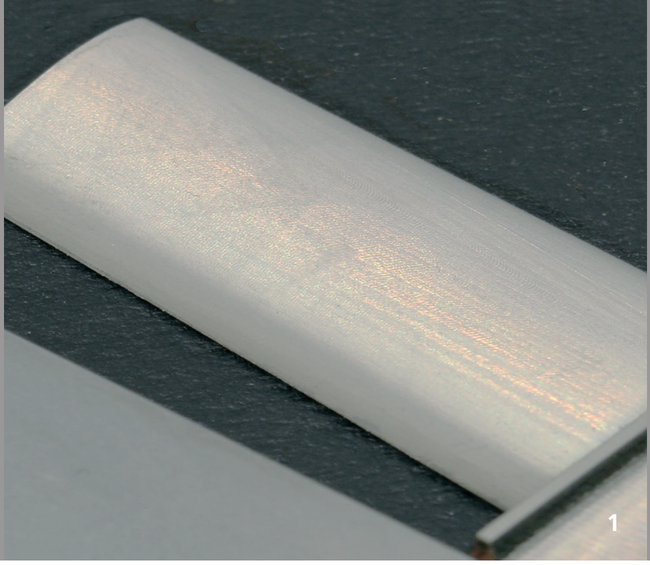

HIGH SPEED USP ABLATION BY TWO STEP PROCESSING

Task

Ultrashort pulsed (USP) laser radiation – with pulse durations of less than 10 ps – enables high-precision laser ablation with negligible thermal influence. The processing quality meets very high standards, but productivity, which is defined by the average applicable laser power, is too low for many applications. For potential applications in turbomachinery construction, the ablation rates and, thus, productivity during ablation should be improved with ultrashort pulsed laser radiation for nickel and titanium-based alloys.

Method

In addition to multi-beam approaches and the use of ultra-fast beam deflection systems, this project examined power scaling with the use of established, highly flexible galvanometer scanners. So that good surface quality could be attained with relatively high average laser power (>> 10 W), controlled heat was applied on the workpiece by using a large spatial pulse overlap (> 95 percent) and pulse repetition frequencies > 5 MHz. As a result, a thin melt film is generated during processing, preventing very rough microstructures from forming at the workpiece surface. The induced melt film can be removed in an optional second process step by using lower average laser power.

Result

For Inconel® 718, ablation rates of 9 mm^3/min can be achieved with a surface roughness Ra < 1.5 µm. For Titanium 6246 the maximum ablation rate reached is 8 mm^3/min with a surface roughness Ra < 1.6 µm. The induced melt film is < 5 µm thick and can be completely ablated in the optional second process step. Compared to what is achieved with conventional USP ablation, this corresponds to an increase of the ablation rate by a factor of 20.

Applications

One potential application is the finishing of turbomachinery components that have limited accessibility. Through the transfer of the process approach presented here to other materials, the productivity of USP processing for the mold and tool industry can be significantly increased with the use of highly flexible, well-established system technology.

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1 Mock-up blade made by laser ablation out of IN718.

2 Field of drill hole entrances on Ti 6246.

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