

CONTRATOS PREDOCTORALES 2020 SEVERO OCHOA

PROJECT TITLE / JOB POSITION TITLE:

Liquid-assisted laser synthesis of complex graphene nanocomposites for energy storage applications

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:

(2.000 characters – including spaces)

Nanocarbon-based hybrid electrodes are strategic elements for future high-performance electrochemical energy storage devices exhibiting high power-energy densities and durability. In particular, the synergistic combination of heteroatom-doped graphene coated with transition metal oxides nanoparticles (MO) is especially suitable for energy storage applications due to their high surface area, storage performance and high conductivity. **The aim of the proposal is to synthesize hybrid graphene-based electrodes using earth-abundant, low cost and eco-friendly materials for the production of high performance electrochemical energy storage devices.** In particular, the UV-laser irradiation of liquid dispersions containing graphene oxide platelets, MO nanoparticles and reactive precursor molecules will be carried out for the fabrication of electrodes constituted by complex nitrogen- and boron-doped graphene coated with MO nanostructures. The project encompasses (i) the synthesis of the composite as a powder; (ii) its coating on current collectors; (iii) the study of the structural, compositional and electrochemical properties of the electrodes; and, finally, (iv) the fabrication of electrochemical energy storage devices (asymmetric supercapacitors / supercapattery).

The Laser Processing Research Group at ICMAB develops hybrid carbon-based electrodes by means of a variety of laser-induced chemical synthesis and deposition methods. The technique to be developed is expected to be easily scalable to the industrial sector, and will put forward new ways for the fabrication of hybrid nanocomposite electrodes eluding inconveniences of the conventional synthesis methods with complex, expensive and toxic pathways. The work will be carried out in the frame of a Societal Challenges research project financed by the Science and Innovation Ministry.

JOB POSITION DESCRIPTION:

(2.000 characters – including spaces)

Include all the relevant information about the position, role, responsibilities and skills required within the project/group

The objective of the project is to simultaneously modify the graphene structure and induce the crystallization of electroactive MO nanostructures on its surface through UV laser radiation, leading to significant enhancement of the electrodes performance. The experimental work will address different disciplines related to physics, organic-inorganic chemistry, synthesis and advanced characterization of nanomaterials as well as instrumentation-materials engineering. Technical training related to the synthesis and study of nanostructures will be offered. A variety of characterization methods will be used for the investigation of the nanostructure and chemical composition of the obtained materials (optical and electron microscopies; IR, X-ray photoelectron and Raman spectroscopies; X-ray diffractometry). Besides, the electrochemical properties of the electrodes will be also studied, as well as correlated to their structural-compositional nature. Finally, asymmetric supercapacitor - supercapattery devices will be fabricated with the optimized electrodes and their functionality will be assessed by electrochemical cycling tests.

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