

Reducing the Propagation Losses of Substrate-Type Photonic Crystal Waveguides for Active Photonic Devices

Line-defect photonic crystal (PhC) waveguides are promising for integrated photonic circuits, because they exhibit frequency regimes of slow light propagation. Slow waves are characterized by strongly enlarged light intensities, which enhance the interaction of the propagating light with its host material. The enhancement of the non-linear light-matter interactions can be used to reduce the device lengths of integrated photonic components.

PhC waveguides exploiting slow light modes to reduce the device length of all-optical logic gates have already been demonstrated. However, for an all-embracing photonic integrated circuit technology, efficient electrically driven PhC waveguides with a net gain are desired too. But efficient electrically driven PhC devices are still lacking today.

One approach for the implementation of electrically driven line-defect PhC waveguides is based on a vertical heterostructure with a weak refractive index contrast. These so-called substrate-type line-defect PhC waveguides suffer from substantial lateral current leakage and large propagation losses in the order of 600-1000 dB/cm. The focus of my presentation is thus solely devoted to the question 'If and how the large propagation losses in those substrate-type line-defect PhC waveguides can be reduced ?'

Finally, a single-mode line-defect PhC waveguide design, that could be used for an electrically pumped optical amplifier is presented. This design exhibits propagation losses below 20 dB/cm and simultaneously provides the possibility for vertical carrier injection.