

CONTRATOS PREDOCTORALES – MATRANS24 (CEX2023-001263-S)

RESEARCH CHALLENGE:

RC NRG1 Earth abundant elements for novel light harvesting devices

PROJECT TITLE / JOB POSITION TITLE:

Carbon-Dots Based Phosphors for Efficient Light Emitting Diodes

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:

(Max. 2.000 characters – including spaces)

This project focuses on developing a scalable synthesis method for producing high quantum yield carbon dots (CDs) and gaining a deeper understanding of the fundamental mechanisms behind their photoluminescence. The goal is to create a reproducible, cost-effective synthesis process that maintains consistency in size, structure, shape, and surface properties across large-scale production, addressing a key challenge in the field. By optimizing reaction conditions, such as temperature, pressure, and time, the aim is to enhance the quantum yield and improve the overall efficiency of the CDs. Hybrid nanostructures with semiconducting organic small molecules such as phthalocyanines or with metal colloids could also be considered. In parallel, the project seeks to investigate the fundamental mechanisms driving the photoluminescence of CDs, including the roles of quantum confinement, surface functional groups, and defect states. Advanced characterization techniques, such as optical spectroscopy, electron microscopy as well as high pressure techniques, will be used to correlate the structural features of CDs with their optical properties. Finally, exploitation of the optical properties of these nanomaterials will be carried out in different device configurations, opening different pathways for the exploitation of this non-toxic and abundant light source.

The research will be carried out in the NANOPTO group whose research focuses in the areas of energy harvesting (thermoelectrics, organic photovoltaics), scalable photonic architectures, thermal transport and optical spectroscopy. Furthermore, two research secondments within ICMAB are envisioned in order to provide the researcher expertise in atomic layer deposition and chemical synthesis of nanomaterials.

JOB POSITION DESCRIPTION:

(Max. 2.000 characters – including spaces)

Include all the relevant information about the position, role, responsibilities and skills required within the project/group

The prospect FPI fellow will be trained in a broad range of multidisciplinary skills, including relevant aspects from chemical physics, material science and engineering as well as in the characterization and processing of low-dimensional semiconductors for the fabrication of novel light-emitting devices, using a variety of methods which would necessarily be carried out in high-tech controlled environments. The work plan to be developed by the fellow includes:

1. Investigate the precise mechanisms behind the photoluminescence of carbon dots, focusing on factors such as quantum confinement, surface states, and defects.
2. Develop methods to control and predict the emission behavior of carbon dots by addressing the complexity of multiple contributing factors.
3. Enhance the scalability of producing high-quality carbon dots from sustainable sources, while maintaining uniformity and minimizing costs.
4. Conduct research to improve the quantum yield and stability of carbon dots, especially for long-term applications in bioimaging and electronics.
5. Overcome the challenges to advance the practical use of carbon dots in commercial and industrial settings

The fellow will be also trained in non-transferrable skills, such as communication, academic English writing, ethics in research or intellectual property protection, offered to the fellow through the Severo Ochoa training opportunities at ICMAB.

Any previous knowledge in solid-state physics, optical spectroscopy, and nanofabrication would be appreciated but is not strictly necessary.

PhD CO-DIRECTORS:

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RELATED LINKS TO THE POSITION (optional)

URL: <http://nanopto.icmab.es>

Title link: link to the NANOPTO WEB