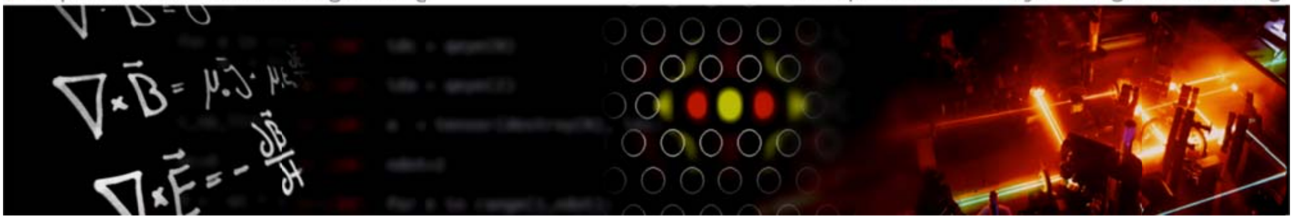

M.Sc. project

Experimental characterization of slow light enhanced photonic crystal optical amplifiers.

The semiconductor optical amplifier is a key component for any optical network, however, for use in an integrated platform, downscaling the required size footprint is of major importance. The aim of this project is to experimentally investigate the fundamental as well as practical limits for achieving enhanced amplification using photonic crystal waveguide based optical amplifiers that exploit slow light effects.

Planar photonic crystals are fabricated by creating periodically placed holes (~100 nm apart) in a membrane that generates a "photonic bandgap" in which light cannot propagate. By leaving out a row of holes a waveguide is created, in which light may travel (see fig. 1). The propagation velocity of the guided light may be designed by the tuning the size and position of holes adjacent to the waveguide. Enhancing the gain by exploiting slow light is intuitively understood by visualizing the effective slow as a multiple back-and-forth scattering of the light beam. This lengthens the local dwell time in the medium and thereby increases the gain coefficient proportionally with the slow down effect. Thus achieving a slow down of light by a factor of 100, seems promising for downscaling the length of optical amplifier to a few tens of micrometers. However, several fundamental as well as practical effects may play an important achieving such enhancements. These include Anderson localization, disorder induced losses, heating, and optical nonlinearities.

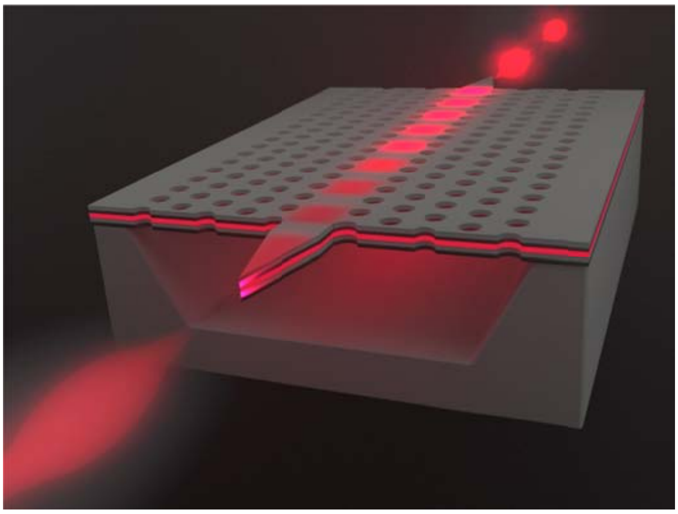

Fig. II Artistic illustration of a photonic crystal waveguide that amplifies optical pulses

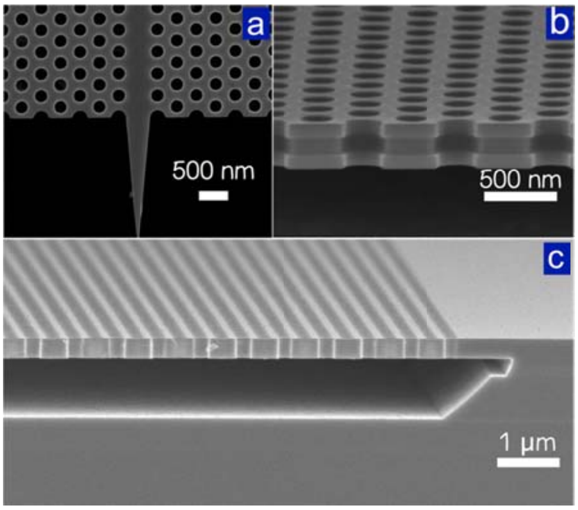

Fig. III Scanning electron microscopy images of a fabricated sample

In this project you will investigate the role of (some of) these effects by monitoring the amplified spontaneous emission as well as measuring the fast electron-hole dynamics using ultra short laser pulses. Our group has a solid theoretical foundation and the project thus offers the possibility for including some theoretical modeling as well.

Some prior knowledge of waveguide theory, optics in semiconductors, quantum mechanics, programming (LabView, Matlab and/or Python) as well as some experimental experience is recommended.

Sounds interesting? If you want to hear more about the project, do not hesitate to come by our offices or send us an email, we do not bite (at least not students).

Supervisors:

Per Lunnemann (plha@fotonik.dtu.dk) building 345V/177, tel. 45 25 63 79

Jesper Mørk (jesm@fotonik.dtu.dk) building 345V/081, tel. 45 25 63 79

Topic related references

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