



MODULAR HELICAL-BEAM OPTICS

Task

To produce accurate holes and cuts, ultrashort pulsed laser radiation is generally used in combination with fast beam rotation. A helical-beam optical system, which moves the laser beam at high speed on a circular path, should be adapted to the requirements of the market with respect to its areas of application and functionality. The goal is a more compact system with enhanced process sensors and automated settings. Care must be taken to ensure system stability and achieve industrially useful process capability.

Method

So that the possible applications can be increased and the integration enhanced, the drilling optical system has been divided into three subsystems. The system consists of steel rotator, camera module and focusing system. In this way, the new camera module and the focusing module can be used separately from the main module. This modular concept is also reflected in the control soft- and hardware.

- 1 *Modular helical optical system with freely adjustable process head.*
- 2 *Negative conical bore with an aspect ratio of 25 in 1.2 mm thick steel.*

Result

To increase flexibility, Fraunhofer ILT has developed several focusing modules, which can be exchanged as a plug & play modular system without needing to be readjusted. Along with an encoder system of the hollow shaft motor, an integrated CMOS camera allows the adjustment states to be recorded automatically at defined positions of the hollow shaft. Since the DOVE prism is mounted with plastic cup springs and the ultrafine adjustment screws can be adjusted precisely, the system reaches an accuracy in the helical geometry of 1 μm .

Applications

The helical optical system is being used extensively in several industrial sectors. It dominates in several different areas: drilling precision holes with a defined drill channel in up to 3 mm thick metallic and nonmetallic materials, micro-crack-free precision cutting of sapphire and chemically tempered glass, and generating microscopic holes in the range of less than 50 μm with adjustable conicity for diverse applications, such as for microfilters. The combination of the helical design with an ultra-short pulsed laser beam source enables the system to be used virtually independent of the material to be processed.

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