Faradaic electrochemical impedimetric analysis on MoS_2/Au-NPs decorated surface for C-reactive protein detection

Abstract - Background: A label-free Faradaic electrochemical impedimetric was developed for a highly sensitive detection of C-reactive protein using a gold interdigitated microelectrode bio-sensing platform enhanced by a gold nanoparticle-decorated molybdenum disulfide (Au-NPs/MoS2) nanosheet via selected chemical linking processes. C-reactive protein (C-RP), a crystalline protein, generates by the liver and hikes when there is inflammation throughout the patients' body. The concentrations of C-RP plasma levels tend to increase rapidly when the patient facing major injury which will lead to cardiovascular disease (CVD). Methods: The 5 µm microelectrode and gap size g-IDE with the nanostructured materials was demonstrated to increase the impedimetric detection response in Faradaic-mode electrochemical impedance spectroscopy high performance detection environment. The high surface area-to-volume ratio of the modified Au-NPs/MoS_2 nanocomposite increased the probes loading onto the transducer and enhanced the impedimetric detection response of the C-RP target post-binding due to an amplified net change in the charge transfer resistance. The developed immunoassay revealed a linear detection of C-RP biomarker in a logarithmic-scale from as low as 1 fg/mL up to 1 µg/mL, and a limit of detection of 0.01 fg/mL. The sensor shows great potential as an early warning risk for cardiovascular disease at a threshold concentration value of C-RP at 1 µg/mL. Significant findings: The biosensor demonstrates an excellent discrimination against other competing proteins in serum, exhibiting the highest predilection to C-RP spiked human serum target. The sensor's reproducibility is reported within an acceptable range of relative standard deviation of 1–4% for n = 3.

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