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The effect of loading carbon nanotubes onto chitosan films on electrochemical dopamine sensing in the presence of biological interference

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ABSTRACT

In vivo monitoring of the neurotransmitter dopamine can potentially improve the diagnosis of neurological disorders and elucidate their underlying biochemical mechanisms. While electrochemical sensors can detect unlabeled dopamine molecules, their sensing performance is dramatically reduced by electrochemical currents generated by other, interfering molecules (e.g., uric acid) in the biological environment. To overcome this caveat, the surface of the sensor is often modified with electrocatalytic materials, which are encapsulated inside a polymeric film; however, the effect of the encapsulating film on the sensing performance of the electrode has not been systematically studied. This study characterizes the effect of loading carbon nanotubes (CNTs) onto a chitosan film on the electrochemical sensing performance of dopamine in the presence of uric acid. Higher CNT loading increases the diffusion and electron transfer rate coefficients of the sensor and, in the presence of uric acid, provides better sensitivity (3.00 μA L μmol^{-1} for 1.75% CNT loading, *vs* 0.01 μA L μmol^{-1} for 1% loading) but a poorer limit-of-detection (2.00 μmol L^{-1} *vs* 1.00, respectively), as reported here for the first time. These findings can help optimize the sensitivity and the limit-of-detection of electrochemical sensors in complex biofluids to enable an *in vivo* monitoring of dopamine and other redox-active molecules.