Electrochemical biosensors often employ enzymes as detection elements. These sensors are highly selective towards target analytes, however the scope of their application is limited by the poor stability of the enzyme. In this study, multi-valent inorganic cerium oxide nanoparticles were used as sensing elements for the detection of hydrogen peroxide (H$_2$O$_2$). The electrochemical response of the cerium oxide towards H$_2$O$_2$ analyte is defined through cyclic voltammetry and chronoamperometry. This response was found to be dependent on nanoparticle redox state (Ce$^{3+}$:Ce$^{4+}$ ratio) and this property is exploited to fabricate a biosensor optimized for H$_2$O$_2$ detection. As fabricated, the biosensor demonstrated sensitivity at picomolar analyte concentrations. Further, the sensitivity of the electrode is stable across a range of temperatures and pH's which inhibit the function of standard enzyme-based sensors.

In order for a biosensor to be competitive with enzyme-based sensors, the platform must function in protein-containing bio-media. Therefore, the sensor should be resistant towards protein adsorption, bio-fouling. To accomplish this, the produced sensor was coated with a thin layer of porous Nafion and tested in blood serum. The sensor retained function in serum demonstrating the high selectivity and robustness of the platform. The demonstrated reactivity with hydrogen peroxide is representative of CNPs interaction with biological reactive oxygen species shown to be associated with many life-threatening disease states. The sensor performance in detecting hydrogen peroxide suggests broader application in detection of other reactive oxygen species. Due to this, the described sensor platform can potentially replace multiple enzyme-based sensors by detecting several reactive oxygen species and other analytes.

Major: Materials Science and Engineering

Educational Career:
Bachelor's of Biotechnology, BS, 2014, University of Central Florida
Bachelor's of Micro & Molecular Biology, BS, 2014, University of Central Florida

Committee in Charge:
Sudipta Seal, Chair, Materials Science & Engineering
Hyoung Jin Cho, Mechanical & Aerospace Engineering
Stephen Florczyk, Materials Science & Engineering

Approved for distribution by Sudipta Seal, Committee Chair, on June 10, 2016.

The public is welcome to attend.