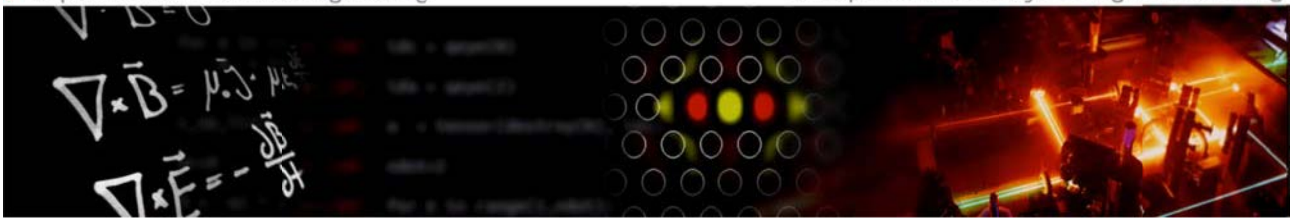

M.Sc. project

Experimental time resolved dynamics of photonic crystal switches

An optically controlled photonic switch is a key component for achieving high speed all optical signal processing. However, data processing at nodes is still carried out using integrated electronic circuits with limited possibilities for further increasing the speed owing to heating issues. Photonic crystal nanocavities provide an excellent platform for achieving the necessary optical non-linearity required for all-optical switching. In this project you will experimentally explore the fast dynamics of InP photonic crystal switches using pump-probe spectroscopy.

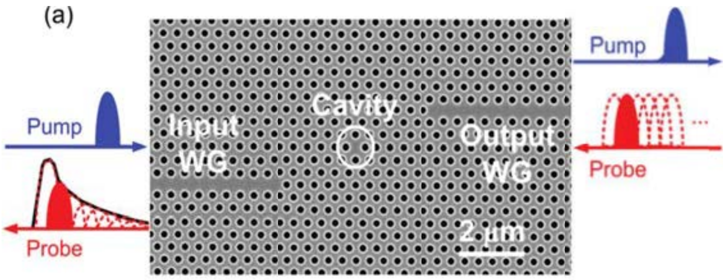

Fig. I Scanning electron microscopy image of a 2-port photonic crystal switch

Planar photonic crystals are fabricated by creating periodically placed holes (~ a few 100 nm apart) in a membrane that generates a “photonic bandgap” in which light cannot propagate. By leaving out a few holes row of holes a cavity is formed in which light with a specific wavelength may resonate. Light is coupled into the cavity from a nearby photonic crystal waveguide. The build up of a huge electric field inside the cavity induces a shift of the resonance, forbidding any subsequent pulse to be transmitted. A crucial point using optical switches is the energy requirements for switching, but also the recovery time, i.e. the time from a switching operation until a new can be applied, is important. For this, the choice of material and photonic crystal geometry play an important role.

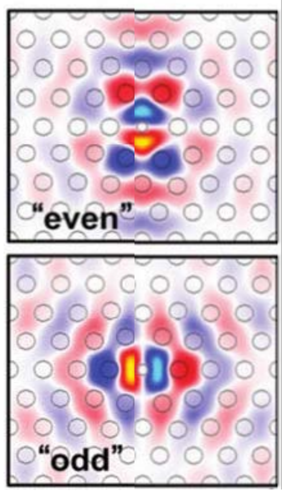

Fig. II Resonating optical modes in a photonic crystal cavity

In this project you will experimentally explore InP-based photonic crystal switches with different geometries using short pulses. Using short 150 fs laser pulses in a heterodyne pump-probe setup in combination with a waveshaper, the spectral as well as temporal dynamics can be measured, providing information of the underlying light matter interaction. 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).

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Jesper Mørk (jesm@fotonik.dtu.dk)

Topic related references

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