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Nonenzymatic electrochemical detection of acetaminophen using well-distributed nickel nanoparticles on multi-walled carbon nanotubes

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Background and Aims: The peresence study introduces a novel modified electrode based on Ni nanoparticles (NiNP) modified multi-walled carbon nanotubes (MWCNT) for electrocatalytic oxidation of acetaminophen. The carbon past electrode was manufactured by adding MWCNT and NiNP. Modified carbon paste electrode (MCPE) can be used for effective electrocatalytic oxidation of acetaminophen in alkaline solution.
Methods: MWCNT: NiNP /CPE electrode with constant ratios were prepared. galvanostatic deposition were examined for their redox process and electrocatalytic activities towards the oxidation of acetaminophen in alkaline solutions. The methods of cyclic voltammetery (CV), Chronoamperometry (CA) were employed.
Results: The cyclic voltammogram of NiNP /MWNT/CPE demonstrates the formation of α/ß crystallographic forms of the nickel oxyhydroxide under prolonged repetitive potential cycling in alkaline solution. In CV studies, NiNP /MWNT/ CPE modified electrode shows a significantly higher response for acetaminophen oxidation. The peak current of the oxidation of nickel hydroxide increase is followed by a decrease in the corresponding cathodic current in presence of acetaminophen. The anodic peak currents show linear dependency with the square root of scan rate. This behavior is the characteristic of a diffusion controlled process. Under the CA regime the reaction followed a Cottrellian behavior and the diffusion coefficient of acetaminophen was found to be 5.2×10-6 cm2 s-1. A mechanism based on the electro-chemical generation of Ni3+ active sites and their subsequent consumptions by acetaminophen have been discussed and the corresponding rate law under the control of charge transfer has been developed and kinetic parameters have been derived.
Conclusions: These remarkable characteristics make the prepared sensor suitable for analysis of AC in pharmaceutical tablets.

Keywords: Multi-walled carbon nanotubes; Modified electrode; Ni nanoparticles; Acetaminophen