



Education and Culture DG

ERASMUS MUNDUS



MASTER IN PHOTONICS – “PHOTONICS BCN” ERASMUS+ “EUROPHOTONICS”

MASTER THESIS PROPOSAL

Dates: April - September 2019

Laboratory : Optoelectronics

Institution: The Institute of Photonic Sciences

City, Country : Castelldefels, Barcelona, Spain

Title of the master thesis: Interferometric Imager with Subnanometer-resolution for Material Analysis

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Keywords : Lensfree Interference Microscopy, Tomography, Optics, Programming

Summary of the subject (maximum 1 page) :

Imaging surfaces with nano-scale topology is essential for the field of nanosciences, in particular for material analysis and medical applications. To-date such imaging devices are often very expensive, bulky and mostly for laboratory usage. This project is about developing and verifying a prototype of such an imaging device (based on CMOS) for material analysis (e.g. detection of defect in transparent glass). The detection mechanism is based on a lens-free interferometric method allowing the detection of height differences down to a few Å over an area of $\sim 1\text{cm}^2$. Using an appropriate algorithm will allow the precise 3-dimensional detection of particulates, defects or surface deformation. This is in particular essential for transparent substrates for flexible electronics.

The goal of this master-/ or project-thesis is to further develop an interference microscopy including a tomographic algorithm and to verify the system on real samples. The project could include the following parts:

- Further develop interference microscopy
- Development and implementation of the holographic tomography software
- Evaluate 3D samples for detection
- Use machine learning to improve reading
- Using quantum sources and single-photon detectors to increase sensitivity and develop first practical quantum device for imaging (part of EU project)

The student would learn to build an optical interferometer (including the fields of optics, programming, electronics), design a Internet-of-Things / Point-of-Care prototype, design & verify computational holography including machine learning and develop practical quantum imaging device. The exact project can be adapted to the interest of the student and his availability.