

CPP 41: Optical and Nonlinear Optical Properties I (joint session DF, CPP)

Time: Wednesday 9:30–11:00

Location: EB 407

Invited Talk

CPP 41.1 Wed 9:30 EB 407

Holographic microstructuring of liquid-crystalline elastomers — ●IRENA DREVENSEK-OLENIK^{1,2}, MARTIN ČOPIČ^{1,2}, MARTIN FALLY³, VALENTINA DOMENICI⁴, and ANTONI SÁNCHEZ-FERRER⁵ — ¹Faculty of Mathematics and Physics, University of Ljubljana, Jadranska 19, SI1000 Ljubljana, Slovenia — ²J. Stefan Institute, Jamova 39, SI1000 Ljubljana, Slovenia — ³Faculty of Physics, University of Vienna, Boltzmanngasse 5, A-1090 Wien, Austria — ⁴Dipartimento di Chimica e Chimica Industriale, Università degli studi di Pisa, via Risorgimento, 35, 56126 Pisa, Italy — ⁵Department of Health Sciences and Technology, ETH Zurich, Schmelzbergstrasse 9, 8091 Zurich, Switzerland

Adding a small amount of photoactive component, for instance a photo-isomerizable azobenzene derivative, to the matrix of a liquid-crystalline elastomer (LCE) opens up various possibilities for optical manipulation of mechanical, thermal, electrical and optical properties of the material. Holographic microstructuring in LCEs is based on the coupling between isomerization state of the azobenzene groups and orientational order of the mesogenic side chains. Due to collective nature of this process light-induced spatial modifications of optical refractive index in LCEs are several magnitudes larger than in conventional azobenzene-based holographic media. Holographic patterning of LCEs consequently provides a very convenient method for fabrication of tuneable optical diffraction structures that can easily be manipulated by external stimuli, such as strain, external fields and temperature variations.

CPP 41.2 Wed 10:00 EB 407

Random-Cavity Lasing from Electrospun Polymer Fiber Networks — ●SARAH KRÄMMER¹, CHRISTOPH VANNAHME², CAMERON L. C. SMITH², TOBIAS GROSSMANN¹, MICHAEL JENNE¹, STEFAN SCHIERLE¹, MINH TRAN¹, LARS JØRGENSEN³, IOANNIS S. CHRONAKIS³, ANDERS KRISTENSEN², and HEINZ KALT¹ — ¹Institute of Applied Physics, Karlsruhe Institute of Technology (KIT), Germany — ²Department of Micro- and Nanotechnology, Technical University of Denmark (DTU), Denmark — ³DTU-Food, DTU, Denmark

Electrospinning is a versatile, simple, low-cost and high-throughput technique for the fabrication of fibers and fiber networks with fiber diameters in the micro- and nanometer range. The resulting high surface-to-volume ratio makes the fibers excellent candidates for sensing, tissue-growth and filtering. In the field of photonics they serve as waveguides and light sources when doped with an emitter. We report on the lasing emission from random cavities formed in networks of electrospun dye-doped polymer fibers. Spatially resolved spectroscopy and spectral analysis prove that the observed laser emission originates from individual ring resonators randomly distributed throughout the network. Preliminary measurements show the suitability of the fiber networks as gas sensors where the spectral position of a lasing mode serves as transducer.

CPP 41.3 Wed 10:20 EB 407

Whispering Gallery Modes in Single Copolymer Microspheres — ●DANIEL BRAAM¹, KENICHI TABATA², SOH KUSHIDA², ROBERT NIEMÖLLER¹, GÜNTHER M. PRINZ¹, YOHEI YAMAMOTO², and AXEL LORKE¹ — ¹Faculty of Physics and CENIDE, University of Duisburg-Essen, Lotharstraße 1, 47057 Duisburg, Germany — ²Faculty of Pure and Applied Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8573, Japan

Copolymers are promising candidates for use in optoelectronic devices due to their low fabrication cost and high emission efficiency. Here we investigate several π -conjugated alternating copolymers, which combine the advantages of being a dye, a dielectric and a self-assembled resonator, as they form nearly perfect spheres when precipitated from solution. Excitation leads to standing waves inside these microspheres, known as whispering gallery modes (WGMs). Their spectral position, number and line width is dependent on the sphere diameter. The measurements, showing both TM- and TE-modes, are in good agreement with model calculations [1]. The relative amplitude of the modes is strongly dependent on the sphere's excitation spot, revealing leakage of polar modes to the substrate, while equatorial modes sustain. During continuous illumination we observe lifting of degeneracy of the WGMs, followed by slow deterioration. Covering the spheres with a thin layer of titanium leads to an improved resistance against irradiation damage.

[1] Tabata, K., Braam, D. *et al.* Self-assembled conjugated polymer spheres as fluorescent microresonators. *Sci. Rep.* **4**, 5902; DOI:10.1038/srep05902 (2014).

CPP 41.4 Wed 10:40 EB 407

TiO₂ coated Whispering Gallery Mode (WGM) Resonators for Label-free Biosensing — ●FABIAN RUF¹, SARAH KRÄMMER¹, CHRISTOPH VANNAHME², ANTONINA VIGOVSKAYA³, LJILJANA FRUK³, ANDERS KRISTENSEN², and HEINZ KALT¹ — ¹Institute of Applied Physics, Karlsruhe Institute of Technology (KIT), Germany — ²Department of Micro- and Nanotechnology, Technical University of Denmark (DTU), Denmark — ³DFG-Centre for Functional Nanostructures CFN, Karlsruhe Institute of Technology (KIT), Germany

Biosensors for label-free detection offer a huge variety of applications in life sciences and medicine since they facilitate point-of-care diagnostics. We use goblet-shaped polymeric high-Q WGM microresonators fabricated within a low-cost manufacturing process also suitable for mass production. After fabrication the polymeric resonators are coated with titanium dioxide using sputter deposition techniques. The sensitivity as figure of merit is given here by the size of the shift of a resonant mode when the surrounding of the resonator changes. Finite element simulations predict a significantly increased sensitivity for resonators coated with TiO₂. Moreover, titanium dioxide is a well-suited platform for functionalization with dopamine derivatives. The use of antibody-protein binding processes is expected to enable the specific detection of proteins and antibodies interesting for medical analysis.