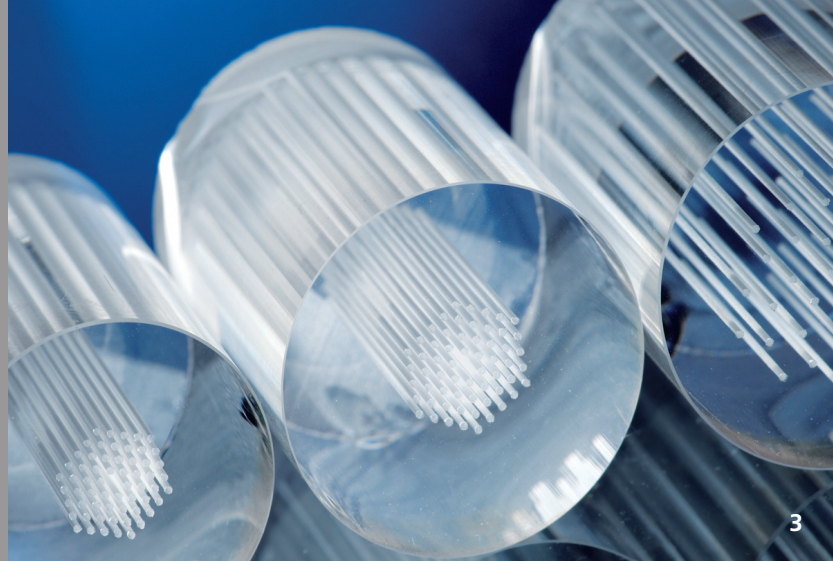




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INVERSE LASER DRILLING FOR MANUFACTURING FIBER PREFORMS

Task

Optical fibers play an important role in telecommunications technology and in materials processing. Undoped fibers are used for low-loss guidance; doped fibers for generating and amplifying laser radiation. These kinds of fibers are manufactured by drawing preforms into which geometrical structures have already been incorporated. These structures then determine the optical properties of the fibers. Common techniques for manufacturing preforms include ultrasonic drilling or bundling a large number of individual tubes. A laser-based technique allows the manufacturing process to be automated, largely avoids contamination of the surfaces, and provides greater flexibility in relation to the geometry of the holes.

Method

To manufacture holes, the material being removed is ablated in successive layers. Each layer is scanned using a focused laser beam. The ablation takes place from the underside of the transparent material. The laser beam propagates through the unprocessed volume. In this way virtually any hollow volumes can be generated in the glass, including holes with an extreme aspect ratio and adjustable conicity.

A Q-switched INNOSLAB laser with a wavelength of 532 nm and a pulse duration of approx. 15 ns is used for the machining process. To improve the achievable drill depth, the influence of various process parameters is being investigated. A preform is manufactured with the ascertained process parameters and is subsequently drawn.

Result

Inverse laser drilling has been used to manufacture initial fiber preforms out of silica glass with a photonic structure, consisting of multiple drilling channels with a diameter of 800 μm and a length of 100 mm. The diameter of the fibers is 109 μm after the drawing process; the incorporated structures have a diameter of 3.9 μm .

Applications

Possible applications of inverse laser drilling include all fields requiring drilling channels in glass with a high aspect ratio and low or adjustable conicity. The contactless machining process is particularly suited to manufacturing optical components such as fiber preforms.

Contacts

Dipl.-Phys. Marcel Werner
Phone +49 241 8906-423
marcel.werner@ilt.fraunhofer.de

Dipl.-Ing. Dipl.-Wirt.-Ing. Martin Traub
Phone +49 241 8906-342
martin.traub@ilt.fraunhofer.de

2 Drawing onion of a photonic fiber with a diameter of 26 mm.

3 Various fibre preforms for photonic fibers: drill diameter 600 μm , external diameter 43 mm.