Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)

SUBJECT: Smart hybrid organic-inorganic nanocomposites with multifunctional properties.

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DESCRIPTION: The application of light-responsive nanomaterials has represented a compelling solution in several fields ranging from photonic to bio-related applications[1]. Particular attention has been devoted to the utilization of plasmonic nanoparticles (NPs) such as gold NPs for their capability to collect a huge amount of visible and/or near-infrared light due to a physical phenomenon named localized plasmonic resonance[2]. Typically, NPs convert light into heat, which can be used in cancer and/or pathogenic-related disease treatments. Exploiting the photo-thermal heating of Au NPs immobilized in electrospun fibrous membranes by utilizing a light source is one of the most exciting branches of nanotechnology. The realization of multifunctional light-assisted photo-thermal materials paves the way towards a new paradigm in the field of smart device fabrication especially if photoresponsive nanoparticles with different and exotic geometries (e.g., nanorods) are used to reach enhanced performances due to their excellent photo-thermal properties.
Electrospinning plays a vital role in the production of such materials. Electrospinning is a nanofiber fabrication technique offering various advantages, including the possibility of producing high surface area materials, a tunable porosity, and the ability to adjust fiber composition to obtain new functions[3]. For this reason, electrospun nanofibers have recently found application in several fields[4]. Here, we plan to use electrospinning to fabricate multifunctional membranes in which their nanostructure can be filled with photoresponsive nanoparticles made by gold[5]. Additionally, the fiber engineered surface can be characterized by the presence of additional functional nanoparticles.
The aim of this Ph.D. path is to develop a hierarchical structure that possesses multifunctional properties, high performance, and efficient light-responsiveness, which is crucial to generate multifunctional nanomaterials activated by light irradiation. The final nanostructure will find applicability in different fields, but the main target is applying the nanoplatform for biomedical applications. It is expected that the project will lead to the publication of several articles in international scientific journals as well as a patent application.

BIBLIOGRAPHY:

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