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Quasicrystals are aperiodic structures which possess long-range order but no translational symmetry. We fabricated one-dimensional metallic photonic crystals with quasiperiodic lateral spacing. Gold nanowires were arranged on top of an Indium-Tin-Oxide (ITO) waveguide in a Fibonacci sequence or in Cantor sets. Examining the extinction spectra and comparing them to a purely periodic structure, additional peaks arise. The modelling of the extinction spectra both in TE as well as in TM polarization works well using the model of Nau et al. [1], which takes the spatial Fourier transform of the structure together with the waveguide dispersion into account. Angle-dependent measurements also reveal the photonic bandstructure of such quasiperiodic metallic photonic crystal samples.

[1] D. Nau et al., Phys. Rev. Lett. 98, 133902 (2007).

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Nonlinear Coordinate Transformation as an Extension of the Fourier Modal Method to Finite-Sized Structures — •Thomas Zebrowski[1], Sabine Essig[1,2,3], and Kurt Busch[1,2,3] — [1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe — [2]DFG Forschungszentrum Center for Functional Nanostructures (CFN), Universität Karlsruhe — [3]Karlsruhe School of Optics & Photonics (KSOP), Universität Karlsruhe

The Fourier Modal Method (FMM) can be extended to solve electromagnetic wave propagation problems associated with finite-sized structures. Since the basic algorithm is handling systems which are infinitely periodic in the lateral plane, non-periodic structure simulations via FMM have to introduce an artificial periodicity. In this case, however, interactions between the unit cells are unavoidable unless special measures are taken. Such an isolation of the unit cells may be facilitated through nonlinear conformal mappings. This means that we map the infinitely extended space surrounding the finite-sized structure onto a finite edge layer surrounding the unit cell. The resulting coordinate transformation is easily introduced into the algorithm. On our poster we show that this extended FMM algorithm can treat three-dimensional wave propagation problems that are difficult to solve with other frequency-domain methods such as the finite element approach.

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Time-Domain Simulations using Discontinuous Galerkin methods — •Kai Stannigel[1], Michael König[1,3], Jens Niegemann[1,2,3], Lasha Tkeshlashvili[1,2,3], and Kurt Busch[1,2,3] — [1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe — [2]DFG Forschungszentrum Center for Functional Nanostructures (CFN), Universität Karlsruhe — [3]Karlsruhe School of Optics & Photonics (KSOP), Universität Karlsruhe

The accurate numerical treatment of complex nano-photonic structures requires a flexible spatial discretization scheme. Standard finite elements are of limited use for time-domain calculations, since they usually require the inversion of large matrices in each time-step and are thus computationally expensive. This problem can be overcome by the use of Galerkin discontinuous elements. We demonstrate the superior accuracy and performance of this method by applying it to typical problems in the field of nano-photonics. The results are compared to standard methods such as FDTD.

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Numerical Treatment of Nonlinearities in Higher-Order Time-Domain Methods — •Jan Gieseler[1], Jens Niegemann[1,2,3], Lasha Tkeshlashvili[1,2,3], and Kurt Busch[1,2,3] — [1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe — [2]DFG Forschungszentrum Center for Functional Nanostructures (CFN), Universität Karlsruhe — [3]Karlsruhe School of Optics & Photonics (KSOP), Universität Karlsruhe

The accurate numerical treatment of field propagation in complex nano-structures often requires the use of higher-order methods. In nonlinear systems, advanced discretization schemes are particularly important to deliver reliable results. In this poster, we demonstrate how to calculate numerical fluxes for the nonlinear Maxwell equations. These fluxes are then used to construct a higher-order discontinuous Galerkin scheme for solving Maxwells equations with a Kerr nonlinearity. Our approach is further compared to standard methods such as FDTD.

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Component Analysis and Optimization of Photonic Crystal Based Semiconductor Laser Diodes — •Helmut Zarschizky[1], Lin Zschiedrich[1,2], Jan Pomplun[1,2], and Sven Burger[1,2] — [1]JCMwave GmbH, Haarer Straße 14a, 85640 Putzbrunn, Germany — [2]Zuse Institute Berlin, Takustraße 7, 14195 Berlin, Germany

Due to the reasonably large photonic bandgap in semiconductor based photonic crystals widely tunable laser diodes seem to be an attractive application. Design and optimization of layer thicknesses, lateral laser channel width, dimension of the unit cell and orientation of the crystal lattice for wave guiding and resonator facets are carried out using FEM-based simulation software. 2D- and 3D-results give detailed suggestions on appropriate resonator designs for wavelength tuning ranges over 100 nanometers in the telecommunication band (1550 nm) and for gas sensing (about 1850 nm).

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Defocused Imaging of Fluorescent Beads in Photonic Crystals — •Sven Zimmermann, Frank Cichos, and Rebecca Wagner — Molecular Nanophotonics Group, University of Leipzig, Linnéstraße 5, 04103 Leipzig

Photonic crystals are materials with a periodically varying dielectric constant. Multiple scattering of light on this spatially modulated refractive index causes a photonic band structure and photonic band gaps. We show that the fluorescence of emitters embedded into the photonic crystals is spectrally and spatially redistributed. Thus they can be used for studying the angular dependence of the photonic stop band. The photonic crystals are produced by self organisation of polystyrene beads using a vertical deposition technique. A small amount of beads is replaced by dye doped beads. They are detected using defocused fluorescence microscopy. Since the photonic crystal introduces an anisotropy to their emission the defocused imaging patterns are modified compared to a homogeneous medium (which is a medium without band structure). The diffraction patterns show a threefold symmetry which is clearly caused by the photonic crystal since it does not exist for emitters outside of it. This modification of the patterns is compared to simulations of the band structure and defocused images.

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Wannier function based numerical analyses of Photonic-Crystal functional elements incorporating optically anisotropic materials — •Patrick Mack[1,2], Daniel Hermann[2,3], Christoph Kölper[2], and Kurt Busch[2,3,4] — [1]Institut für Nanotechnologie, Forschungszentrum Karlsruhe — [2]Institut für Theoretische Festkörperphysik, Universität Karlsruhe — [3]DFG Forschungszentrum Center for Functional Nanostructures (CFN), Universität Karlsruhe — [4]Karlsruhe School of Optics & Photonics (KSOP), Universität Karlsruhe

Actively tunable properties of photonic crystals (PCs) may yield the key to integrated all-optical circuitry, allowing for new devices in optical telecommunication. We present numerical investigations of tunable functional elements in macroporous silicon PC structures based on infiltrating optically anisotropic materials into individual PC pores.

The numerical data has been obtained with the photonic Wannier function approach which is very well suited for computing the optical properties of PC-based optical devices. Recent advances in the experimental realization of such structures indicate that corresponding designs may be realized in the near future.

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Chirp dependent Emission of a fs-pumped Semiconductor Disc Laser — •Eckhard Kühn[1], Angela Thränhardt[1], Stephan W. Koch[1], Wolfgang Stolz[1], Sangam Chatterjee[1], Christoph Lange[1], Wolfgang Rühle[1], Wendel Wohlleben[2], and Marcus Motzkus[3] — [1]Fachbereich Physik, Philipps Universität Marburg, Deutschland — [2]Polymer Research, BASF AG Ludwigshafen, Deutschland — [3]Fachbereich Chemie, Philipps Universität Marburg, Deutschland

We present an experimental study and theoretical analysis of a semiconductor disc-laser system (VCSEL) under coherently controlled, phase sensitive excitation conditions. We show that the sign and the amplitude of the quadratical chirp modifies the total number and the average energy of the injected carriers. This strongly influences the laser gain and therefore the overall VCSEL emission. For the theoretical analysis of this effect, we use nonequilibrium simulations based on the microscopic carrier treatment of coupled Maxwell-multiband