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Electrochemical Sensing of L-Histidine Based on Fullerene-C60 Mediated Gold Nanocomposite

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Abstract : Histidine is one of the twenty-two naturally occurring essential amino acids exhibiting two conformations, L-histidine and D-histidine. D-Histidine is biologically inert, while L-histidine is bioactive because of its conversion to neurotransmitter or neuromodulator histamine in both brain as well as central nervous system. The deficiency of L-histidine causes serious diseases like Parkinson's disease, epilepsy and the failure of normal erythropoiesis development. Gold nanocomposites are attractive materials due to their excellent biocompatibility and are easy to adsorb on the electrode surface. In the present investigation, hydrophobic fullerene-C60 was functionalized with homocysteine via nucleophilic addition reaction to make it hydrophilic and to successively make the nanocomposite with in-situ prepared gold nanoparticles with ascorbic acid as reducing agent. The electronic structure calculations of the AuNPs@Hcys-C60 nanocomposite showed a drastic reduction of HOMO-LUMO gap compared to the corresponding molecules of interest, indicating enhanced electron transportability to the electrode surface. In addition, the electrostatic potential map of the nanocomposite showed the charge was distributed over either end of the nanocomposite, evidencing faster direct electron transfer from nanocomposite to the electrode surface. This nanocomposite showed catalytic activity; the nanocomposite modified glassy carbon electrode showed a tenfold higher k_et, the electron transfer rate constant than the bare glassy carbon electrode. Significant improvement in its sensing behavior by square wave voltammetry was noted.

Keywords : fullerene-C60, gold nanocomposites, L-Histidine, square wave voltammetry
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