Gözde Aydogdu, Insights in Analytical Electrochemistry, 3:2
DOI: 10.21767/2470-9867-C1-002

Simultaneous sensing of ascorbic acid, dopamine, uric acid and L-tryptophan using AgNPs, graphene oxide and poly (L-Arginine) composite

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Electro-analytical methods are routinely used in analytical applications and clinical investigations to determine the concentration of biological compounds in human body fluids. Ascorbic acid (AA), dopamine (DA), uric acid (UA) and L-tryptophan (L-Trp) play critical roles in human metabolism, central nervous and renal systems. Abnormal concentration levels of these biomolecules can cause serious health problems such as mental illness, cancer, Parkinson's disease, hyperureaemia and gout. It is known that AA, DA, UA and Trp usually co-exist in biological samples such as serum and urine. Therefore, it is highly desirable to develop a sensitive method that can determine these biomolecules simultaneously in diagnostic research and analytical applications. However, the oxidation potentials of these compounds are too close to be separated at bare electrodes owing to their overlapping signals. Recently, metal/metal oxides nanoparticles have received great attention as a modifier material in developing electrochemical sensors due to their excellent properties such as high electron transfer ability, easy synthesis and small size. Graphene oxide (GO) which has a layered structure with a large specific area has been extensively used in the recent years for bio-sensing applications. Nowadays, graphene/conducting polymers composites have been considered as one of the most promising functional components due to their good electrical conductivity, chemical stability and high electrochemical capacity. Electropolymerization of amino acids have gained great attention in the field of sensors/biosensors. Among the poly (amino acids), poly (L–arginine) (P (Arg)) has attracted great attention in constructing biosensors owing to its functional $–NH_2$ and –COOH groups and it could electrostatically interact with negatively charged groups of GO. In this study, a composite glassy carbon electrode (GCE) based on AgNPs, GO and P (Arg) was prepared for the determination of AA, DA, UA and L-Trp. The composite was characterized by cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and scanning electron microscopy (SEM). All compounds can be well separated by their different peak potentials and they can be simultaneously detected in the quaternary mixture. Moreover, this proposed sensing strategy revealed excellent stability and reproducibility. The potential application of the modified electrode for sensing these compounds in human urine samples was also investigated.

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