## Abstract

In this thesis photonic crystals are discussed. They are composed of different materials and form a periodically structured index of refraction. Often, photonic crystals consist of 2D pores or spheres in the (sub-)micrometer range, which give a spatial modulated permittivity. The possibility to design the dispersion relation enables new approaches for optical devices. Light is reflected at band gaps, or propagates very slowly through the crystal close to the band edges. Inside a band the crystal is almost transparent. In this thesis 2D crystals are investigated. They are produced by an established and designable batched process.

Theoretically, a perfect crystal has no surfaces. But real crytals do have interfaces, where surface states can occure. The opposite surface states can couple in small crystals (with a lattice size smaller than ten periods) and allow transmission inside the band gap. In this thesis, new kinds of surface states are used to enhance the transmission at band edges. A novel gas sensor, based on low group velocities, could therefore be realized.

Surface states have an important influence on the negative refraction index effect of photonic crystals. For negative refraction the well-known model from literature is discussed and an improved model is suggested. The new model is based on non-coupling bands. To complete the negative refraction investigation the scattered light of a low index photonic crystal is simulated and measured in the microwave frequency range.