Membrane-Based Nanostructured Biosensor to Detect Hemolytic Bacteria

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Early detection of bacterial pathogens is increasingly important in health care. Currently, the most common method to detect hemolytic bacteria in blood is culture testing. This method is time-consuming, patients must wait 72 hours to receive results. Preliminary research into electrochemical methods to rapidly detect hemolytic bacteria yielded no previous studies. A novel biosensor was developed to detect hemolytic bacteria in blood within 1 hour. The biosensor consists of a gold electrode coated with a lipid membrane, which when disrupted generates a signal. Three different surface treatments were tested on the gold surface (no-plasma, plasma oxidation, and mercaptohexanol - MCH) to optimize the sensor performance. Cyclic voltammetry was used to detect any breaches in the membrane and test the sensitivity of the sensor. These tests were done by submerging the electrodes in solutions without disruptive factors and solutions containing 0.1% surfactant (sodium dodecyl sulfate, to disrupt the membrane), in the presence of a redox active molecule. Electrodes prepared with no plasma treatment had the least uniform membranes and 43% gave false-positives. The MCH functionalized electrodes created more uniform membranes, but the sensitivity was reduced because the MCH monolayer reduces the electron transfer efficiency. The plasma treated electrodes were the most successful because 100% of the membranes tested were uniform and inhibited electron transfer. Furthermore, upon 10-minute exposure to surfactant, these sensors showed signal comparable to a positive control. This demonstrates that this novel biosensor is capable of rapidly detecting membrane-disrupting factors.

Awards Won:

Second Award of $2,000

China Association for Science and Technology (CAST): Award of $1,200