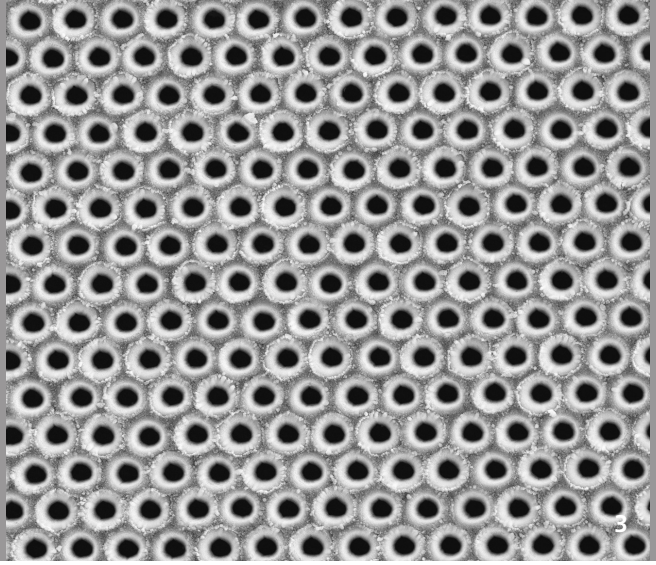

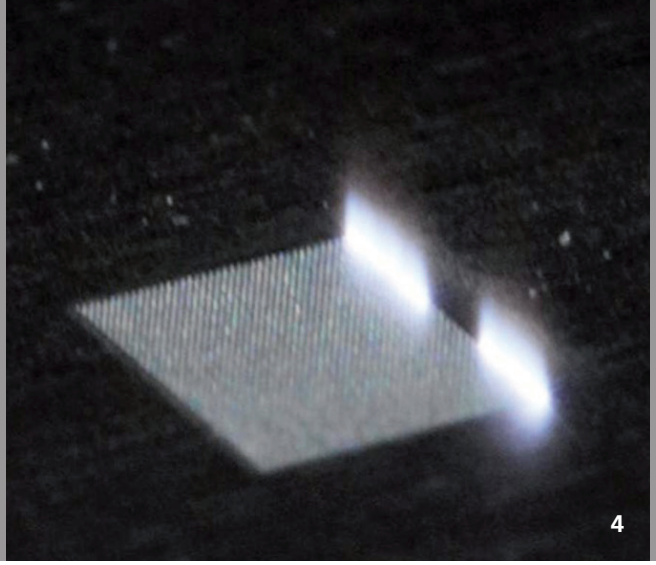

PROCESS STABILITY FOR PERFORATION WITH ULTRA-SHORT LASER PULSES

Task

Sectors in engineering and medicine increasingly require perforated materials, e.g. as filters and microstrainers. The perforation diameter of these strainers often lies in the range of < 20 µm at a material thickness of typically < 200 µm. The materials to be drilled are thin foils of different materials such as metals, glass, ceramics or also plastics. The number of drill holes per foil can amount to several thousands. Since these perforated foils are commonly used as filters, the most important requirements are defined hole diameters and geometry with small hole spacing. In order to reach this, factors are still being examined as to their influence upon process stability while thin foils are perforated with ultra-short pulses.

Method

In order to reach very small hole diameters at equally small hole spacing, a frequency-tripled Nd:YAG ps laser is used. The ps laser allows the thermal load upon the foil to be minimized during processing. The laser beam is focused by means of a lens with a short focal length. To position the material flexibly and quickly, a galvanometer scanner is used.

Result

Thanks to the use of the ultra-short laser pulse, holes can be drilled with diameter of approx. 5 µm and a minimum hole spacing of 13 µm. The process window to generate round holes is limited by two effects. First, the ellipticity of the holes is influenced by the sequence in which they are drilled into the foil. Second, polarization effects can cause the hole outlet to become irregular.

Applications

The applications of this process lie mainly in the micro- and ultrafiltration technology used in mechanical water purification. Further applications can be found in photovoltaics for the generation of back side contacts in solar cells or also in the field of lithium-ion rechargeable batteries.

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3 Perforated aluminum foil with a hole diameter of 6 µm and hole spacing of 19 µm.
4 Perforation process of an aluminum foil.