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Applied nanotechnology for analytical investigation of nanomaterials

Quantum Dots (QDs) are semiconductor nanocrystals in which quantum size effects permit tuning of optical and electronic properties by varying size, shape and composition. This allows to exploit their light emission and absorption properties, making them effective building blocks for numerous emerging optoelectronic technologies. Latest generation QDs include complex compositions, core/shell architectures and light elements like carbon [1]. Such systems are difficult to characterize with standard electron and photon probes. Dedicated instrumentation with optimal spatial and spectral resolution is thus needed to characterize the morphology and composition of QDs, designed and synthesized for optimal light harvesting and optical absorption across a broad spectral range [2, 3].

In the framework of the development of the “Molecular and Optical Science and Technology” beamline (MOST) at Elettra, Trieste [4] and of the experimental project “Confocal micRoscopy at sOfT x-ray WaveleNgths” (CROWN) funded by INFN [5], we propose a PhD project to: (1) investigate the spectroscopy and morphology of QDs with state of the art techniques; (2) advance the design of state of the art instrumentation. The work will include both computational/simulation research, and experimental tests performed at Elettra (Trieste).

[1] Y. Zhou, et al. 2018, *Nano Energy* **44**, 378–387; doi: 10.1016/j.nanoen.2017.12.017

[2] B. Luo, et al. 2021, *Nano Energy* **88**, 106220; doi: 10.1016/j.nanoen.2021.106220

[3] L. Jin, H. Zhao, Z.M. Wang, F. Rosei, 2021, *Adv. En. Mater.* **11**, 2003233; doi: 10.1002/aenm.202003233

[4] www.elettra.eu/lightsources/elettra-beamlines/most.html

[5] Z. Ebrahimpour, et al. *NIM A* **1083**, 171181; doi: 10.1016/j.nima.2025.171181