Q 47 Photonische Kristalle III

Zeit: Mittwoch 17:30–18:30 Raum: HV

Q 47.1 Mi 17:30 HV

Superfocusing of scanning beams — •Anton Husakou and Joachim Herrmann — Max Born Institute, Max Born Str. 2a, 12489 Berlin, Germany

Overcoming the diffraction limit $\lambda/2$ of light focusing is of great importance in numerous fields. Although it can be done by near-field methods, they suffer from the required subwavelength proximity between a moving near-field element and an object. Here, we study a method to achieve subdiffraction focusing of a scanning beam without subwavelength spatial control. This method is based on the suggestion that evanescent waves can be amplified by a slab of a negative-refraction material, as confirmed by extensive theoretical and experimental work using metamaterials or photonic crystals. We have recently shown that it is possible to focus a light beam below the diffraction limit by using an element which creates seed evanescent waves, and a material with negative refraction, such as a photonic crystal, to amplify them and to form a subdiffraction spot (superfocusing). To achieve focusing of a *scanning* light beam to an arbitrary position, we need a light-controlled nonlinear element for the creation of seed evanescent components. Here we evaluate Kerr-like nonlinear materials as such elements, placed before the layer of a negative-refraction material. The calculations are performed both with effective-medium theory appropriate for metamaterials and by numerically solving Maxwell equations for a photonic crystal. We predict that subdiffraction focusing in the range of 0.2λ is achievable.

Q 47.2 Mi 17:45 HV

Photonic Crystal Lens — •Pshenay-Severin Ekaterina[1], Chii-Chang Chen[2], Thomas Pertsch[1], Markus Augustin[1], Arkadi Chipouline[1], and Andreas Tünnermann[1,3] — [1]ZIK Ultraoptics, Friedrich-Schiller-Universität Jena, Institute of Applied Physics, Max-Wien-Platz 1, D-07743, Jena, Germany — [2]National Central University, Taiwan — [3]Fraunhofer Institute for Applied Optics and Precision Engineering, Jena

One of the problems existing in the application of Photonic Crystals (PCs) is the coupling of light into Photonic Crystal Wave Guides (PCWG). We propose a method for Photonic Crystal waveguide coupling using a Photonic Crystal lens. The PC lens consists of a photonic crystal with gradually varying radii of the air holes. Similar to a normal lens, the PC lens focuses a parallel beam into a spot. However, the PC lens structure is much more compact and structurally compatible with PCWGs. We propose a method to optimize the parameters of a PC lens based on an effective refraction index approach. Based on optimized lens designs we demonstrate efficient coupling into a Photonic Crystal waveguide. The results are compared with existing taper couplers and a considerable shortening of the coupling device is demonstrated. Details of ongoing experimental realization based on low-index photonic crystals are discussed [1].

[1] R. Iliew, C. Etrich, U. Peschel, F. Lederer, M. Augustin, H.-J. Fuchs, D. Schelle, E.-B. Kley, S. Nolte, and A. Tünnermann, Appl. Phys. Lett. 85, 5854-5856 (2004).

Q 47.3 Mi 18:00 HV

Geometrical Freedom for Negative Refraction-based Photonic Crystal Lenses — •Jozef Havran[1], Javad Zarbakhsh[1,2], and Kurt Hingerl[1] — [1]Christian Doppler Lab, Halbleiter und Festkoerperphysik, Johannes Kepler Universitaet Linz, AltenbergerStr 69, A-4040 Linz, Austria — [2]Institut fuer Theoretische Festkoerperphysik, Universitaet Karlsruhe, 76128 Karlsruhe, Germany

Photonic band-gap materials are artificial structures with spatial variation of permittivity. Periodicity has been considered as an essential requirement for the formation of a photonic band gap. Investigations on photonic quasi-crystals, curvilinear photonic crystals, and circular photonic crystals (CPC) have changed this view. The negative refraction can be seen over a wide range of size changes in period array of air holes in Silicon wafers.

We calculate the geometrical freedom contour plot (GFCP) for Negative refraction by means of finite-difference time-domain simulations in order to determine the negative refraction range for different Period/Radius pairs. We present to which extent PC structures are flexible - still preserving negative refraction with favorable transmission. A goal function is defined to describe the rate of negative refraction. It is shown that GFCP can help us to design curvilinear PC lenses. The curvilinear negative refraction lens can focus electromagnetic waves better that PC flat lenses. We analyze the focusing effect theoretically and optimize the shape of lens in order to minimize the losses.

Q 47.4 Mi 18:15 HV

Design of all-optical spatial beam switches using the superprism effect in one-dimensional photonic nanostructures — •Felix Glöckler, Sabine Peters, Martina Gerken, and Uli Lemmer — Lichttechnisches Institut, Universität Karlsruhe (TH), Kaiserstraße 12, 76131 Karlsruhe

Photonic crystal superprism structures exhibit a rapid change in the group propagation direction with wavelength. For a fixed wavelength, a small change of the refractive index in such a superprism structure also results in a rapid change in the group propagation direction. We investigate the implementation of an all-optical switching device using a multilayer one-dimensional photonic crystal with coupled defects (cavities). As the active medium we integrate optically nonlinear polymer layers into the structure, since organic polymer materials show large nonlinear effects and fast switching times. This device will allow the switching of an incident laser beam to one of several output positions by variation of the optical pump intensity. The proper design of the layer structure is a key component for optimizing the performance of the device. We present and compare different designs based on coupled cavities. The active layer can be placed inside the cavities or it can serve as a coupling layer between two cavities. Both approaches are evaluated with respect to performance parameters such as switching energy and necessary number of layers.