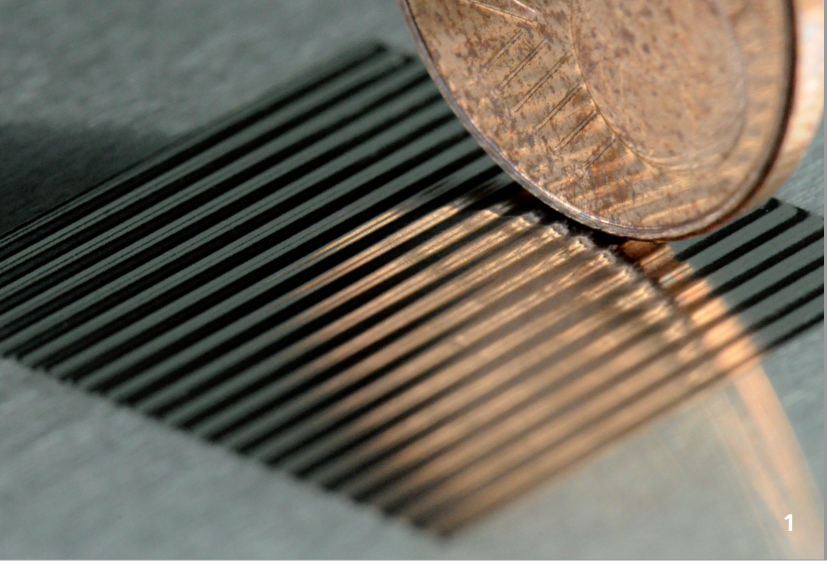
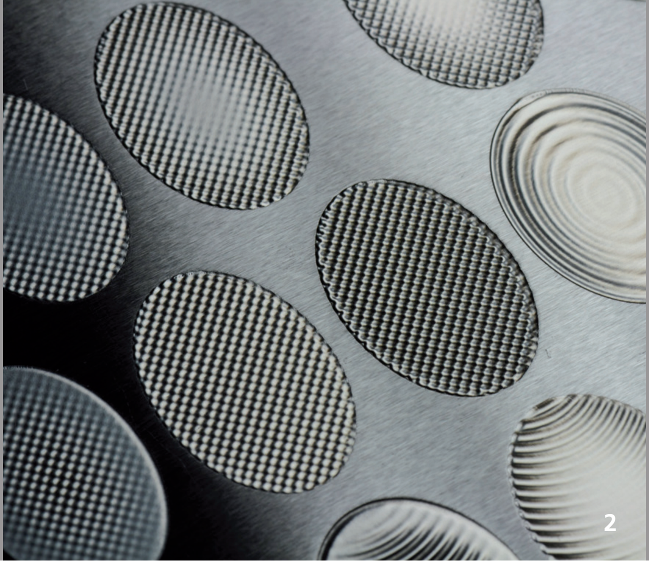


1



2

LASER REMELT STRUCTURING (LUST) OF INCONEL 718

Task

In many industrial fields, components with structured surfaces have become indispensable. In many fields nowadays, the nickel-based superalloy IN 718 can be found in a broad range of applications, particularly for components in the aerospace, automotive and power generation sectors. However, the structuring methods currently used (e.g., etching, laser ablation ...) are often time-consuming and/or expensive and are based on structuring by removing material. Both methods often produce rough surfaces, which only have limited use for flow-optimized applications in motor or jet engine areas. Furthermore, they still have shortfalls owing to the low removal rates.

Method

Therefore, a novel method – laser remelt structuring (LUST) – has been developed. In this process a laser beam melts the metal surface by local heat input. At the same time, the laser power is modulated at frequencies between 10 Hz - 100 Hz. This results in a continuous change in the melt pool volume and surface so that the material is redistributed. This way the process generates peaks and valleys which are half above and half below the initial level. The surface layer solidifies directly from the melt, thereby polishing the surface. At the same time it is structured. In order to expand the spectrum of materials that can be processed by LUST (previously, tool steel 1.2343 and titanium alloy Ti6Al4V), Fraunhofer ILT carried out systematic experimental studies of IN 718 based on single tracks. The investigations took place within the scope of »WaveShape«, funded by the Volkswagen Foundation.

Result and Applications

The investigations show that IN 718 is basically very well suited for LUST (Figure 1). On the basis of single tracks, it is shown that structures with a height of more than 10 µm can be produced in a single processing step. This corresponds to about twice the structural height that can be generated with comparable process parameters on tool steel 1.2343. Furthermore, the studies show that the scan speed – 100 mm/s also approximately twice as large – can be selected with a corresponding adjustment of the process parameters so that processing times of 1 min/cm^2 will allow for structures with a height about 200 µm. The process is thereby suitable for generating a wide range of aperiodic and periodic structures (Figure 2). In this case the structured surfaces have a small micro-roughness (Ra < 0.1 µm). Applications for such structures are, among others, in all areas where new functional, i.e. flow-optimized, elements should be used.

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1 Wave structure on IN 718.

2 Demonstration structures generated with laser remelt structuring.

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