Biocompatible and nanostructured monolayers on graphite for drug delivery applications

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Abstract

The development of new nanostructured coatings with biomedical applications has been receiving greater attention in recent years due to the ability to give them specific and versatile functions by controlling their architecture. Stepwise methods, based on self-assembly properties of molecules, can provide a simpler and reproducible solution to prepare supramolecular structures with molecular control. The scanning tunneling microscope (STM) is a versatile tool to fabricate and control the molecular assemblies at the nanoscale. In particular, when operated at the solid/liquid interface, by placing a solvent droplet between the STM tip and the substrate, it is possible to add molecules in order to create organized structures.**[1-3]**
We have been applying a stepwise method to built nanostructured and biocompatible monolayers composed of glycosaminoglycans adsorbed on Highly Oriented Pyrolitc Graphite (HOPG). The idea is to functionalize graphite with biomolecules that can act as anchor points to adsorb nanocarriers used in drug delivery. Figure 1 shows a monolayer composed of glucuronic acid (AcGl) and 1-heptanoic acid (AcHept). Both molecules were added to graphite at the same time and their adsorption was monitorired using STM at solid/liquid interface **[1-3]**. Theoretical simulations and X-ray photoelectron spectroscopy (XPS) showed that the stability of the monolayer is controlled by the H-bond interactions between the two acids. High resolution STM images show the formation of AcGl dimmers separated by lamellas with planar AcHept. At moment, we are using these monolayers to absorb an alpha-2-adrenergic receptor agonist encapsulated in a cyclodextrin. Drug release kinetic studies monitored by UV-spectroscopy are underway and preliminary results suggest that this monolayer is very stable and that it is possible to control the drug release in function of time.

References

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Figures

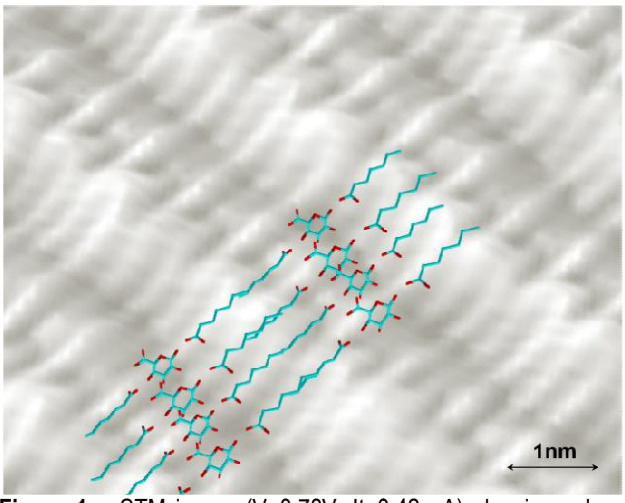

Figure 1 – STM image (V=0.78V, It=0.42 nA) showing a lamellar structure of a self-assembled monolayer formed by co-adsorption of glucuronic acid and 1-heptanoic acid.