Fabrication and development of optoelectronic devices based on nanomaterials

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About the Project

Colloidal semiconductor nanocrystals are intrinsic single-photon emitters thanks to quantum confinement. Single-photon emission from individual and isolated nanocrystals has been studied in details using optical excitation. Yet, the possibility to obtain single-photon emission from a nanocrystal under electrical pumping (i.e. direct electron-hole injection) still requires major developments concerning nanocrystal positioning, electrodes deposition and general device architecture design.
Here, the research activity will aim at the development of tools for deterministic positioning of colloidal semiconductor nanocrystals, fabrication of device architectures and characterization of the obtained light-sources. Single nanocrystal deposition will be carried out on functionalized substrates previously prepared via lithographic tools. In addition to substrate functionality, solution deposition control is also important to obtain ordered arrays of isolated nanocrystals. Therefore, the PhD candidate will study which solution deposition method promotes high reproducibility in isolated nanocrystals array production and how substrate-solution interactions affect the overall fabrication. Afterward, the PhD candidate will use nano/micro fabrication tools to electrically access individual nanocrystals thus obtaining a single-nanocrystals electroluminescent device which will then be characterized optically in terms of emission statistics.
The research activity will first focus on the exploitation of metal chalcogenides and halide perovskites nanocrystals. Funding for this position is provided by the European Research Council trough the 2019 Starting Grant "NANOLED". The project aims at developing light-emitting diodes based on individual colloidal NCs, thus paving the way to novel electrically driven single-photon sources with small footprint that are embeddable in photonic quantum networks.

Requirements: The ideal candidate must have a master's degree in one of the following areas: Materials Science, Chemistry, Chemical Engineering or Physics. The candidate must be interested in a very interdisciplinary research activity encompassing chemistry, engineering and physics.

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