K 7: Laser Beam Interaction and Laser Diagnostics

Time: Wednesday 14:00–15:00 Location: f428

K 7.1 Wed 14:00 f428

Broadband mid-infrared phase reconstruction in the focal plane of a microscope — •Niklas Müller, Florian Nicolai, and Tiago Buckup — Physikalisch-Chemisches Institut, Universität Heidelberg, Deutschland

The temporal shape of ultrashort laser pulses has high impact on nonlinear and time-resolved spectroscopy. However, its exact shape is often not known due to challenges in phase reconstruction in all spectral regions, especially far beyond the visible region. The successful phase reconstruction over $1000\,\mathrm{cm}^{-1}$ of a mid-infrared (MIR) laser pulse ranging from $1750\,\mathrm{cm}^{-1}$ up to $3200\,\mathrm{cm}^{-1}$ is presented. After reconstructing the complex near-infrared (NIR) electric field by a dispersion scan based on a spatial light modulator, the phase retrieval in the MIR is performed on the sum-frequency signals generated by the NIR-MIR interaction. Two different approaches are implemented: (i) In a time scan method, the NIR laser beam is delayed by inserting a specific amount of glass. Thus, the detected sum-frequency light depends on the temporal overlap of the NIR and MIR laser pulses and allows a phase reconstruction. (ii) In the second method, the dispersion of both laser pulses is scanned via glass insertion in the collinear MIR and NIR beam path and phase reconstruction is provided by the dispersion scan method. Although not restricted to it, the nonlinear feedback signals are generated inside the focal plane of a nonlinear microscope and the phase reconstruction provides knowledge about the temporal shape of the driving laser pulses in the point of interest.

K 7.2 Wed 14:15 f428

Self-Written Optical Waveguides (SWWs) in Photopolymer Material — •Monali Suar, Axel Guenther, and Bernhard Roth — Hannover Centre for Optical Technologies, Leibniz Universität Hannover, Nienburger Str. 17, 30167 Hanover, Germany

Self-written optical waveguides (SWWs) have received much attention in recent years as light guiding elements in integrated photonic circuits of telecommunication networks. They lend themselves for fast and easy implementation techniques in photopolymer materials and can be realized with very low cost. The physics behind writing these SWW interconnects is influenced by the combined effect of self-focusing and self-trapping of light. An induced change in refractive index is observed as the laser-light propagates through the photopolymer sample leading to the formation of the SWWs. A combined experimental and theoretical study on SWWs was performed and is reported here. The multiphysics modeling and simulation part involved the implementation of a two-dimensional (2D) Crank-Nicholson based beam propagation method which was then coupled to a diffusion material model to obtain the induced change in refractive index. A simple one polymer approach was followed to create SWWs that do not require the removal of residual cladding material in experiment. The transmitted power from the SWWs was recorded during the writing process and then compared to the simulations. We achieved an experimental attenuation below 1 dB/cm for SWWs at a wavelength of 638nm which agree well with our numerical approach. In future, the developed approach will be applied to more complex structures and processes.

K 7.3 Wed 14:30 f428

Highly Efficient Rhodamine B Doped Polymer Fiber Lasers — •Stefanie Unland[1], Simon Spelthann[1,2], Jonas Thiem[1,2], Florian Jakobs[3], Jana Kielhorn[3], Pen Yiao Ang[3], Hans-Hermann Johannes[3,4,5], Dietmar Kracht[1,5], Jörg Neumann[1,5], Axel Ruehl[1,2,4], Wolfgang Kowalsky[3,4,5], and Detlev Ristau[1,2,4,5] — [1]Laser Zentrum Hannover e.V., Hannover, Germany — [2]Leibniz University Hannover, Institute of Quantum Optics, Hannover, Germany — [3]TU Braunschweig, Institut für Hochfrequenztechnik, Braunschweig, Germany — [4]Academic Alliance Braunschweig - Hannover QUANOMET, Germany — [5]Cluster of Excellence PhoenixD, Hannover, Germany

Rhodamine B (RB) doped polymer optical fiber amplifiers and lasers were already broadly investigated since the 1990s. New applications in the field of integrated photonics open new opportunities for the use of such fibers, e.g. lab-on-a-chip applications. As degradation of the dye or the polymer is expected during the manufacturing process, high efficiencies are desired to ensure lasing. To provide high energies, the performance of single-wavelength RB:POF lasers has to be optimized. We will present results on the optimization of a Rhodamine B doped poly(methyl-methacrylat) (PMMA) fiber laser which were achieved by varying the doping concentration and the output coupler reflectivity. High pulse energy of 1.65 mJ, a slope efficiency of 57%, and a half-life of 905000 pulses were achieved by pumping a 10 ppm doped fiber at a wavelength of 550 nm. Furthermore, simulations on the wavelength tunability of a laser based on such polymer fiber will be presented.

K 7.4 Wed 14:45 f428

Quantitative determination of molecules in cooling laser-induced plasmas — •Joshua Klose, Thomas Dietz, Peter Kohns, and Georg Ankerhold — University of Applied Sciences, RheinAhrCampus, Laser Spectroscopy and Photonics, Joseph-Rovan-Allee 2, 53424 Remagen

Laser induced plasma spectroscopy ("LIBS") is a promising method to determine the elemental contribution of samples which has found a lot of applications. While most LIBS analyses use the emission of atoms the quantitative analysis of molecular emission ("Molecular LIBS") can achieve additional information.

For example, the quantitative determination of atomic chlorine emission can be performed using atomic LIBS. However, this requires sophisticated setups under helium atmosphere. Very often the samples under examination contain Calcium. In this case in the generated LIBS plasma atomic chlorine and calcium form calcium-mono-chloride (CaCl) radicals which emit strongly in the visible range. No additional buffer gas is needed to acquire the CaCl emission which allows an indirect determination of the chlorine concentration within the sample.

While the simple observation of CaCl emission allows the qualitative detection of chlorine the determination of the intensity ratio of chlorine dependent and independent band emission can be used to create a linear calibration of the chlorine contamination. Thus, the quantitative determination of the chloride concentration becomes possible. As an application we show measurements obtained with chloride contaminated samples of concrete.