

# International Doctoral Program in Science Position

## Functionalization of 2D materials using ultra-low energy ion implantation

### Background and motivation

2D materials, such as graphene, transition metal dichalcogenides (TMDs) and boron nitride hold great potential for application in nanoelectronics, spintronics, valleytronics, and quantum technologies. Towards such applications, it is crucial to understand how 2D materials can be functionalized, i.e. how to tune their electronic properties and even induce new phenomena, for example, to modify the conductivity (e.g. n-type or p-type doping), the magnetic behavior (e.g. induce ferromagnetism), or valley polarization (e.g. in TMDs).

This project deals with understanding the how the electronic properties of 2D materials are modified or induced by dopant atoms (e.g. foreign atoms replacing boron or nitrogen in boron nitride). The dopants are introduced using ultra-low energy ion implantation, a novel technique for modification of 2-dimensional materials. Among a wide range of complementary experimental techniques, we rely on scanning tunneling microscopy and spectroscopy and (angular-resolved) photo-emission spectroscopies for revealing the (local and non-local) electronic and magnetic properties. This fundamental understanding of the electronic and magnetic properties of the doped 2D materials will be used to explore new functional phenomena, in particular in the context of nanoelectronics, spintronics, valleytronics and quantum technologies.

### Profile

- Diploma: Master's degree in Physics or an equivalent degree.
- A solid background in solid state physics is required.
- Experience with 2D materials, ion beam techniques, or semiconductor doping is not required but may be considered as an advantage.
- Good knowledge of the English language, both spoken and written, is essential.
- Strong commitment, ability to work in a team, and eagerness for international mobility is desired.

### Opportunities

- Participating to an international collaboration between KU Leuven (Belgium) and Università Cattolica del Sacro Cuore (Italy)
- Double degree opportunity.
- Develop didactical experience by being involved in teaching and training duties for a limited amount of time (e.g. daily supervision of small research projects of Bachelor and Master students).

### Supervisors

- Prof. Lino da Costa Pereira, KU [lino.pereira@kuleuven.be](mailto:lino.pereira@kuleuven.be)
- Prof Luca Gavioli, UCSC [Luca.gavioli@unicatt.it](mailto:Luca.gavioli@unicatt.it)
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