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Amine Functionalisation of Polypyrrole for Bioaplications

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INTRODUCTION: Polypyrrole (PPy) has high conductivity, good environmental stability and excellent biocompatibility in either cell culture or in-vivo applications [1]. To improve the biointeractions of this polymer is necessary to introduce reactive groups in the normally inert surface [2]. In this work PPy was functionalised in controlled areas with -NH_2 groups by the grafting of Allylamine using UV radical activation. To evaluate the activity of the functionalised films, it was test their capacity to improve protein adsorption using fluorescent bovine serum albumin (BSA).

METHODS: PPy deposition on porous silicon was done by galvanostatic oxidation (26A /m^2 for 300s) from an aqueous electrolyte solution of Pyrrole (0.05M) and Lithium Perchlorate (0.05M).

The PPy films covered by a patterned metallic mask (150µm circular mesh) were immersed in a 5% aqueous solution of Allylamine and expose to UV light (intensity = 15 $\times 10^{-4} W/m^2$; λ : 280-450nm) during 20minutes. Further characterization of the functionalised surfaces was done by TOF-SIMS and XPS.

To test the bioactivity, the functionalised films were immerse in a 45µg/ml BSA solution in PBS (20mM pH=7.5) during 20 minutes and after the samples were analysed with a fluorescent microscope.

RESULTS: In the ToF-SIMS image (Figure 1) is presented the $C_3H_4NH_2^+$ ion image of the surface after Allylamine grafting. It is possible to see that this Allylamine characteristic ion is concentrated in the areas were the surface was exposed to UV. XPS studies showed that the grafted areas had 2% of carbon with -NH_2 function. Figure 2 presents a fluorescent microscope image of the BSA adsorption in the PPy surface after the introduction of amine groups. The image shows that the BSA adsorption was concentrated in the grafted areas.

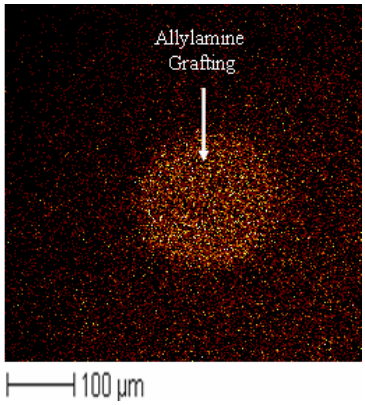

Fig. 1: Tof-SiMS image of $C_3H_4NH_2^+$ ion distribution of controlled Allylamine grafting.

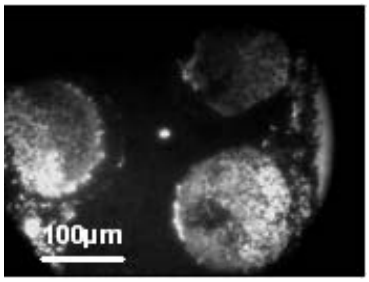

Fig. 2: BSA adsorption in PPy surface after controlled Allylamine grafting.

DISCUSSION & CONCLUSIONS: The studies show that Allylamine grafting using UV light as a radical initiator is a quick and technically simple way of introducing a controlled amount of -NH_2 functional groups onto the surface of PPy. An additional benefit of this method is the ability of directly pattern the functionality. Detailed surface analysis studies have determined the introduced active -NH_2 levels to be sufficient to enhance preferential protein adsorption. The results show that this method is potentially attractive for the fabrication of PPy based electrodes to use in electrochemical biosensors.

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