GRAPHENE/CYTOCHROME C HYBRID THIN FILMS PREPARED BY A MODIFIED LANGMUIR-SCHAEFER METHOD

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ABSTRACT

The scientific and technological potential of graphene includes the development of light, open 3D structures with high surface area, tunable pore size and aromatic functionalities. Towards this aim, we describe a bottom-up approach that combines self-assembly and Langmuir-Schaefer deposition for the production of cytochrome c intercalated graphene hybrid materials. The Langmuir-Blodgett technique is one of the most promising layer-by-layer methods for preparing monolayer and multilayer graphene based thin films [1,2]. This bottom-up approach enables the precise control of the single layer thickness and allows homogeneous deposition over large areas on almost any kind of solid substrate [3]. This method uses graphene nanosheets as templates for the attachment of cytochrome c molecules in bi-dimensional arrangement, allowing for perfect layer-by-layer growth with control at the molecular level. Our film preparation approach relies on a bottom-up process that includes the formation of a hybrid graphene Langmuir film, which is transferred onto a substrate and then brought into contact with cytochrome c molecules in aqueous solution to induce self-assembly. By repeating these deposition cycles results in a facile and low-cost layer by layer procedure for the formation of highly ordered hybrid multilayers, which were characterized by X-ray photoelectron (XPS), Attenuated Total Reflectance (ATR), Raman spectroscopies as well as X-ray diffraction (XRD) and atomic force microscopy (AFM). Moreover, the hybrid multilayers tested with regard to the catalytic properties of cytochrome c, and it was found that these films exhibit high activity, stability and reusability.

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