New Standards in 3D Micro Printing

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The technique of two-photon polymerization (TPP) is a powerful 3D printing solution for miniaturization which offers sub-micrometer features sizes and resolution, design freedom beyond conventional micro/nanolithography and short iteration design cycles. Here, we present how 3D micro printing works and we further discuss both scientific disruptive breakthroughs and applications in industry in a wide range of fields spanning from photonics and plasmonics to microfluidics and biomedical devices.

While TPP was previously known for ultra-fine yet small objects mostly viewed under the scanning electron microscope, now mm^3-scale fabrication (Fig. 1, left) has become the novel standard in 3D microfabrication with still sub-micrometer precision. Application examples in optics and photonics include photonic crystals, metamaterials [1, 2], optical cloaks [3], diffractive optical patterns (Fig. 1, center), photonic multi-chip integration [4] and high-precision free-form micro-optics [5]. Furthermore, gears, mixers, micro-robots [6] and micro-needles for painless drug delivery, high aspect ratio micro pumps (Fig. 1, right) and 3D scaffolds for cell culture [7] will be discussed.

References

[1] N. Muller, J. Haberko, C. Marichy, and F. Scheffold, Advanced Optical Materials 2 (2014), 115–119
[2] J.K. Gansel, M. Thiel, M.S. Rill, M. Decker, K. Bade, V. Saile, G. von Freymann, S. Linden, and M. Wegener, Science 325 (2009), 1513-1515.
[3] T. Ergin, N. Stenger, P. Brenner, J. B. Pendry and M. Wegener, Science 328 (2010), 337-339.
[4] N. Lindenmann, G. Balthasar, D. Hillerkuss, R. Schmogrow, M. Jordan, J. Leuthold, W. Freude, and C. Koos, Optics Express 20 (2012), 17667.
[5] Gissibl, T., Thiele, S., Herkommer, A., Giessen, H., Nature Photonics 10 (2016), 554-560.
[6] Medina-Sánchez, M., Schwarz, L., Meyer, A. K., Hebenstreit, F., Schmidt, O. G., Nano Letters 16 (1) (2016), 555-561.
[7] Marino, A., Barsotti, J., de Vito, G., Filippeschi, C., Mazzolai, B., Piazza, V., Labardi, M., Mattoli, V., Ciofani, G., ACS Appl. Mater. Interfaces 7 (46), (2015), 25574-25579

Figures

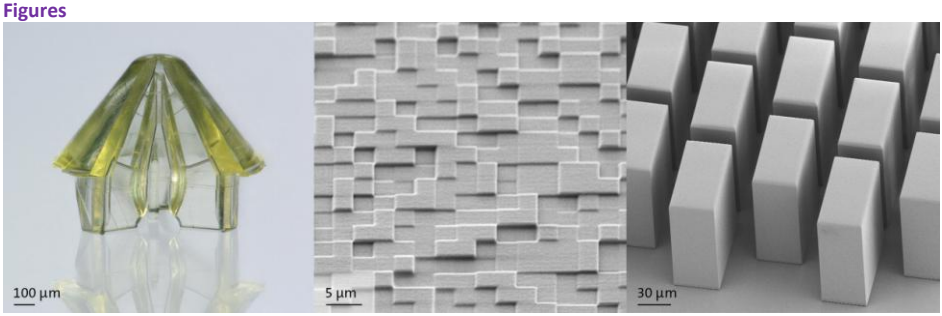

Figure 1: (from left to right) 3D printed nozzle. Diffraction multilevel pattern. High aspect ratio microfluidic capillary pump.