

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

### MASTER THESIS PROPOSAL

**Dates: April - September 2019**

**Laboratory :** Quantum Nano-Optoelectronics group of Prof. Frank Koppens (Website: Graphene.icfo.eu)

**Institution:** ICFO

**City, Country :** Castelldefels, Spain

**Title of the master thesis:** Integration of graphene with Si-CMOS integrated circuits

**Name of the master thesis supervisor:** Frank Koppens

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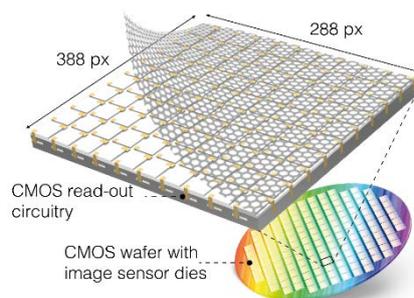
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**Keywords :** graphene, transfer, integration

#### **Summary of the subject (maximum 1 page) :**

The marriage of graphene with colloidal quantum dots has proven to be very successful for photo detection [1]. These hybrid detectors are very sensitive and on par with state-of-the-art technologies. The detectors can be used in a plethora of applications such as safety and security applications in automotive vision systems for driver safety, food and pharmaceutical inspection, civil and military surveillance, night vision applications and environmental monitoring (see also <https://youtu.be/szL-ejdpNgU>). We have already shown several prototypes including a CMOS integrated broadband camera [2].



Now the concept has been shown to work, we are working on upscaling the fabrication of the image sensors. One of the main challenges is to transfer high quality large area graphene from the growth substrate (chemical vapour deposition) onto a Si-CMOS integrated circuit (image on the left). The project involves development of a novel automated transfer machine and characterization of the transferred graphene by optical methods including Raman spectroscopy.

We offer you an exciting, multi-disciplinary research project in a highly motivating research environment. You can expect to gain in-depth knowledge about the

fields of 2D materials.

provide you with very valuable experience for a future career in research.

Working on this project will

[1] Konstantatos et al., *Nature Nanotechnology* **7**, (2012), doi:10.1038/nnano.2012.60

[2] Goossens et al., *Nat. Photonics* 2017, <https://doi.org/10.1038/nphoton.2017.75>

**Keywords : graphene, materials, transfer, photodetectors, nanofabrication**

**Additional information :**

Required skills : Courses or hands-on experience in the following fields come in very useful: electronics, material science, optical systems, micro/nano fabrication, semiconductor physics, optoelectronics, sensors, micro-fabrication.

\* Miscellaneous :

**Additional information :**

\* Required skills :

\* Miscellaneous :