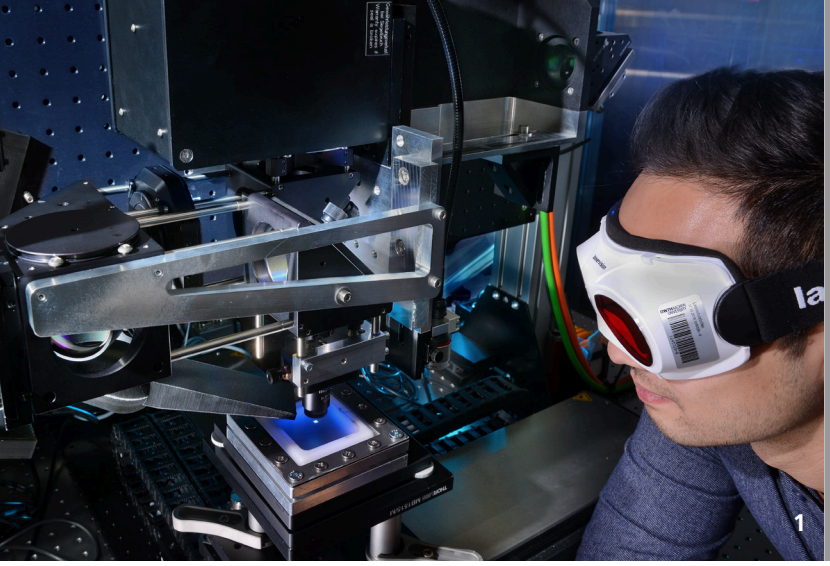

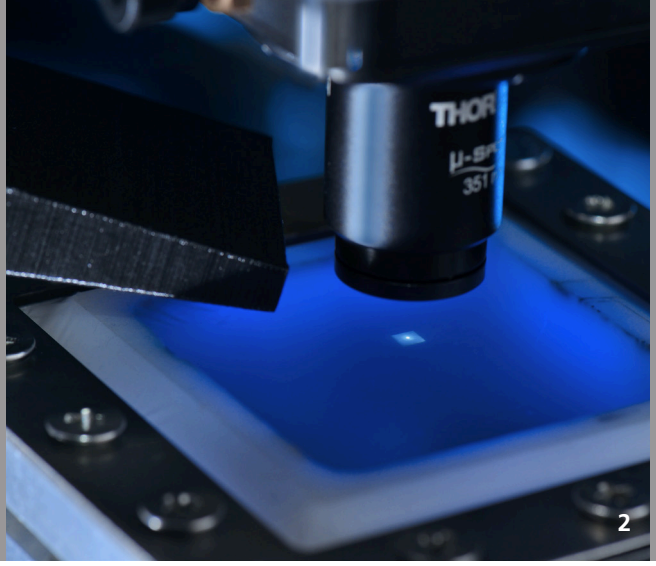

SUB-MICROMETER DRILLING IN PLASTICS

Task

Laser material processing using ultrashort pulsed laser radiation can be used to produce microholes with the highest precision in almost all materials. Holes with diameters larger than 0.7 µm can, thus, be made in metal membranes for various filter applications and leakage tests. For plastics in particular, the demand is growing for precision holes with diameters smaller than 1 µm. Here, the low absorption of plastics in the infrared and visible wavelength range results, however, in thermal loads and limits the precision and reproducibility achievable. As the microholes have to meet strict geometrical requirements, the thermal impact must be reduced and the process needs high-precision system technology.

Method

Fraunhofer ILT has developed a special UV microscanner to generate micro- and nanoscale structures and holes in different materials with great flexibility. The shorter wavelength of 343 nm is not only advantageous due to the higher absorption, especially in plastics, but also allows a significant reduction of the laser focus diameter. Indeed, focus diameters with a size of down to the sub-µm range can be generated when the suitable focusing objective is selected. The high-precision processing station is complemented by a linear axis system and a chromatic-confocal distance measurement sensor, each with sub-µm accuracy.

Results

With the UV microscanner, micro- and nanoscale through holes can be produced in various polymer films (such as PC, PE, PI and PP). Holes up to 800 nm in size can be reproducibly generated with a tolerance of less than 10 percent. By flexibly selecting the focusing objective and path guidance, the institute can use the drilling process for plastics with a material thickness of more than 500 µm. It can even achieve a high hole density in thermally sensitive material with a material thickness of 12.5 µm without thermally induced material distortion.

Applications

Precisely reproducible holes in plastics with diameters in the single-digit and sub-µm range are required in numerous applications: for example, in medical technology, filter technology, microsystem technology or in the pharmaceutical industry.

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1 Process development on the UV microscanner.

2 Drilling with a focus diameter of 1 µm.

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