Tunable Surface Area Electrochemical Biosensors through Self-Assembly

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Electrochemical sensors have been widely pursued and adapted to a range of microfluidic platforms. An area of increasing interest is the detection of trace quantities of biologically relevant molecules. Our studies aim to create electrochemical biosensors that can be easily incorporated into microfluidic systems and adapted to the sensitivity needs of a particular application. Our approach is to create these biosensors by co-assembling nanoscale metal particles with template-directing colloidal materials. The resulting hierarchical structures have a high surface area that can be further functionalized. This porous electrode contains a high surface area that could be useful in biosensing applications, especially for the analysis of trace quantities of analytes. The pore-forming colloidal material can be fine-tuned to determine the dimensions of the pores and their corresponding surface area. The potential application of these porous electrodes in biosensing applications is demonstrated by immobilization of glucose oxidase onto the surfaces of the electrodes. A wide range of dissolved glucose concentrations were measured using these electrodes to assess their sensitivity. The electrochemical processes within these porous electrodes were evaluated using cyclic voltammetry and chronoamperometry techniques. These studies provide insight into the dynamics of the electrochemical detection of dissolved glucose within these porous electrodes and methods to further improve the sensitivity of these sensors. This simple method of making high surface area electrodes could be extended to the fabrication of other electrochemical biosensors with applications in microfluidics.