Stimuli Responsive Graphene Oxide For Sensing and Drug Delivery Application

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Abstract

Graphene oxide (GO), with its 2D nanocarbon structure but also many oxygenated defects, offers a convenient platform for surface tailoring, either covalent or non-covalent, owing to the great surface activity and good solution processability [1]. The peculiar electronic, thermal and mechanical properties of graphene-based materials allow intensive promising applications in nanoelectronic devices, sensors, and nanocomposites. The present work tackles the functionalization of GO sheets to fabricate multifunctional nanoplatforms whose assembly states can be controlled in response to chemical stimuli for imaging and drug delivery applications [2]. Specifically, the grafting onto the surface of GO nanosheets of pH-responsive acrylate (PAA) oligomers was optimized as function of the surface charge and scrutinized by a multitechnique approach of spectroscopic (Raman, X-ray photoelectron spectroscopy, UV-visible, fluorescence) and microscopic (confocal and atomic force microscopy, scanning electron microscopy) methods, both in solution and at the solid surface (Figure 1). In addition, First Principle and Molecular Dynamics calculations were performed in parallel with the experiments. The energy transfer processes between GO or GO-PAA samples and fluorescein-labeled human serum albumin (HSA) and the loaded of the anticancer drug doxorubicin (Dox) were investigated in terms of sensitivity and reproducibility at different ionic strength and pH values. Then, the hybrid nanoassemblies GO/HSA/Dox were tested in cellular models of the blood-brain barrier. In summary, pH-responsive GO nanomaterials were prepared and tested at the hybrid biointerfaces with dye-labeled albumin and doxorubicin, eventually in proof-of-work cellular experiments. Results are very promising for the understanding and control of the processes, both kinetics and thermodynamics aspects, at the graphene-(bio)molecule interface as well as for the (bio)molecule-target interaction.

References
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Figure 1- AC mode AFM images of GO-based nanoplatforms. From left to right: GO, GO-PAA1 and GO-PAA3.