Cost-effective and Green Synthesis of Tomatoes Derived Hierarchical Meso-Macroporous Carbon Nanospheres Aerogels for Glucose Oxidase-Based Electrochemical Biosensing and Bioenergy Harvesting from Real Samples on Flexible Substrate

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Abstract

In the last few years, various materials with nanostructures have been introduced as electrode materials to immobilize biocatalysts and therefore improve the performance of electrochemical biosensors [1] and biofuel cells (BFCs) [2]. In this work, we demonstrate the synthesis of tomatoes-derived hierarchical meso-macroporous carbon nanospheres aerogels (T-HMCNAs) using tomato as a low-cost and environmental benign material. By comparing the electrochemical performance of T-HMCNAs with that of carbon nanotubes (CNTs) as electrode material in this work, we reveal that T-HMCNAs is a favorable carbon electrode material for constructing glucose oxidase (GOD)-based electrochemical biosensor and BFC flexible substrate. The fabricated glucose biosensor functionalized with GOD, 1,4-naphthoquinone (NQ) and T-HMCNAs shows a satisfactory analytical performance. In addition, a compartment-less glucose/air BFC was also constructed, with the bioanode fabricated by co-immobilizing GOD, tetrathiafulvalene (TTF) and T-HMCNAs for electrocatalytic oxidation of glucose and the biocathode assembled by bilirubin oxidase (BOD), 2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid ammonium salt) (ABTS) and ketjenblack (KB) for electrocatalytic reduction of O_2. Such BFC can operate in the glucose solution with a remarkable performance. Meanwhile, this work realized the glucose detection and power generation with glucose as a biofuel from a range of real samples containing glucose (e.g., Sprite, Minute Maid, watermelon juice, and peach juice) on flexible substrate.

References

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