A Detailed Study of the Nano-Porous Membranes with Applications in the Enhanced Detection of Cardiovascular Biomarker Proteins

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Abstract: Nanomaterial is widely used to design ultra-sensitive molecular biosensors. The objective of our study is to identify the role of nanoporous alumina membranes in achieving nano confinement of protein biomolecules towards designing protein biosensors with enhanced sensing capabilities. The purpose of investigating these nano-porous alumina membranes is to enhance detection through mimicking the phenomena of macromolecular crowding, which states that nano scale confinement enhances stability and efficacy of biomolecules in biological systems. We are mainly focused on the properties of these alumina membranes that cause the largest increase in sensitivity in detection including pore diameter, pore depth and pore densities. We are evaluating C-reactive protein, an inflammatory protein as the study protein. We have been using silicon based microchips integrated with the nanoporous alumina membranes as cardiac biosensors for detecting C-reactive protein. These biosensors exhibit binding of biomarker proteins through the impedance changes analyzed through electrical impedance spectroscopy. We see these changes in impedance due to the perturbation of the double layer at the solid liquid interface on the gold electrode located on the silicon microchip of the biosensor. The ultimate goal of this research is to develop a relationship between the properties of nano-porous alumina membranes and the performance metrics of the biosensors.

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