HL 42 Symposium: Photonic Crystals

Zeit: Montag 15:00–18:00 Raum: TU P270

HL 42.1 Mo 15:00 TU P270

The Mid-field microscope: Development of a 50 nm resolution microscope based on surface plasmon effects — •Ian T. Young, Yuval Garini, and Margreet Docter — Department of Imaging Science & Technology, Faculty of Applied Sciences, Lorentzweg 1, Delft University of Technology, NL-2628 CJ Delft, The Netherlands

Ebbesen, Lezec and others have described a technique to achieve an extraordinary transmission of light through small holes (< 200 nm) in a thin metallic film. This phenomenon is thought to be due to photon-plasmon interactions in thin metallic films that contain a periodic structure (e.g. a set of holes). Three main features of this phenomenon are: 1) Larger transmitted intensity than predicted by quantum calculations; 2) Well-defined transmission spectrum, and; 3) Possibly a very small diffraction (about 3 degrees) of transmitted light, in contrast to conventional diffraction. We are constructing a nano-array illuminator consisting of a thin metallic film containing an array of nano-sized holes and a mechanical translation mechanism. This configuration will be used with conventional optics and a scientific CCD camera to achieve a new type of NSOM system that we refer to as a mid-field microscope. With this microscope we expect lateral resolution on the order of the hole diameter, 50 nm, a sample depth up to 1-2 microns, and partial confocality permitting high-resolution, high-speed, three-dimensional image acquisition.

HL 42.2 Mo 15:30 TU P270

Controlled coupling of a subwavelength dipole to a photonic crystal microcavity — •V. Sandoghdar, F. Koenderink, and B. Buchler — Laboratory of Physical Chemistry, Swiss Federal Institute of Technology, (ETH), 8093 Zürich, Switzerland

Recently there has been a remarkable progress in the design and fabrication of photonic crystal microcavities with very high quality factors and low volumes. This promises interesting experiments in various fields including Cavity Quantum Electrodynamics and integrated optics. We discuss the coupling between a photonic crystal microcavity and a subwavelength object, such as a single quantum emitter or a scanning probe tip. We show how the cavity modifies the radiative properties of an emitter and how a subwavelength particle modifies the spectral properties of the resonator.

HL 42.3 Mo 16:00 TU P270

Noise properties of supercontinua generated in photonic crystal fibers (PCFs) — •Harald R. Telle and Nils Haverkamp — Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

The generation of femtosecond supercontinua in PCFs results from the complex interplay of various nonlinear effects like self-phase-modulation, four-wave-mixing, fission of Raman solitons, wave-braking and so on. A similar complexity is expected for the noise properties of such white-light-sources. Experimental investigations of several modulation transfer functions of a typical PCF will be presented from which noise- and phase-coherence-properties of the generated spectra can be inferred. Possible effects of such fluctuations on practical applications like optical frequency metrology or heterodyne-CARS will be discussed.

HL 42.4 Mo 16:30 TU P270

Novel photonic quasicrystal geometries and waveguide designs for applications in dispersion engineering — •M. D. B. Charlton [1], M. E. Zoorob[2], G. J. Parker [1], N. Perney [3], M. C. Netti[2], P. Ayliffe[2], S. J. Cox [1], J. J. Baumberg [3], and J. S. Wilkinson [1] — [1]Dept of Electronics and Comp. Science, University of Southampton, SO17 1B — [2]Mesophotonics Ltd, 2 Venture Road, Chilworth Science Park, Southampton, SO167NP — [3]School of Physics and Astronomy, University of Southampton,Southampton SO17 1BJ, UK

After a review of previous work on 12-fold symmetric quasicrystals, I present more recent unpublished theoretical work on dispersion and localisation effects in novel quasicrystal geometries with higher symmetry order. Implications for applications will also be discussed. In addition, recent theoretical and practical work on loss reduction in planar photonic crystal slabs will be presented, addressing in particular the issue of etch depth.

HL 42.5 Mo 17:00 TU P270

Interaction between Photonic Gaps and Material Excitations in 1- and 2-Dimensional Structures — •Carl G. Ribbing[1], Herman Högström [2], and Andreas Rung[1] — [1]Dept. of Functional Materials, Swedish Defense Research Agency, Linköping, Sweden of Sensor Technology, Swedish Defence Research Agency, Linköping, Sweden — [2]Department of Engineering Sciences, The Ångström Laboratory, Uppsala, University, Box 534, 751 21 Uppsala, Sweden

Photonic gaps in periodic dielectric structures originate from diffraction and interference, and can be observed phenomenologically as total reflectance and zero emittance. Mathematically, the appearance of a gap coincides with the occurrence of an imaginary wave vector. This is characteristic also for homogenous materials with a negative dielectric function – typical for metals in the visible and infrared spectral regions. Investigations of so called metallodielectric crystals with new and interesting features were published in the later part of the 90's. In this contribution, the case of polaritonic, photonic crystals is discussed. In the infrared region, a group of compounds with ionic binding have Reststrahlen Bands within which the dielectric function is negative. This will give rise to the formation of *polaritonic* gaps that are narrow, in contrast to the metallodielectric case, and occur in a material that is an electric insulator. Depending on the detailed conditions, different features arise from the interaction between the *polaritonic* gap and the photonic gap (fixed by the choice of structure and lattice constant).

HL 42.6 Mo 17:30 TU P270

Sol-Gel Approaches to Photonic Crystal Systems — •Frank Marlow, Denan Konjhodzic, Helmut Bretinger , and Hongliang Li — Max-Planck-Institut für Kohlenforschung, Kaiser-Wilhelm-Platz 1, D-45470 Mülheim an der Ruhr

A prerequisite for an efficient "molding the flow of light" by photonic crystals is the molding of materials in desired nanostructures. Very often, conventional materials and processing techniques cannot fulfill the theoretical requirements for the materials and structures. Sol-gel methods enable the controlled introduction of porosity into the materials by the use of molecular or supramolecular templates. The porosity can be used for lowering the refractive index, for soft processing of the materials and for stress relaxation. Examples for this are ultra-low refractive index film used as supports for 2D photonic crystals, inverse opals with a skeleton-like unit cell filling and ferroelectric films with high transparency and good structuring possibilities. Detail results will be described on mesoporous silica films with a refractive index of 1.14 and on their use in 2D photonic crystals waveguide systems. The films are synthesized by a template-modified sol-gel process using triblock copolymers.[1] Furthermore, the structure tuning possibilities of inverse opals and their photonic properties will be investigated. Here materials with new possible bandgaps can be constructed.[2] Finally, first investigations of sol-gel processed ferroelectric PZT films will be shown. They can lead to switchable photonic crystals.

[1] M. Schmidt, G. Boettger, M. Eich, W. Morgenroth, U. Huebner, H. G. Meyer, D. Konjhodzic, H. Bretinger, F. Marlow, Appl. Phys. Lett. 85 (2004) 16.
[2] F. Marlow, W. Dong, ChemPhysChem 4 (2003) 549.