SUSTAINABLE MATERIALS, PROCESSES AND SYSTEMS FOR ENERGY TRANSITION

UNIPA - Carbon dot based-LEDs

Funded By	UNIVERSITA' DEGLI STUDI DI PALERMO [P.iva/CF:00605880822]
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Context of the research activity	The research topic of the doctoral scholarship will focus on the development, optimization, fabrication and characterization of carbon-dot based light-emitting devices, aiming to overcome the technical and economic challenges for their implementation on an industrial scale.
Objectives	Carbon Dots (CDs) are fluorescent carbon nanoparticles, with an average diameter of less than 10nm. The structure is carbon-based, has sp2 and sp3 hybridized carbon atoms and a high number of surface functional groups containing oxygen, nitrogen and other heteroatoms. These particles are decidedly more efficient than traditional quantum dots, as they are characterized by high stability, ease of synthesis and disposal, biocompatibility, good conductivity and resistance to light bleaching. The research will be divided into three main areas: 1. Development of advanced CDs with properties of high photoluminescence (PL) intensities: (i) synthesis and characterization of different precursors with high efficiency and stability, specifically designed for obtaining high values of PL. (ii) study properties of CDs through advanced spectroscopy, X-ray diffraction (XRD) and electron microscopy techniques (SEM, TEM) (iii) Purification of the material by dialysis or other techniques. 2. CD embedding in solid state matrix: (i) synthesis and characterization of different matrix (PMMA, urea, PC, etc.) to embed optimized CDs. (ii) fabrication of thin films of CD-embedded solid-state matrix. (iii) Characterization of luminescence properties of the films and reduction of the aggregation-caused quenching (ACG) phenomena. 3. Fabrication of CD-based light-emitting diodes (LEDs): (i) Study and selection of the characteristics of the pump sources. (ii) Fabrication of the LEDs by spinning of wafer-level LEDs. (iii) Fabrication of the LEDs by dipping of commercial LEDs. (iv) Characterization and optimization of the electrical and optical properties.

Skills and competencies for the development of the activity	The ideal candidate should be an electronic engineer, material scientist or engineer, a physical, chemical or energetic engineer, a chemist or a physicist. Expertise in thin film fabrication, electronic measurements, advanced materials processes, as well as problem solving ability and practical experience in laboratory would be an additional value. Candidates should have a strong motivation to learn through advanced research.