Carbonyl functionalized single walled carbon nanotube-Hb crosslinked network: A Novel platform for studying bio-electrochemistry and electrocatalysis of hemoglobin

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Abstract

In this work, the direct electrochemistry of hemoglobin (Hb), which was immobilized on carbonyl functionalized single walled carbon nanotube (SWCNT) and deposited onto a gold (Au) electrode has been described. The synthesis of the network of crosslinked SWCNT /Hb was done with the help of crosslinking agent EDC (1-ethyl-3-(3-dimethylaminopropyl) carbodiimide). The UV–Vis and FTIR spectroscopy of SWCNT/Hb networks showed that Hb maintained its natural structure and kept good stability. In addition with this, scanning electron microscopy (SEM) illustrated that SWCNT/Hb networks had a featured layered structure and Hb being strongly liked with SWCNT surface. Cyclic voltammetry (CV) was used to study and to optimize the performance of the resulting modified electrode. The cyclic

voltammetric (CV) responses of SWCNT/Hb networks in pH 7.0 exhibit prominent redox couple for the FeIII/II redox process with a midpoint potential of -0.46 V and -0.34, cathodic and anodic respectively. Furthermore, SWCNT/Hb networks are utilized for the detection of hydrogen peroxide (H_2O_2). Electrochemical measurements reveal that the resulting SWCNT/Hb electrodes display high electrocatalytic activity to H_2O_2 with high sensitivity, wide linear range, and low detection limit. Overall, the electrochemical results are due to excellent biocompatibility and excellent electron transport efficiency of CNT as well as high Hb loading and synergistic catalytic effect of the modified electrode toward H_2O_2.

KEYWORDS: Carbon nanotube; Functionalization, Hemoglobin, Electrochemistry, Hydrogen peroxide