



PRECISION PROCESSING OF TRANSPARENT CERAMICS WITH ULTRASHORT PULSE RADIATION

Task

Novel processes enable the production of transparent ceramics that transmit light at 85 percent. Thanks to suitable powdered raw materials, it is now possible to produce mechanically high-strength, transparent ceramics with material thicknesses ranging from less than 100 μm up to several millimeters. The unique mechanical, optical and thermal properties of this class of materials require, however, machining and packaging technologies that can process high quality and high productivity materials for specific applications.

Method

Fraunhofer ILT is investigating and developing processes for structuring and separating novel transparent ceramics using ultrashort pulsed laser radiation (USP). Pulse durations shorter than 10 ps make it possible – by selectively focusing the laser radiation – to process surface and volume structures precisely, contact-free, with accuracies of 1 μm and without damaging them. In addition, a suitable system technology is used to adjust the spatial and temporal energy deposition exactly to the absorption properties of the transparent ceramics for a productive separation or processing result.

Results

To develop an effective laser ablation or modification process, Fraunhofer ILT analyzed the absorption of the laser radiation from the transparent ceramics by means of fundamental pump-probe measurements on a time scale in the range of a few picoseconds. The process know-how obtained determines a pulse duration and shape for which the ceramic can be effectively processed with reduced damage in areas on the kerf. By adjusting the pulse duration, focusing conditions and the process strategy, the institute can specifically adapt both size and morphology of the structures produced.

Applications

The processed transparent ceramics can be used as scratch-resistant protective covers that increase the wear resistance of components for switching and display elements in the automotive industry. In addition, thin, flexible, transparent ceramics can be used for flexible electronics in the field of consumer electronics.

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1 Cavities produced by
ultrashort pulsed laser ablation.

2 Transparent ceramics.