Simultaneous electrochemical determination of ascorbic acid, dopamine, uric acid and tryptophan with azure A-interlinked multi-walled carbon nanotube/gold nanoparticle composite modified electrode

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Ascorbic acid (AA), dopamine (DA), uric acid (UA) and tryptophan (TRP) are considered as crucial small biomolecules for physiological processes in human metabolism. It is well known that AA, DA, UA and TRP usually coexist in biological matrixes. Abnormal levels of these species will lead to several diseases and disorders. Tryptophan is an important amino acid owing to its crucial roles in biological systems. It is a vital constituent of proteins and indispensable in human nutrition for establishing and maintaining a positive nitrogen balance. Therefore, the determination of their concentration is important not only for biomedical chemistry and neurochemistry but also for diagnostic and pathological research. Multi-walled carbon nanotube/Azure A/gold nanoparticle composites (AuNPs/MWCNTs/AA) were prepared by binding gold nanoparticles to the surfaces of azure A-coated carbon nanotubes. AuNPs/MWCNTs/AA based electrochemical sensor was fabricated (Fig. 1) for the simultaneous determination of ascorbic acid, dopamine, uric acid, and tryptophan. Cyclic voltametry and electrochemical impedance spectroscopy were used to characterize the electrochemical properties of the modified electrodes. The modified electrode showed excellent electrocatalytic activity toward ascorbic acid, dopamine, uric acid, and tryptophan (pH 7.0) (Fig. 2). The experiment results showed that the linear response range for simultaneous detection of AA, DA, UA and TRP were 300 –10000 µM, 0.5–50 µM, 0.5–50 µM and 1.0–100 µM, respectively, and the detection limits were 16 µM, 0.014 µM, 0.028 µM and 0.56 µM (S/N=3). The proposed method offers promise for simple, rapid, selective and cost-effective analysis of small biomolecules. The procedure was also applied to the determination of tryptophan in spiked milk samples.

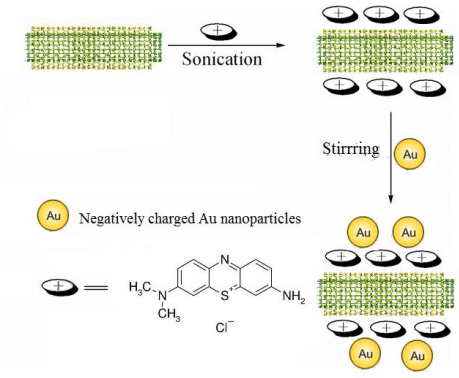

Fig. 1. Schematic diagram of fabrication method.

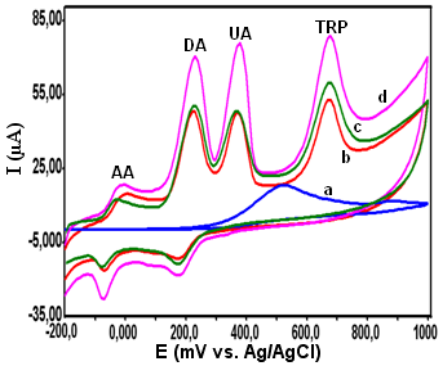

Fig. 2. CVs of the GCE (a), Nafion/MWCNTs/ AuNPs (b), Nafion/AzA/MWCNTs/ AuNPs /GCE(c) and AzA/MWCNT/Nafion/ AuNPs /GCE(d)