

## DC2: Multi-functional carbon-based nanoparticles with antimicrobial properties for therapy and detection

**Host institution:** [Centro de Investigación Cooperativa en Biomateriales CIC \(CIC biomaGUNE\)](#), Donostia-San Sebastián, Spain

**Supervisor:** [Prof. Maurizio Prato](#)

**Co-supervisors:** Dr. Lucia Cardo (CIC biomaGUNE); Prof. Iolanda Francolini (Sapienza University of Rome)

**Project description:** Biofilm-associated infections represent a major and persistent challenge in wound care, as current diagnostic approaches are often slow, invasive, and lack the sensitivity required for real-time monitoring. In this context, emerging nanomaterials, particularly carbon-based nanostructures, offer promising opportunities for the development of non-invasive diagnostic tools and innovative antimicrobial strategies.

This PhD project will focus on the design, synthesis, and functionalization of carbon dots (C-dots), an emerging class of ultrasmall, carbon-rich nanoparticles, as multifunctional platforms for both infection diagnostics and antimicrobial intervention. The candidate will develop C-dots with finely tunable physicochemical and optical properties, including chirality, multimodal fluorescence, and light-responsive behaviour, enabling advanced sensing and imaging capabilities.

A central objective of the project is the engineering of nanomaterials that combine high biocompatibility and low toxicity toward mammalian cells with the ability to selectively interact with microbial species. This will be achieved through rational design strategies based on molecular recognition and/or external stimuli (e.g., light-triggered activation). The most promising candidates, identified based on their optical performance and biological compatibility, will be further functionalized to introduce additional features such as targeting capability and improved antimicrobial activity. In parallel, the project will explore the integration of selected C-dot systems into advanced three-dimensional biomaterials, such as antibacterial films, to create multifunctional platforms capable of detecting and disrupting biofilms while supporting tissue regeneration in wound healing applications. The successful candidate will benefit from a highly interdisciplinary training environment at the interface of nanomaterials chemistry, cell and microbiology, and biomedical engineering. They will acquire expertise in nanoparticle synthesis, advanced optical characterization, and biological evaluation in relevant *in vitro* models, within the collaborative framework of an international doctoral network.

**Host Laboratory:** The mission of the Carbon Bionanotechnology Laboratory is to develop tailored carbon-based nanostructures for applications at the interface of nanotechnology and biology. This is achieved through the rational design of nanomaterials with highly tunable properties — including optical, chiral, photoactive, surface, and biorecognition features — that can be adapted to specific bio-related applications. Therefore, the group is largely dedicated to establishing innovative synthetic protocols and advanced analytical methodologies that enable the controlled, reproducible, and scalable production of carbon nanostructures, as well as to studying the relationship between the physicochemical properties of materials and their activity in biologically relevant settings. The candidate will receive comprehensive training in a wide range of techniques and methodologies, including nanoparticle synthesis, bioconjugation chemistry, and advanced characterization methods (e.g. chromatography, optical spectroscopy, and optical and electron microscopy). The project will also involve the development and characterization of hybrid 3D materials. In addition, the candidate will gain hands-on experience working in cell biology and microbiology laboratories, developing skills in biological evaluation and working with relevant *in vitro* models.

**Secondments:** This project is carried out in collaboration with the following groups, and visits to their laboratories are expected during the project. A willingness to travel and spend time abroad is therefore essential:

- [Prof. Iolanda Francolini](#), Sapienza University of Rome, Rome, Italy
- [Prof. Bengt Fadeel](#), Karolinska Institutet, Stockholm, Sweden

**Eligibility conditions:**

- Master's degree in Chemistry, Materials Science, Nanoscience, Chemical Engineering, Physical Chemistry or related fields.
- Applicants must be doctoral candidates, i.e. not already in possession of a doctoral degree.
- Mobility rule: researchers must not have resided or carried out their main activity in the country of the recruiting beneficiary for more than 12 months in the 36 months immediately before their recruitment date.

**Required skills:**

- Experience in organic chemistry and/or nanomaterial synthesis, ideally demonstrated through a Master's thesis work or research internships.
- Familiarity with physicochemical and optical characterization techniques (e.g. optical spectroscopy, fluorescence analysis, TEM, DLS, AFM, etc) and basic understanding of structure-property relationships in nanomaterials; prior exposure to bio-related applications or antimicrobial systems is not compulsory but it would be an advantage.
- Proficiency in the English language is required, as well as good communication skills, both oral and written. Successful candidates will need to provide an English test (e.g. IELTS, TOEFL, Cambridge English). You may be exempt if you are a national of a majority native-English speaking country or have qualifications / degree that has been taught and assessed in English. The supervisor may also confirm that a candidate has the required level of English.

**Remuneration:**

The Doctoral Candidate will be hired under a three-year predoctoral contract and will receive a gross monthly salary of EUR 3,407 in accordance with the MSCA Doctoral Networks programme, including a living allowance and a mobility allowance. This amount corresponds to the contractual gross salary and is stated before the deduction of employee taxes and social security contributions. An additional family allowance (if applicable) is foreseen. The net salary will depend on local taxation, social security, and employment regulations.

According to the contract regulations, the candidate will be enrolled in the Doctoral Programme in Applied Chemistry and Polymeric Materials at University of the Basque Country (UPV/EHU) upon joining the centre.

**Enquiries:**

For general information about the **HEAL-4WARD Doctoral Network** visit the project website ([www.heal4ward.eu](http://www.heal4ward.eu)) or send an email to [heal4ward@gmail.com](mailto:heal4ward@gmail.com).

For additional information on this project (DC2) please contact Prof. Maurizio Prato ([mprato@cicbiomagune.es](mailto:mprato@cicbiomagune.es)) or Dr. Lucia Cardo ([lcardo@cicbiomagune.es](mailto:lcardo@cicbiomagune.es))

**How to apply**

For this position, apply directly through the institutional website: <https://www.cicbiomagune.es/job-offer-detail?id=43435>.

**Required documents:**

- Statement of interest (limit of 2,500 characters) explaining why you wish to be considered for the fellowship and which qualities and experience you will bring to the role.
- Curriculum vitae et studiorum.
- A certificate of University examinations taken (with marks).
- A final degree certificate translated in English. If, at the time of application, candidates should not be yet in possession of a degree certificate, they can submit it at the time of the examination.

A limited number of applicants will be invited for an interview and will be required to provide contact information of up to two contact person for reference letters.

**Application deadline:** The closing date for applications is **30 June 2026**.