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OPTIMIZING LASER-STRUCTURED MICROTEXTURES FOR IMPROVING SURFACE FUNCTIONALITY

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ABSTRACT

During the past decade, efforts to increase the wear life of industrial components, such as cutting and forming tools, has provided an enormous impetus to improve the functionality of surfaces. An enhancement of surface functionality includes creating surfaces which exhibit lower friction when moving against one another and less wear. This can be accomplished by more efficient lubrication as well as wear debris reduction and removal.

There are various methods with which surface functionality can be improved. One route is *in-process* structuring and the other is laser texturing; both are promising technologies. Laser texturing is a particularly flexible method with which various topographies, on surfaces of a wide variety of materials, can be readily realized by simply varying the laser parameters.

In this report, a Q-switch-operated Nd:YAG laser was used to produce well-defined surface micropores on AISI M3 steel (S653, DIN 1.3344) and AISI 52100 bearing steel (100Cr6, DIN 1.3505) surfaces. Some texturing was also performed using in-process structuring during deposition of hard coatings by physical vapor deposition (PVD). The microtextures were characterized with optical microscopy and scanning electron microscopy (SEM), including replica techniques. In a previous study, a systematic investigation using various pulse energies, different pulse numbers and two focusing systems was performed. This report focuses on the best micropore dimensions, namely the micropore diameter and depth combination, for a given tribological situation (load, sliding velocity etc.) that results in the least friction and wear. For tribological testing, a defined quantity of a mineral oil was deposited on the textured surface. Comparative friction measurements revealed a pronounced effect of the texture on the life-cycle of the tribosystem. The most advantageous effects were realized within a certain micropore diameter-depth regime. The effect of different surface contact areas as well as the effect of micropore patterning was also determined.

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