tact leads to a Schottky-barrier and a corresponding electrostatic potential in the semiconductor. This potential is different within the aperture, i.e. at the semiconductor-insulator-air interface. As this electrostatic potential adds to both, the valence and the conduction band energy, it is not visible in the optical transitions seen in Figs. 1(d). However, as soon as electrons and holes are generated within such a lateral potential well under the aperture, they modify the potential landscape. Numerical solutions of the drift-diffusion equations, self-consistently solved together with Poisson's equation, lead to the static carrier distributions shown in Fig. 2(b). Holes accumulate at the edge of the aperture, electrons in the center. This allows for spatially direct optical transitions in the center of the aperture, which are spectrally unshifted, and spatially indirect optical transitions close to the edge of the hole, which are expected to be red-shifted. For larger optically excited carrier densities, the charges completely screen this potential and the spatially direct, spectrally unshifted luminescence is recovered. This reasoning explains all the unusual linear and nonlinear features seen in our experiments.

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QMN4 **4:45 pm**

Coherent imaging of local fields in photonic crystals

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In the past years, much research has been focused on so called photonic crystals. Different ways of fabricating and simulating these structures have been introduced. Characterization is performed mostly with black box experiments, where reflected or transmitted light is detected.[1,2] We demonstrate a different approach, which allows us to take a direct look inside such structures. With a heterodyne interferometric photon scanning tunneling microscope (PSTM), we are able to visualize not only the amplitude of the local optical field, but also the phase information of light propagating inside the crystal.

Conventional Photon Scanning Tunneling Microscopes (PSTM) have proven to be very useful tools for characterization of integrated optics devices. Already different results were achieved by investigating photonic structures.[3–5] To obtain heterodyne the phase information, we included our PSTM in one leg of a Mach-Zehnder interferometer.[6]

Using focused ion beam milling we succeeded to fabricate various low-dimensional photonic crystals. The waveguides used as basis for all our structures are Si_3N_4 ridges with a width and height of 1.5um and 55nm, respectively.

Figure 1a shows a focused ion beam image of the conventional ridge waveguide containing an array of 15 air rods (diameter of the air rods: 110 nm, period: 220 nm). An interferometric PSTM image of light inside the structure is depicted in figure 1b. Most of the intensity is confined in the waveguide region. After passing the periodic air rod region, two intense beams are diffracted under an angle of approximately 20 degrees. The periodicity of the horizontal stripes (phase fronts) corresponds to the wavelength of light in the material. A pure phase image is shown in figure 1c. A variety of different phase singularities is revealed outside the waveguide. Additionally, circular shaped waves with their origin in the region of the 15 air rods can be seen. In the periodic air rod region, a slightly different refractive index than the one of the material can be determined from the local spacing between the phase fronts.

To investigate the scattering behavior of 15 air rods, experiments for a range of different wavelengths (585nm – 647nm) of incoupled light are performed. Figure 2 depicts a line plot of the intensity along the waveguide axis. In front of the air rod array, a standing wave is built up due to interference between incoming and backreflected light. The modulation depth of the standing wave reveals the reflection coefficient of the structure. In the region of the periodic air rod array, a wavelength dependent attenuation is found.

In conclusion, heterodyne interferometric photon scanning tunneling microscopy gives detailed insight in reflected and transmitted waves as they develop through periodic structures. Ultimately, this method will allow us to visualize the opening of a stop gap in one or two-dimensional photonic crystals.

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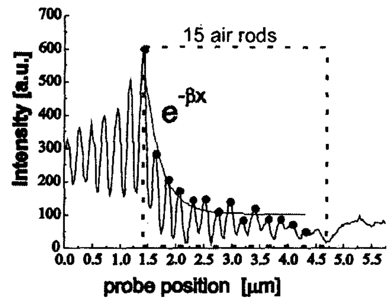
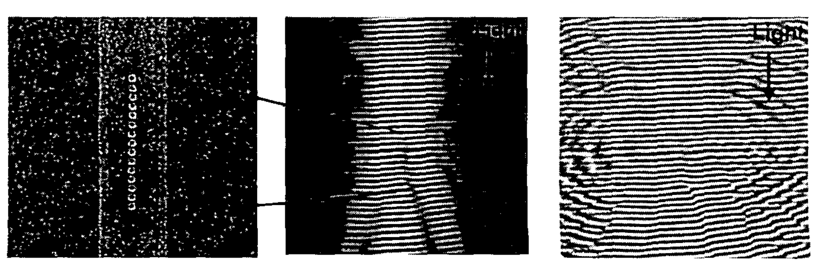


QMN4 **Fig. 2.** Lineplot along the waveguide axis of the intensity of light. Light propagates from left to right. An exponential decay can be fitted in the air rod region.



QMN4 **Fig. 1.** One-dimensional photonic crystal: 15 air rods milled into a waveguide ridge. (a) Topography obtained by focused ion beam imaging. (b) Product of the amplitude of light and the cosine of the phase. (c) The cosine of the phase of light reveals local information about the refractive index. (Image size: 14.25µm × 9.37µm)

QMN5 **5:15 pm**

A pyramidal silicon probe with an extremely high throughput and resolution for optical near field technology

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For improvement in the performances of spatially resolved spectroscopy, optical data storage, and so on, we demonstrate here an extremely high throughput and resolution capability of a