Universität Münster

Allgemeines Physikalisches Kolloquium

Donnerstag, 07.05.26 – 16 Uhr c.t.

IG1 – HS 2 | Wilhelm-Klemm-Str. 10

Kolloquiums-Kaffee ab 16 Uhr vor dem Hörsaal

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3D printed complex microoptics: Fundamentals and first benchmark applications

We introduce 3D printed complex microoptics, spanning a range between a few micrometers up to 5 mm. Our lens system consists of aspherical multiplet lens systems which can give high numerical apertures with simultaneously excellent imaginag properties over the entire field of view, even directly on an optical fiber tip. Combining several printed materials with different refractive indices and dispersions and the combination with diffractive elements allows for realization of micro-optical achromats or even apochromats which are aplanatic (no first- and third-order aberrations such as spherical aberration, astigmatism, coma, distortion etc.) and achromatic for 3 wavelengths (red, green, blue). We also demonstrate the direct printing of black resists, which results in aperture stops and blackened hulls.

Atomic layer deposition yields antireflection coatings on all optical elements. Confocal surface profiling and wavefront interferometry demonstrate accuracies far better than lambda/20. In combination with high-resolution nanostructuring, also 3D holograms and metasurfaces can be included. We utilize these methods to demonstrate the smallest endoscope in the world, being able to pass through a root canal of a tooth, as well as ultracompact sensors with hologon or hypergon lenses or a set of Scheimpflug lenses with nearly 2pi steradian imaging solid angle. Illumination systems as well as holographic projectors and beam shapers directly on optical fiber tips are demonstrated. Coupling single quantum emitters or single photon detectors to single mode fibers is demonstrated. Furthermore, single-fiber optical trapping of polystyrene beads, live cells, or atomic systems becomes a possibility.

Recently, we also demonstrated the use of 3D printed optics inside of a laser cavity, connecting a DBR mirror in a fiber with a solid state laser crystal.