

Siemens Competition

Math : Science : Technology

Regional Finalist

Name: Ruchi Pandya

High School: Lynbrook High School

Mentor: Dr. Jessica Koehne

Project Title: *Development of a Carbon Nanofiber Electrode Based Biosensor for Cardiac Health Diagnostics. (Materials Science/Nanoscience)*

Acute myocardial infarction, or cardiac arrest, causes one-third of the deaths in the world. When the heart muscle degenerates, three cardiac biomarkers are released: troponin, myoglobin, and C-reactive protein. Currently, concentrations of these proteins are determined through multi-step, low sensitivity, and expensive procedures. Electrochemical based biosensors have potential for quick, sensitive, portable, accurate, inexpensive biomolecule detection. Here, an electrochemical biosensor is based on vertically aligned carbon nanofibers (VACNFs). Their inherent nanometer scale, high conductivity, wide potential window, biocompatibility and well-defined surface make VACNFs ideal candidates as biosensor electrodes. The nanofiber is modified with antibody probes. Subsequent binding of target protein is characterized using electrochemical impedance spectroscopy, cyclic voltammetry and differential pulse voltammetry techniques. Each step of electrode modification results in changes in electrical resistance to charge transfer due to modifications at the electrode surface upon antibody immobilization and specific antigen binding. In this study, varied concentrations of cardiac troponin-I, C-reactive protein and myoglobin are measured, and a protocol to eliminate nonspecific binding was developed. This sensor demonstrates high sensitivity to 0.02 ng/mL—a good candidate for early diagnosis of myocardial infarction. This solution has potential for a cost effective, efficient, highly sensitive, and reliable diagnostic tool for cardiac arrest.