



LASER PROCESSING OF HIGH PERFORMANCE CERAMICS

Task

Due to their outstanding thermal, mechanical, electrical and chemical properties, ceramic materials are increasingly being used in areas such as medical technology, bearing and seal construction, turbomachinery construction and high-performance electronics. However, owing to their high hardness and strength in connection with low fracture toughness ceramics are difficult to process with conventional manufacturing processes. Indeed, challenges lie in the short tool life and the generation of unwanted microcracks during machining.

Method

Fraunhofer ILT is investigating the use of short (nanoseconds) and ultrashort (picoseconds) pulsed laser radiation (USP) for the processing of various technical ceramics. The decisive advantage over conventional methods lies in the quasi wear-free tool and contactless processing.

Results

USP laser radiation can be used to process various ceramics such as zirconium oxide, aluminum oxide or silicon carbide without inducing cracks. Moreover, high power USP laser sources can achieve comparatively high volume ablation rates of up to 250 mm³/min. This allows ceramics to be productively and precisely separated, drilled or patterned. In comparison with nanosecond pulses, picosecond pulses not only enable better machining qualities, but also higher ablation rates at the same laser power.

Applications

This process can be used, for example, to produce functional surface structures for ceramic sleeve bearings or seals, to insert high-precision through-holes or blind-hole bores for applications in high-performance electronics or to process ceramic cutting tools.

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3 Surface structure on oxide ceramics produced with USP laser radiation.

4 Drilling grid on oxide ceramics produced with USP laser radiation.