595c Electrochemical Biosensor Platform Based on Nanofibrous Carbonaceous Supports

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Conductive carbon nanotubes allow for engineering a broad range of electrochemical biosensor devices. Carbon nanotubes (CNT) allow for building surface architectures with distinct levels of hierarchical organization of pore structures. Nanofibrous supports (NFS) derived from such nanotubes demonstrate pore structure that provides unique biosensing capabilities due to controlled fluid delivery and retention.

We have developed the synthesis of a hierarchically porous conductive membrane derived from carbon papers with consecutively grown multi-wall carbon nanotubes. Carbon paper is a synthetic lightweight matrix with pore spaces on the micro-meter scale. The multi-walled CNT's are grown on this matrix by chemical vapor deposition (CVD) from acetylene precursor at an elevated temperature. This process is preceded by electrodeposition of cobalt nano-particles as a catalyst for CNT growth. As a result a decorative phase of CNT is grown on the filament substrate of the carbon paper. The length of the individual CNT filaments and the spacing between them is at the nano-meter scale. The density of the carbon nanotubes is evidently proportional to the amount of cobalt deposited and the volume fraction is proportional to the time of CVD. Being able to control the cobalt deposition and the time of carbon vapor deposition allows building surface architectures with distinct levels of hierarchical organization of pore structures.

The paper will discuss the functionality of the CNT carbon paper matrix with enzymes as an avenue for engineering biosensors for variety of substrates. Horseradish peroxidase (HRP) was chosen as a model enzyme to demonstrate the utility of the CNT/Carbon Paper materials in biosensor designs. A biosensor platform is being developed to accommodate flow-through sensor design with direct electron transfer detection of the enzyme label on the nanofibrous carbonaceous matrix. Flow-injection and flow-through modes of enzyme substrate detection were examined and compared in terms of analytical figures of merit. The ultimate goal of the work is to design immunosensors with electrochemical detection of the enzyme label.