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Laser induced surface functionalization for decreased friction

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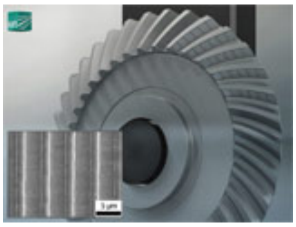
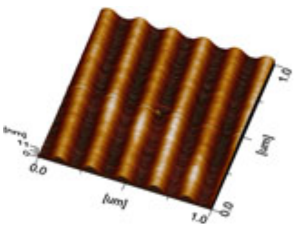
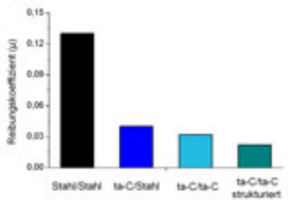


Bevel gear with patterned steel surface © Fraunhofer IWS Dresden



Patterned ta-C coating with a period Λ of 180 nm © Fraunhofer IWS Dresden



Coefficient of friction of steel/steel, steel/ta-C, ta-C/ta-C and ta-

Laser patterning techniques are key technologies for fabricating one- and more dimensional surface patterns on a wide variety of components. They offer significant advantages such as enabling precise modification of the surfaces without contamination, remote and contact-less operation, flexibility, and precise energy deposition. The challenge is that conventional patterning techniques for large areas are typically time consuming or expensive. This difficulty is solved by direct laser interference patterning (DLIP). Compared to other laser technological processes, DLIP does not require the use of masks, it is very flexible because the shape and the dimension of the interference patterns can be just adjusted by controlling the number of laser beams (from several µm to nm resolution) allowing also high fabrication speeds (~50 cm^2/s). With this technology it is possible to pattern an area of several square centimeters of tetrahedral amorphous carbon with 90 nm broad lines within a single laser pulse, for instance.

The tribological performance of mechanical components can be improved by modifying the contact geometries of the frictional partners. The main advantages of a surface patterning are lower adhesive forces between the frictional partners, the formation of particle traps as well as an extended lubricant lifetime.

Tetrahedral amorphous carbon (ta-C) comes up with outstanding properties like high hardness, low friction in lubricated and even under non-lubricated conditions and low wear. Due to these properties, ta-C is predestined for a wide variety of tribological applications, e.g., in the automotive industry, medicine technology or electronics. A further significant reduction of the friction of ta-C coated parts can be achieved by patterning the carbon coating with laser interference, such a patterning reduces the friction by about 30 %.

C/patterned ta-C (measurement with lubricant)
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Contact

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Surface Functionalization

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more info

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