Adsorption and Electrochemical Behaviour of Cyt-c on Carbon Nanotubes/TiO_2 Nanocomposite Films Fabricated at Various Annealing Temperatures

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The achievement of electron mediator free communication between the cofactors of redox proteins and a solid electrode surface could provide a simple and efficient way for studying fundamental protein function and structure and for developing novel amperometric biosensors. However, direct electrical contact of redox proteins on bare solid electrodes is usually prohibited due to deeply buried redox centers by the protein matrix and/or the denaturation of bioentities on the electrode surface.

In recent years, nanostructured metal oxide materials such as mesoporous TiO_2 films have overcome such problems and offer an ideal surface for protein immobilization from aqueous solutions with high binding stability and undetectable protein denaturation [1]. It has been demonstrated that these films offer excellent biocompatibility, high surface area, electrical conductivity, optical transparency, a simple and low cost fabrication method and therefore could be used for the development of electrochemical biosensors [2]. However, the fact that these films are semiconductors and exhibit limited conductivity at low negative potentials limits the quality of the electrochemical signals obtained.

In this work, carbon nanotubes (CNTs) were incorporated into mesoporous TiO_2 films resulting in TiO_2/CNT nanocomposites with improved electrical conductivity. Characterization of novel nanocomposite films was carried out with XRD, SEM and Raman, while conductivity and electrochemical properties were examined via cyclic voltammetry and spectroelectrochemistry. The immobilization and electrochemical behavior of a redox protein, such as Cytochrome-c, supported on these TiO_2/CNT films was studied in detail and particularly the effect of CNTs on the interfacial electron-transfer process between the electrode and the adsorbed biomolecules [3].

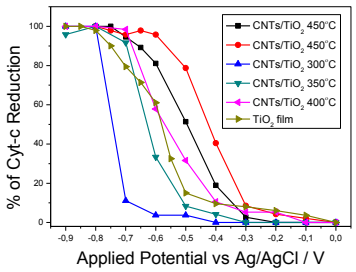

Figure 1: Percentage of Cyt-c reduced on DWCNTs/ TiO_2 films prepared at various annealing temperatures as a function of the applied potential determined from the relative spectroelectrochemical data.

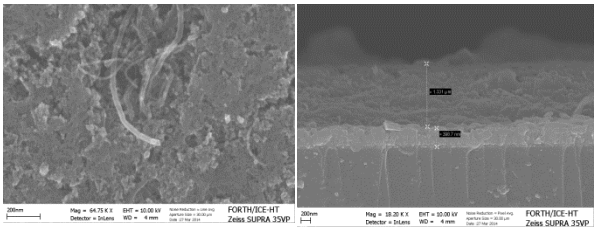

Figure 2: SEM images of a DWCNTs/TiO_2 film (top view and cross section).

References

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