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Ascorbic Acid-Sensitized Au Nanorods-functionalized nanostructured TiO_2 Transparent Electrodes for Photoelectrochemical Genosensing

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Abstract

Au nanorods (NRs) modified nanostructured TiO_2/ITO electrodes have been fabricated and characterized in order to develop a biosensing platform for the photoelectrochemical determination of microRNAs. The proposed method is based on the use of thiolated DNA capture-probes (CPs) immobilized onto Au NR surface. The Au NRs are chemically bound at the surface of TiO_2/ITO electrodes by means of the mercaptosuccinic acid linker. Subsequently, the DNA CPs are bound to the Au NR surface through the thiolate group, and reacted with the target RNA sequence. Finally, the obtained biosensing platform is incubated with alkaline phosphatase and L-ascorbic acid 2-phosphate (AAP) enzymatic substrate, for the *in situ* generation of ascorbic acid (AA). Such AA molecule, coordinating to surface Ti atoms, generates a charge transfer complex, that results in a shift of the UV absorption threshold toward the visible spectral region of the nanostructured TiO_2 forming the electrode and, hence, in the occurrence of an absorption band centered at 450 nm. The photoelectrochemical monitoring of the formation of the AA-TiO_2 complex, under the visible light of a commercial LED light source, allows the selective and quantitative detection of the target microRNA strands.

Keywords: photoelectrochemical, nanostructured TiO_2, Au nanorods, nucleic acid, ascorbic acid, small RNAs