Ecole Doctorale de Physique de la Région Parisienne (ED107)

PROPOSITION DE SUJET DE THESE

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Lieu de la thèse: Technical University of Denmark, Kgs. Lyngby, Denmark

Financement proposé : Non
Si oui, type de financement :

Optical actuation of a micromechanical resonator

The framework of the work is a long standing collaboration between DTU Fotonik and a CNRS/CEA Grenoble team. An exchange visit at CEA/CNRS in Grenoble during the project is a possibility.

The general context of this work is the study of the strain mediated coupling between a single semiconducting quantum dot and a micromechanical resonator [1]. The resonator is a photonic "trumpet" nanowire shown in Fig. 1 optimized for efficient single photon extraction [2]. The strain induced by the wire motion affects strongly the transition energy of an embedded quantum dot.

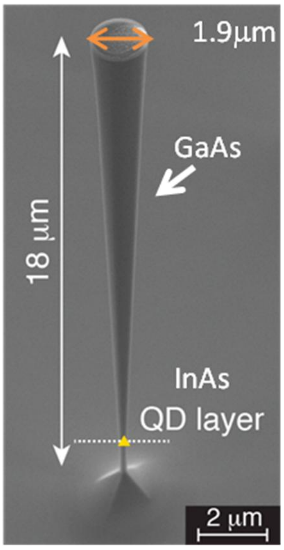

Fig. 1. Scanning electron micrograph of the photonic nanowire.

The Grenoble team has experimentally observed that the wire can be set in motion by being illuminated with an off-centered laser beam. If the laser intensity is chopped at the mechanical frequency of the first fundamental mode, the light exerts a periodic force that drives the wire oscillations. Moreover, this force could be large enough to allow for a static bending of the wire that would enable the tuning of the quantum dot transition energy.

The goal of the project is to compute this optical force as a function of the laser position to find its maximum. This will be done by numerically calculating the electromagnetic field spatial distribution with a finite element software (COMSOL). The corresponding experiment will be carried out in Grenoble, allowing a theory-experiment comparison.

The student will thus

- compute the electromagnetic field using an optical simulation tool (COMSOL).
- analyze the optical forces exerted on the nanowire as function of geometry.
- propose a novel photonic trumpet design and a corresponding optimized laser beam profile.

Knowledge of electromagnetics (Maxwell's equations) and basic Matlab programming is recommended.

References:

[1]: I. Yeo et al, http://arxiv.org/abs/1306.4209 to appear in Nature Nanotechnology.

[2]: M. Munsch et al, Phys. Rev. Lett. **110**, 177402 (2013).