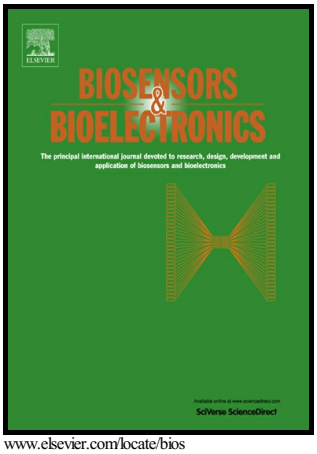

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Reticulated Vitreous Carbon as A Scaffold For Enzymatic Fuel Cell Designing

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Abstract

Three – dimensional (3D) electrodes are successfully used to overcome the limitations of the low space – time yield and low normalized space velocity obtained in electrochemical processes with two – dimensional electrodes. In this study, we developed a three – dimensional reticulated vitreous carbon – gold (RVC-Au) sponge as a scaffold for enzymatic fuel cells (EFC). The structure of gold and the real electrode surface area can be controlled by the parameters of metal electrodeposition. In particular, a 3D RVC-Au sponge provides a large accessible surface area for immobilization of enzyme and electron mediators, moreover, effective mass diffusion can also take place through the uniform macro – porous scaffold. To efficiently bind the enzyme to the electrode and enhance electron transfer parameters the gold surface was modified with ultrasmall gold nanoparticles stabilized with glutathione. These quantum sized nanoparticles exhibit specific electronic properties and also expand the working surface of the electrode. Significantly, at the steady state of power generation, the EFC device with RVC-Au electrodes provided high volumetric power density of 1.18 ± 0.14 mW cm^{-3} (41.3 ± 3.8 μW cm^{-2}) calculated based on the volume of electrode material with OCV 0.741 ± 0.021 V. These new 3D RVC-Au electrodes showed great promise for improving the power generation of EFC devices.