Photonic crystal resonators with electrical contacts — Martin Kamps, Benedikt Friess, Thomas Schlireit, Sven Höfling, and Lukas Worschech — Technische Physik, Am Hubland, 97074 Würzburg

Photonic crystal (PhC) resonators with embedded quantum dots have become an intensively studied solid state system for experiments on cavity quantum electrodynamics. Contacts that allow carrier injection/extraction or the possibility to apply an electric field to the quantum dots provide an additional degree of control over these structures.

We have investigated PhC resonators fabricated in GaAs membranes with embedded InGaAs quantum dots. The upper and lower half of the GaAs membrane were doped, thus forming a pn junction. After definition of the contact metallization to the front and back side of the sample, photonic crystal resonators based on three missing holes in a PhC lattice were fabricated. The structures were measured by low temperature photo- and electroluminescence. The latter was observed when operating the structures in forward bias. A reverse bias allowed to tune the emission wavelength of quantum dots in the cavity by the quantum confined Stark effect. In addition, photocurrent spectroscopy was performed by scanning a tunable laser over the resonance of the cavity and detecting the photocurrent. The resonance of the PhC cavity is clearly observed, with a quality factor comparable to that observed in the photoluminescence.

Angle-resolved fluorescence detection by defocused wide-field imaging — Rebecca Wagner, Georg Kohnert, and Frank Chichos — Molecular Nanophotonics Group, University of Leipzig, Linnéstraße 5, 04103 Leipzig

Photonic Crystals (PCs) are materials where the dielectric constant varies periodically. Multiple scattering of light on this spatially modulated refractive index leads to the formation of a photonic band structure including photonic band gaps where light can not propagate through the material. This band structure can for example be probed by angle resolved reflection spectroscopy. However, for every angle of incidence the detection angle has to be varied since reflections can occur on different lattice plane families, which makes this method very time consuming. A faster method is angle resolved fluorescence spectroscopy of internal emitters where only the angle of detection has to be varied. Still the problem remains to make sure that the scattering properties of this type of materials make them extremely interesting for fiber optical filters in the visible wavelength range and that filtering materials with a relatively high turbidity are in general potentially useful as filling materials for solid core photonic crystal fibers.

Growth of Pyramidal GaAs Cavities — Daniel Rüke, Matthias Karl, Dongsin Hu, Daniel M. Schaadt, Heinz Kalt — Institut für Angewandte Physik und DFG Center for Functional Nanostructures (CFN), Karlsruhe Institut für Technologie (KIT), 76131 Karlsruhe, Germany

Based on the fabrication technique of recently investigated pyramidal GaAs microcavities, we have developed a method to create microcavities with the shape of truncated pyramids sandwiched between two distributed Bragg reflectors (DBRs). To this end, an AlAs sacrificial layer is utilized for facet formation in a wet-chemical etching process. The sacrificial layer is then removed in a selective etching step and, after a further selective etching step, truncated pyramids with a DBR underneath are obtained. Overgrown with a second DBR on top, these cavities serve as high-quality (Q) resonators with observed Q-factors of optical modes up to 8000. Compared to conventional cylindrical pillar resonators their smooth facet angle of about 20° promises reduced scattering losses at the edges of the cavity and a reduced density of leaky modes.

Strain dependence of second harmonic generation in silicon — Clemens Schriewer, Christian Bohley, Jörg Schilling, and Ralf Wehrspohn — 1ZIK "Silicon", Martin-Luther-University Halle — 2Martin-Luther-University Halle Wittenberg

In recent years, silicon has become a favored material in photonics, mainly due to its highly optimized CMOS processing technology and extremely interesting for fiber optical filters in the visible wavelength range and that filtering materials with a relatively high turbidity are in general potentially useful as filling materials for solid core photonic crystal fibers.
its suitable optical properties at telecommunication wavelengths. Here it has proven itself as passive optical component. The difficulty of integrating silicon into active optoelectronics, where electrical and optical functionalities are combined in a monolithic device is due to its limited active optical properties. Generally, second order nonlinear optical effects like second harmonic generation are forbidden in silicon because of its inversion symmetry. However, an induced inhomogeneous strain can reduce the symmetry of the crystal and therefore give rise to a second order nonlinear susceptibility. This opens the possibility to create silicon based active optical devices, e.g. electro-optical modulators and switches. Here we determine experimentally the strain dependence of the second order nonlinear susceptibility on the applied strain by means of second harmonic generation in a reflecting geometry. The components of the second order nonlinear susceptibility are determined and compared to the unstrained case. The results agree well with theoretical predictions that take into account the applied strain. There, an analytical dependence of the second order nonlinear susceptibility on the strain is derived from an sp³-orbital concept.