CHEMICAL ENGINEERING

DISAT - Technological advancement of micro-supercapacitors for autonomous devices and IoT applications

Funded By	Dipartimento DISAT
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Context of the research activity	This PhD project focuses on the development of self-powered micro-supercapacitors capable of being charged by light, specifically designed for applications in sensing and the Internet of Things (IoT). To achieve this goal, we will develop advanced nanoscale materials and apply microfabrication techniques to create ultra-compact devices, which will ultimately be integrated into autonomous sensing systems and IoT platforms.
Objectives	This PhD project focuses on the development of self-powered micro-supercapacitors capable of being charged by light, specifically designed for applications in sensing and the Internet of Things (IoT). To achieve this goal, we have defined several key objectives: 1) We will design advanced nanoscale materials, including doped metal oxide nanocrystals and two-dimensional materials such as transition metal dichalcogenides, engineered for specific optoelectronic properties. These materials will be analyzed using a range of optical and optoelectronic techniques, such as steady-state spectroscopy, photoluminescence, photocurrent, and photoconductivity measurements. Part of the PhD work will involve the development of a unique measurement system capable of performing simultaneous mappings of multiple experimental techniques at the microscale. 2) The developed materials will then be fabricated into devices using nano- and microfabrication techniques available in cleanroom environments. These devices will be tested using standard electrochemical characterization methods such as IV curves, impedance spectroscopy, galvanostatic charge-discharge (GCD), etc., both under illumination and in the dark. 3) These ultra-compact devices will ultimately be integrated into autonomous sensing systems and IoT platforms as proof-of-concept demonstrators.
Skills and	Installation and commissioning of equipment for material analysis and

competencies for the development of the activity	production; design and fabrication of functional nanostructured materials. Photocurrent spectroscopy and modeling of IV and CV curves; atomic force/optical microscopy; PL and FTIR spectroscopy. Experience in cleanroom environments and international research settings.