HL 44: Photonic crystals

Time: Tuesday 15:00–16:15 Location: H3

HL 44.1 Tue 15:00 H3

Random Laser Theory - Coherence and Co-Existenze of Random Lasing Modes and Threshold Behavior — •Regine Frank — Instutut für Theoretische Physik, Universität Tübingen

In any quantum or wave system dissipation leads to decoherence. We demonstrate that the loss dynamics of random lasers imply a finite lasing mode volume, which explains the co-existence of random lasing modes. The coherence properties of the laser are dependent to the systems inherent parameters like scatterers' sizes and filling fraction. The modal behavior and the thresholds are derived 'ab initio' by considering quantum field theoretical scattering and transport in disordered granular systems.

HL 44.2 Tue 15:15 H3

Design, Fabrication and Characterization of High-*Q* Photonic Crystal Cavities in SiN — •Michael Adler[1], Carlo Barth[1], Jürgen Probst[2], Max Schoengen[2], Bernd Löchel[2], Janik Wolters[1], and Oliver Benson[1] — [1]Nano-Optics, Institute of Physics, Humboldt-Universität zu Berlin, Newtonstraße 15, D-12489 Berlin, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Institut für Nanometeroptik und Technologie (G-INT), Albert-Einstein-Straße. 15, D-12489 Berlin

Two-dimensional photonic crystal (PC) cavities combine a high quality factor (Q) with a low mode volume. Recently heterostructure cavities with extremely high quality factors operating in the infrared have been realized based on silicon [1]. Our results from finite-difference time-domain (FDTD) simulations prove that high-Q PCs for the visible spectral range can be realized using silicon nitride. First experiments on the realization of such structures are presented.

[1] E. Kuramochi, M. Notomi, S. Mitsugi, A. Shinya, T. Tanabe, T. Watanabe . Ultrahigh-Q photonic crystal nanocavities realized by the local width modulation of a line defect. Applied Physics Letters **88**, 041112 (2006)

HL 44.3 Tue 15:30 H3

Fabrication of GaN photonic crystals using Surface Charge Lithography — •Olesea Volciuc[1], Timo Aschenbrenner[2], Detlef Hommel[2], Ion Tiginyanu[3], and Jürgen Gutowski[1] — [1]Institude of Solid State Physics, Semiconductor Optics, University of Bremen, 28334 Bremen — [2]Institude of Solid State Physics, Semiconductor Epitaxy, University of Bremen, 28334 Bremen — [3]National Center for Material Study and Testing, Technical University of Moldova, 2004 Chisinau

Two-dimensional photonic crystal (2D PhC) structures/slabs based on GaN have been fabricated by a maskless technological approach known as Surface Charge Lithography (SCL). The fabrication and processing techniques of PhCs require both high lithographic resolution and smooth etching of surfaces. The quality demand for spatial resolution is usually achieved by e-beam lithography and reactive ion etching (RIE). However, dry etching gives rise to damaged surfaces which are detrimental to the performance of optoelectronic devices. In addition, e-beam lithography and dry etching techniques involve complex and expensive equipment. SCL is an attractive alternative which avoids the problem of pronounced surface damage and represents an efficient and cost-effective fabrication procedure. This approach is based on a photoelectrochemical etching (PEC) of samples preliminarily treated by low-fluence focused ion beam (FIB). Results concerning the spatial nanoarchitecture of such developed 2D PhCs are presented.

HL 44.4 Tue 15:45 H3

Active focal volume modification for two-photon polymerization process studies — •Erik Waller, Michael Renner, and Georg von Freymann — Department of Physics and Research Center OPTIMAS, University of Kaiserslautern

Direct-Laser-Writing (DLW) is used for the fabrication of almost arbitrary three-dimensional structures by focusing an intense laser beam into photo resists. In standard DLW systems the iso-intensity surfaces of the focal volume and therefore the obtainable feature sizes are defined by the numerical aperture of the focusing optics. The resolution is additionally limited by the proximity effect caused by accumulated intensity in the photo resist. Here, we spatially structure the incoming laser beam with a spatial light modulator to modify the focal volume. Polymer template structures written with these shaped focuses give insight in the formation of the proximity effect.

To evaluate the effect of the accumulated intensity we introduce shaded-ring filters (SRF) which reduce the axial elongation of the focal volume but cause sidelobes. Using SRFs with different sidelobe height and feedback from high resolution three-dimensional structures we find an acceptable sidelobe level for the serial writing process. The evolution of the proximity effect with time is tested using phase patterns that generate highly uniform high-resolution multi-focuses along a line in a parallel writing approach. The resulting obtainable resolution is compared to the obtainable resolution of a two-dimensional grating written in a serial process. The accumulated intensity is deduced from point-spread-function scans, the writing speed and the spot distance.

HL 44.5 Tue 16:00 H3

Angle-Resolved Spectroscopy of Opal Films and Higher Brillion Zones — •Frank Marlow[1,2], Mulda Muldarisnur[1], and Iulian Popa[1] — [1]MPI für Kohlenforschung, 45470 Mülheim an der Ruhr — [2]Center for Nanointegration Duisburg-Essen (CENIDE), University Duisburg-Essen

The angular behavior of light transmission through opal films over a broad range of wavelengths and angles was investigated. The opal films were prepared using the capillary deposition method (CDM). Many well-defined diffraction peaks were detected and indicate that the CDM results in opal films with very high quality. Peaks coinciding at normal incidence split when the samples are rotated. The angular shift of these peaks was found to fit very well with the kinematical diffraction theory. Furthermore, the variation of intensity with incident angle can be interpreted in terms of a simplified dynamical diffraction theory considering the photonic bandstructure of the opals. The behavior at higher Brillion zones turns out to be the key for the interpretation.