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Helical drilling technology using ultrashort pulse lasers: from lab to fab

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Abstract

The ultrafast lasers have been dominantly applied in the fabrication of high-precision structures like micro holes and kerfs, where excellent wall definition and small heat-affected zone are demanded. The helical drilling technology with different concepts has been developing since a decade. General principle is the rotation of laser beam around the optical axis enabled by an image rotator. The key characteristics is the relative motion of laser beam to the workpiece and the possibility to adjust the hole diameter and conicity. Our work is focused on technological development of a Dove-prism-based helical drilling optics. In combination with ultrashort pulsed lasers, high-precision micro drilling and cutting can be performed. In the helical drilling and cutting process, the pulses deposition locate in a spiral trajectory and the ablation volume by each ultrashort laser pulse is very small. As a result, the effect of heat accumulation by pulses with high repetition rate can be dramatically minimized. By means of a classic helical drilling process, microholes with a conicity from 1:5 to 5:1 and circularity more than 0.94 can be achieved in 1 mm thick stainless steel. A dynamic helical process has been developing to fabricate multidimensional holes with higher complexity. In order to improve the productivity for industrial applications, high single pulse energy ultrashort pulsed laser sources has been applied. With the continuous effort on the process development and system technology development, the helical drilling technology find its way to industrial production.

使用言語 : 英語

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