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Master in Photonics – “PHOTONICS BCN” Master ERASMUS Mundus “EuroPhotonics”

MASTER THESIS PROPOSAL

Starting full time from April 2024

Presentation at the end of July or beginning of September 2024

Laboratory: Department of Electronics and Biomedical Engineering

Institution: Universitat de Barcelona (UB)

City, Country: Barcelona, Spain

Title of the master thesis: Optomechanical photonic crystal cavities based on silicon-on-insulator nanopillars

Name of the master thesis supervisor and co-supervisor:

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Keywords: Cavity Optomechanics, silicon, optomechanical crystals

Summary of the subject (maximum 1 page):

Cavity optomechanics, highlighted by the prestigious journal Nature as one of the latest milestones in photonics, studies the interaction between electromagnetic and mechanical modes in optical resonators. Among the different possible realisations of optomechanical cavities, optomechanical crystals (OMCs) are probably those with the strongest potential from the technological point of view since they can be straightforwardly integrated in photonic integrated circuit platforms. As a consequence of the periodic variation of the dielectric properties, OMCs behave as photonic crystals, thus being able to display photonic energy gaps of forbidden energies. By carefully introducing engineered defects within the periodical structure, it is possible to create photonic cavities leading to the comparison of spatially localized photonic states within the gaps. The specific optomechanical crystal cavity geometry that will be studied in this master thesis is composed by a set of silicon on insulator pillars. Each of these pillars can be understood also as a mechanical cantilever that can interact with the photonic cavity mode, giving rise to the optomechanical interaction.

The master student will be integrated into an on-going European project dedicated to the implementation of nanopillar-based OMCs in silicon chips that operate at room temperature in



the near IR optical region, with applications in biological sensing. In particular, the student will study the optomechanical properties of these cavities, both from the numerical and from an experimental characterization point of view.

References (<http://navarrourrios.com/Publications.html>):

- D. Navarro-Urrios et al. Scientific Reports, 11 (1), 7829, (2021). <https://doi.org/10.1038/s41598-021-87558-4>
- D. Navarro-Urrios et al., "Properties of Nanocrystalline Silicon Probed by Optomechanics", Nanophotonics, 9(16), 4819-4829 (2020)
- J. Gomis-Bresco, D. Navarro-Urrios et al. , "A one-dimensional optomechanical crystal with a complete phononic band gap", Nature Communications, 5, 4452 (2014)

Objectives:

- To describe numerically and experimentally the optomechanical interaction of pillar-based optomechanical cavities and understand their potential as biological sensors.

Outcomes:

Getting prepared for a PhD project and/or position. The final master report can culminate in a publication.

Additional information (if needed):

* Required skills: Some knowledge of waveguide and fibre optic operation is recommended. The work will involve experimental duties, so good skills and interest in doing laboratory work is also recommended.