Immunoaffinity biosensors based on nanomaterials for the biomedical applications

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The sensor employs biomaterial such as enzyme, antigen or antibody for the selective molecular recognition of a target analyte from a complex mixture. Especially, the immunoaffinity biosensors utilize the highly specific antigen-antibody interaction as the molecular recognition part. Such immunoaffinity biosensors conjugated with nanomaterials including nanoparticles, nanofilms and so on have been applied for various medical diagnoses of infectious as well as chronic diseases. The autodisplay technology is a protein expression method which produces a target protein as a fusion protein on the outer membrane of E. coli. This work presents the application of autodisplayed proteins such as Z-domain and streptavidin for the hyper sensitive immunaffinity biosensors. Usually, immunoaffinity (IA) biosensors have been made by immobilizing antibodies on metal surface of transducers as a molecular recognition layer. As the antigen-binding sites of antibodies are located at Fab region, only 20% of the immobilized antibodies have active orientation for the binding of analytes. In this work, (1) Z-domain was autodisplayed on the outer membrane of E. coli for the orientation control of immobilized antibodies, and (2) streptavidin was also autodisplayed for the immobilization of antigens with controlled orientation and high density. For the application of such autodisplayed proteins to biosensors, two kinds of assay configurations were used: (1) E. coli cells with autodisplayed proteins were directly used for immunoassay, and (2) the outer membrane with autodisplayed proteins was separated and then layered on the transducers based on surface plasmon resonance (SPR), fluorescence microarray, flow cytometry (FACS) and amperometric analysis. The biosensors with autodisplayed proteins showed far improved sensitivity as well as limit of detection, and such biosensors were demonstrated to be feasible to medical diagnosis of acute and chronic inflammatory diseases.