Self-assembled monolayers with drug delivery functionality

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Abstract

Self-assembly is a versatile technique to prepare materials with multiple and specific functionalities.**[1]** This is a bottom up process, where individual components are combined, in a process mainly governed by specific interactions, to produce complex systems. The bottom up approach has a huge potential, in terms functional materials fabrication, and is a critical tool in nanotechnology. It has been explored in various areas, namely, in organic electronics,**[2]** nanomedicine,**[3]** nanobiotechnology**[4]**, with a particular emphasis on the fabrication of nanostructured materials.

In this communication, we report on the use of a layer-by-layer technique to produce self-assembled monolayers with drug delivery function. The complete system combines three different components that are sequentially assembled on a mica substrate. The first one is composed by the poly(allylamine hydrochloride-PAH) polyelectrolyte, a polycation that at neutral pH deposits as flat chains**[5]**. The second monolayer is made of heparin, a strong polyanion, member of the family of sulfated glycosaminoglycans (GAG), that, due to the electrostatic interaction with the previous monolayer, also deposits as flat chains providing a smooth film. Heparine is the main anticoagulant and a antihrombotic drug**[6]** and we used it as a scaffold to anchor the drug (β-blocker) encapsulated on cyclodextrin (third monolayer). Atomic force microscopy images of monolayers (figure 1 a) and b)) show that the cyclodextrin monolayer has a good affinity towards heparine, since its surface has a very low roughness (root-mean-square (RMS) roughness is approximately 0.230 nm), suggesting that the cyclodextrins are well-organized/dispersed on heparine-functionalized surface.
The drug release from the multilayer surface was monitored by UV-Vis spectroscopy. The film was immersed in an aqueous solution (phosphate-buffered saline solution) at 37ºC and UV-Vis spectra of that solution were recorded over time. Our results revealed that the drug leaves the carrier during the first few hours.

References

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Figures

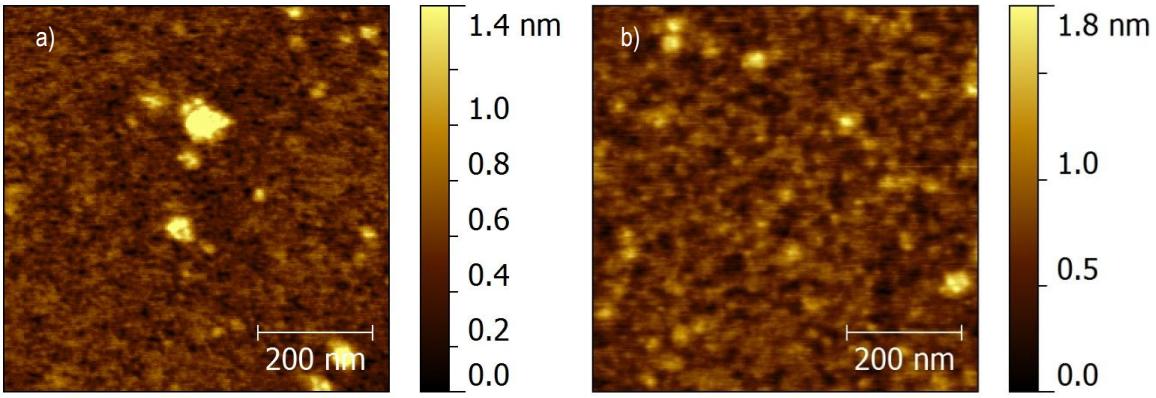

Figure 1 - Topography images (0.66 μm^2) of : a) heparine monolayer (RMS≈0.184 nm), b) cyclodextrin monolayer on heparine (RMS≈0.230 nm) obtained by atomic force microscopy on non-contact mode