SUSTAINABLE MATERIALS, PROCESSES AND SYSTEMS FOR ENERGY TRANSITION

IIT - Development of low-dimensional material based light-driven nanoscale devices

Funded By	FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA [P.iva/CF:09198791007]
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Context of the research activity	The Functional Nanosystems group (https://www.iit.it/research/lines/functional-nanosystems) at the Italian Institute of Technology is focused on developing and studying innovative solutions for energy storage and conversion by employing low-dimensional nanomaterials. The interdisciplinary research approach of the group, which encompasses physics, nanochemistry, material science, spectroscopy, and optoelectronics, creates a stimulating environment that reflects the atmosphere of the Italian Institute of Technology. The institute provides access to numerous facilities that are equipped with state-of-the-art instrumentation. Micro and nano device fabrication can be carried out in the high-level cleanrooms, while wet and dry processing and nanomaterial synthesis can be conducted in the chemistry laboratories. Additionally, there is access to top notch electron microscopy and materials characterization facilities can be utilized for metrology and device characterization. The spectroscopy lab is of great significance to the Functional Nanosystems group as it provides access to state-of-the-art equipment for investigating the interaction in fabricated hybrid nanomaterials devices. The lab is equipped with a micro-Raman, micro-photoluminescence, and time-resolved photoluminescence (TRPL) system, which utilizes a tunable femtosecond laser source and several steady-state and time resolved detection systems. This research position is part of the ERC Starting Grant Light-DYNAMO (https://cordis.europa.eu/project/id/850875).
	The expected objectives of this research proposal is for a PhD student to fabricate hybrid low-dimensional material systems based on 2D materials and/or nanocrystals that are capable of harvesting light energy, storing it and deliver it upon demand. The PhD candidate in particular will: 1. Fabricate novel hybrid low-dimensional material devices based on 2D materials and/or nanocrystals 2. Characterize the optical and electronic properties of the fabricated devices

Objectives	to understand their energy storage and conversion capabilities. 3. Investigate the mechanisms of light energy storage and release in the fabricated hybrid low-dimensional material systems 4. Demonstrate the practical applications of the fabricated hybrid low-dimensional material systems and devices by testing their performance in energy storage and conversion applications. 5. Develop methods to optimize the energy storage and conversion efficiency of the fabricated hybrid low-dimensional material systems and devices.

Skills and competencies for the development of the activity	To be successful in this role, potential candidates should have a passion for working on cutting-edge and interdisciplinary projects. Candidates should hold an M.Sc. or equivalent degree in Physics, Engineering, Chemistry, or Materials Science, and should also have an interest in developing their skills further in areas such as optical microscopy/spectroscopy, micro and nanofabrication, device engineering, theoretical modeling using tools such as finite element analysis, solver, and simulation software (e.g. COMSOL), interfacing with devices such as instruments, cameras, and other devices (e.g. Labview), as well as programming skills (e.g. Python and MATLAB). Previous experience in nanofabrication is highly valued.