Q 66: Photonics I

Time: Friday 11:00–12:30 Location: B/gHS

Group Report Q 66.1 Fri 11:00 B/gHS

Upconversion in photonic environments — •Jan Christoph Goldschmidt[1], Clarissa Hofmann[1], Stefan Fischer[2], and Barbara Herter[1] — [1]Fraunhofer Institut für Solare Energiesysteme, Freiburg, Deutschland — [2]University of California Berkeley, Berkeley, USA

Upconversion is the creation of one high-energy photon out of at least two lower energy photons. Upconversion of low-energy photons from a non-coherent radiation like sunligth is most frequently a multi-step process: ground state absorption is followed by energy transfer between two excited upconverter species, excitation of higher states and spontaneous emission of a high-energy photon. Such upconversion is observed in lanthanide-based upconverters or by triplet-triplet annihilation in organic materials. Solar-energy harvesting and bio-imaging are potential application of upconversion. We present how the upconversion dynamics can be controlled by a photonic environment in a congruent theoretical and experimental analysis. The theoretical model describes the local change of the irradiance and the modification of the local density of photon states induced by the photonic environment. These modifications are then considered in a rate-equation model of the upconversion dynamics. We performed measurements of the upconversion luminescence for two different photonic environments: a resonant cavity and a grating structure. The good agreement found between the experimentally observed enhancement of UC luminescence and the model predictions confirms the developed theoretical method.

Q 66.2 Fri 11:30 B/gHS

Towards integration of a liquid-filled fiber capillary for mid-IR supercontinuum generation — •Stefan Kedenburg, Timo Gissibl, Tobias Steinle, Andy Steinmann, and Harald Giessen — 4th Physics Institute and Research Center SCoPE, University of Stuttgart, Germany

We demonstrate supercontinuum generation in unspliced as well as in integrated CS2-filled capillary fibers at pump wavelengths of 1030 nm, 1510 nm, and 1685 nm. A novel method for splicing the liquid-filled capillary fiber to a standard single-mode optical fiber is presented. This method is based on mechanical splicing. We maintain mostly single-mode operation despite the multi-mode capability of the liquid-filled capillaries. The generated supercontinua exhibit a spectral width of over 1200 nm and 1000 nm for core diameters of 5 μm and 10 μm, respectively. This is an increase of more than 50 percent compared to previously reported values in the literature due to improved dispersion properties of the capillaries.

Q 66.3 Fri 11:45 B/gHS

3D printing of sub-micrometer free-form optics on fiber tips — •Timo Gissibl[1], Michael Schmid[1], Simon Thiele[2], Michael Thiel[3], Alois Herkommer[2], and Harald Giessen[1] — [1]4th Physics Institute and Research Center SCoPE, Stuttgart, Germany — [2]Institute for Applied Optics and Research Center SCoPE, Stuttgart, Germany — [3]Nanoscribe GmbH, Eggenstein-Leopoldshafen, Germany

Optical elements enable wavefront shaping, intensity distribution modification, and polarization control. Therefore, miniaturized optical elements with sub-micrometer feature size that provide the possibility to build integrated optical devices are necessary to extend the field of applications. We demonstrate the capability of three-dimensional dip-in multiphoton laser lithography that enlarge fabrication of sub-micrometer diffractive, reflective, and refractive optical components, as well as free-form optics and Fresnel phase plates directly on the end facet of a single mode optical fiber. With this approach one can specifically shape the intensity distribution directly at the output of an optical fiber by diffractive and refractive elements. Furthermore, the polarization of light can be influenced by structures such as photonic crystals. Our approach is even suitable for the combination of optical elements, characterized by a high resolution of the fabricated polymer structure, and refractive elements with strict requirements for the smoothness and the surface shape. This work will pave the way towards ultra-small endoscopes as well as beam shaping elements directly on LED emitters for future lighting applications.

Q 66.4 Fri 12:00 B/gHS

Fabrication and characterization of 3D direct laser written structures using 515 nm and 780 nm — •Anika Trautmann[1,2], Ralf Hellmann[1], and Thomas Walther[2] — [1]Hochschule Aschaffenburg, Arbeitsgruppe für Angewandte Lasertechnik und Photonik, Würzburger Straße 45, 64743 Aschaffenburg — [2]Technische Universität Darmstadt, Institut für Angewandte Physik, Laser- und Quantenoptik, Schlossgartenstraße 7, 64289 Darmstadt

Two-photon polymerization offers the possibility to produce user-defined 3D structures with great precision from a micro- to nanometer scale. Commonly, ultra-short pulsed lasers in the near infrared spectral region are employed for this process. Using smaller wavelengths promises even higher resolutions. We present results of a comparative study of laser direct writing with focus on the achievable voxel and feature size using a 515 nm and a 780 nm femtosecond laser. In conjunction with the calculated cross-sections of the two photon polymerization we evaluate the potential of the laser direct writing process for the fabrication of medical product. Finally, we present possibilities to further improve the capabilities of the applied optical setup by implementing beam shaping optics.

Q 66.5 Fri 12:15 B/gHS

In-house fabrication and characterization of Rb:PPKTP waveguides for quantum optics applications — •Christof Eigner, Laura Padberg, Helge Rütz, Raimund Ricken, Hubertus Suche, and Christine Silberhorn — Universität Paderborn, Integrierte Quantenoptik, Warburger Str. 100, D-33098 Paderborn

Non-linear processes are of fundamental interest in integrated quantum optics. They are utilised to generate intricate quantum states via parametric down-conversion or used to manipulate or interface photons in network applications. Waveguides offer a multitude of possibilities, as they provide the platform for the network applications, as well as enhance the efficiency of the non-linear processes. The non-linear optical and dispersive properties of Potassium Titanyl Phosphate (KTP) as well as the potentially low-loss rubidium (Rb) exchanged waveguides, make KTP the material of choice for many applications. However, the intrinsic ionic conductivity complicate the reliable fabrication of Rb:PPKTP waveguides.

Here, we present our solution for overcoming this complication and present our first in-house fabricated Rb:PPKTP waveguide. Finally, first optical linear and non-linear characterization results of the fabricated waveguides are presented.