Electrochemical characterization of nitrocoumarin-modified nanostructured electrode platforms: New precursors for the electrocatalysis of NADH

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Abstract

All synthesized nitrocoumarins, 3-acetyl-6-nitrocoumarin 6-Coum, 3-(3-nitrocinnamoyl)-coumarin 3-CinCoum, 3-(4-nitrocinnamoyl)-coumarin 4-CinCoum, and 3-(4-nitrocinnamoyl)-6-nitrocoumarin 4-Cin-6-Coum, were used to generate novel nanostructured multiwalled carbon nanotube (MWCNT) electrode platforms that were electrochemically activatable to generate the redox pair ArNHOH/ArNO. This redox pair is capable of acting as a mediator in electrocatalysis of NADH oxidation. Nitrocoumarin-modified nanostructured electrode platforms were prepared using both drop casting and buckypaper (BP) methods for comparative purposes, and they showed no differences in their electrochemical responses. It was observed that the compound most easily reduced was 4-Cin-6-Coum. The reduction occurred first at the 4-nitrocinnamoyl group due to the withdrawing electron effect exerted by the cinnamoyl carbonyl group. The heterogeneous transfer rate constant, k_h, was calculated for all of the redox mediators, and they decreased in the order 4-CinCoum> 3-CinCoum> 6-Coum> 4-Cin-6-Coum (II). On the other hand, we observed no significant differences for retention of the redox pairs ArNHOH/ArNO from the nitrocoumarin precursor compounds on the electrode, and the retention values ranged from 79.6 to 91.6% after one hour of working with the nanostructured electrodes. With this electrocatalytic response, it is possible to develop an amperometric sensor for the determination of NADH that includes nanostructured platforms with nitrocoumarins. We obtained LODs of 2.95 μM and 3.43 μM for 6-Coum and 4-Cin-6-Coum (II), respectively. © 2023 Elsevier Ltd

Author keywords

Modified electrodes; MWCNT; NADH electrocatalysis; Nitrocoumarin