Biosensitivity of Molybdenum Disulfide for Monitoring Breast Cancer Marker CA15-3 Using Quartz Crystal Microbalance

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This paper verified the biosensors of molybdenum disulfide (MoS_2) and the colloidal gold probe to amplify signals studied by using quartz crystal microbalance (QCM) sensor. The chemical reaction was resulted in the formation of colloidal gold probes by immune colloidal gold technique and then verified by double antibody sandwich techniques (ELISA). Nanometer MoS_2 as the sensitive material of sensor was produced by hydrothermal method. The scanning electron microscope (SEM) and transmission electron microscope (TEM) electron microscopy showed that the gold nanoparticles were successfully modified on anti-CA15-3 antibodies and the prepared MoS_2 was typical two-dimensional material with a hexagonal sheet structure. We found that these QCM sensors had high sensitivity ($26.303 \pm 1.139 \text{ Hz/scale}$, 1 U/ml) and good linearity (0.960 ± 0.013) within the concentration range of CA15-3 between 0.5 U/ml and 100 U/ml . The results show that the response time of the system was less than 20s, had reproducibility and selectivity. It indicated that nanometer MoS_2 is a good biosensor material.

Keyword: molybdenum disulfide; bio-sensitivity; quartz crystal microbalance sensor; immune colloidal gold technique; double antibody sandwich techniques; CA15-3 concentration detection

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