Design and Synthesis of a Novel Biosensor Platform for Health Diagnostics

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Biosensors are becoming increasingly prevalent in today's society with applications in health diagnostics, bio warfare detection, water quality monitoring, and food safety. Currently in health diagnostics, protein concentrations are determined through multi-step, low sensitivity, and expensive procedures. The nanotechnology based biosensor developed uses electrochemistry as a basis for quick, sensitive, and accurate biomolecule detection. Paper based sensors, as developed for this prototype, form a unique technology for fabricating inexpensive, portable, and disposable diagnostic devices. Here, a paper-based biosensor is based in acid washed multi-walled carbon nanotubes (CNTs). CNTs are modified with antibody probes in slurry. Binding of a target protein is characterized using electrochemical measurements including Electrochemical Impedance Spectroscopy. Each step in CNT functionalization results in changes in electrical resistance due to modifications at the electrode surface upon antibody immobilization and specific antigen binding. In this study, the device was calibrated on two scales: Streptavidin-Biotin complex, and antibody-antigen binding. A Streptavidin-Biotin study was conducted to view the binding of molecules on CNTs in paper under the SEM. Varied concentrations of cardiac troponin-I and C-Reactive protein were measured and successfully detected, proving the effectiveness of this device as a cardiac biosensor. A working biosensor, this device is also a platform for sensing a multitude of chronic and acute illnesses. The device is extremely economical, sensitive, quick, accurate, and requires a single drop of blood for biomolecule detection. It has the potential to revolutionize in-home patient care just as the insulin test has done for the diabetes market.

Awards Won:

Second Award of $2,000