Nanoplasmonics and surface enhanced spectroscopy

An adaptive interfacial nano-architecture for the detection of steroid specific reactions

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Analytical approaches based on surface plasmon resonance (SPR) phenomena provide biosensor methods suitable for a wide range of both fundamental and practical applications. In addition to the qualitative direct detection techniques, the SPR systems can be also applied to the development of quantitative assays in a competitive mode, that open the way to overcame the principal limitations of SPR systems for low-molecular weight analytes. Small molecule antigens as steroids, pose challenges not encountered with large molecules. The foremost of these is that the antigen itself cannot generate correctly detectible SPR signal, given its small mass. One of the way to obtain optimal assay sensitivity is the competition format meaning the conjugation of the small molecule antigen to the bigger protein carrier (BSA) with further immobilization at the sensor surface allowing the competition between immobilized and free antigen for the antibody molecules.

It is known that behavior of composite protein molecules in the native conditions essentially depends on their charge state. So it is possible to change a position of the molecule relative to the charged sensor surface by modulation of charge of definite aminoacid groups via changing pH of the ambiance. One of the possible ways to modify the gold surface is a treatment by thiocyanate (NCS), which shares its negative charge approximately equally between sulfur and nitrogen. Owing to the displacement reaction protein molecules replace small counterions NCS, localizing near the surface by many weak single-point interactions.

The combination of the thin NCS sublayer with the blocking of the free space at the sensor surface by free BSA allowed us to develop flexible interfacial nano-architecture for the effective detection of steroids.