SYPC 1 Symposium “Photonic Crystals” I

Zeit: Mittwoch 14:00–16:00 Raum: HV

Hauptvortrag SYPC 1.1 Mi 14:00 HV

Selected Nonlinear effects in photonic crystals — •F. Lederer, C. Etrich, R. Iliew, and U. Peschel — Institute of Condensed Matter Theory and Solid State Optics, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany

During the past several years research in photonic crystals (PCs) has rapidly evolved. As far as applications are concerned the main emphasis is on films with two-dimensional air-hole lattices. Light confinement of Bloch waves, i.e., the realization of waveguides and resonators as key components in microphotonic circuits, is usually achieved by selecting a frequency within a band gap and introducing line or point defects into the lattice. Another PC based waveguide concept consists in coupling the resonators, i.e., coupled-resonator optical waveguide (CROW). Here 1D or 2D arranged point defects are coupled and form transmission minibands with unusual dispersion properties and adjustable bandwidth. Up to date main emphasis was on linear effects in both waveguiding structures. Because of the strong light confinement nonlinear effects are likely to appear for higher intensities. As usual one can distinguish between second and third order nonlinear effects, where the former will appear near half the band gap of III-V-semiconductors and the latter in ferroelectric PCs like Lithium niobate PC films. In the present contribution we review the formation of 1D and 2D lattice solitons in CROWs of Bragg solitons in PC waveguides with Kerr nonlinearity as well as second harmonic generation and optical parametric oscillation at point defects in PC films with quadratic nonlinearity.

Hauptvortrag SYPC 1.2 Mi 14:30 HV

Prospects in Optoelectronic Photonic Crystal Components — •J.-M. Lourtioz — Institut d'Électronique Fondamentale, UMR 8622 du CNRS, Bât. 220, Université Paris-Sud, 91405, Orsay Cedex, France

Photonic crystals (PhC), artificial, wavelength-scale multidimensional periodic structures, have given birth to a number of realizations in semiconductors. Photonic integrated circuits, especially around new integrated lasers are challenging directions of research for miniaturization and new functions in optical telecommunications. After recalling the basic physics behind, we will briefly review some of these applications and underline the current status of this very active research field worldwide. The largest part of the talk will concern the recent advances in $\lambda \approx 1.5 \mu m$ PhC waveguide lasers in the InP substrate approach. After a brief description of coupled cavity waveguide (WG) lasers and their use for integrated optics, we will mostly focus on canonical PhC WG lasers formed by one or several rows of missing holes in the PhC. Most of the results will be taken from the French RNRT CRISTEL project. We will show how a detailed experimental characterization and a detailed laser modeling have led to a better understanding of the laser behaviors with a particular attention to single mode laser emissions. The whole set of results opens new perspectives for photonic crystal lasers in the substrate approach.

Hauptvortrag SYPC 1.3 Mi 15:00 HV

The Wannier function approach to Photonic Crystal circuits — •Kurt Busch — Institut für Theoretische Festkörperphysik, Universität Karlsruhe, 76128 Karlsruhe, Germany

The past years have seen a tremendous increase in the development of Photonic Crystal based functional elements with applications ranging from telecommunication devices, and sensing all the way to fundamental investigations of nonlinear wave propagation and light-matter interaction in these systems. Further progress will simultaneously be driven by perfecting existing and developing novel material synthesis processes as well as by developing optimized device designs and novel operation principles.

In this talk, I will review recent advances in the in the theoretical modeling of Photonic Crystal circuits via the photonic Wannier functions approach [1]. Wannier functions represent a complete set of localized basis functions that are optimally adapted to the description of waveguiding structures embedded in Photonic Crystals. In fact, photonic Wannier functions are the optical analogue of atomic orbitals for Photonic Crystals. Consequently, as compared to traditional modeling methods, the Wannier function approach offers both significant advantages regarding the use of computational resources [2,3] as well as considerable physical insight into waveguiding phenomena in Photonic Crystals [2,4].

[1] K. Busch, S.F. Mingaleev, A. Garcia-Martin, M. Schillinger, and D. Hermann, J. Phys.: Cond. Mat. **15**, R1233 (2003).
[2] S.F. Mingaleev and K. Busch, Optics Letters **28**, 619 (2003).
[3] Y. Jiao, S.F. Mingaleev, M. Schillinger, D.A.B. Miller, S. Fan, and K. Busch, IEEE Photonics Technology Letters **17**, 1875 (2005).
[4] S.F. Mingaleev, M. Schillinger, D. Hermann, and K. Busch, Optics Letters **29**, 2858 (2004).

Hauptvortrag SYPC 1.4 Mi 15:30 HV

Surface plasmon routing along right angle bent metal strips — •Alain Dereux — Laboratoire de Physique de l'Université de Bourgogne, BP 47870, F-21078 Dijon, France

Surface Plasmons Polaritons (SPP) are electromagnetic waves that propagate along the surface of a conductor. The structure of a metal surface can be controlled by nanofabrication techniques in order to tailor the properties of surface plasmons and more specifically their interaction with visible and infra-red light, thereby offering the potential for developping new photonic devices. Surface plasmons physics is being explored for its potential in subwavelength optics, data storage, solar cells, microscopy and biosensing. Surface plasmons photonics, also called plasmonics, could evolve as a promising candidate to satisfy the constraints of miniaturisation of optical devices down to subwavelength sizes. An appealing feature of plasmonic circuitry is that it enables to carry optical signals and electric currents through the same thin metal circuitry, thereby opening the perspectives of unprecedented technical combinations to insert electrically driven devices on the same circuitry on which light is propagating. After a brief overview of plasmon optics, this contribution will present basic optical functionalities, such as Bragg mirrors or filters, that are already demonstrated by prototypes of plasmonic devices. The feasibility of routing SPP along metal stripes waveguides with 90^o bents by the integration of tilted micro-gratings acting as Bragg mirrors in the strips. The quantitative characterization of the mirrors efficiency, performed by means of photon scanning tunneling microscopy, shows that losses as low as 1.9 dB can be achieved. Moreover, SPP 50/50 beamsplitters have been obtained by an appropriate design of the Bragg mirrors constituting elements.