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Modelling of Displacement Method in Surface Plasmon Resonance Sensing

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Existing methods of detecting explosives have many problems in terms of stability, sensitivity, high selectivity, and rapid sensing for any given situation. In this study, we selected a displacement method using a surface plasmon resonance (SPR) immunosensor, which is one of the ways to overcome these problems. In an SPR displacement immunoassay, the methods to realize a high sensitivity were investigated by experimental findings. However, they were not investigated by theoretical approaches. Hence, we developed a method with a higher sensitivity based on the kinetic theory of this system. The strategy of an SPR displacement immunoassay to realize a high sensitivity was determined using the two-layer model simulation by a theoretical approach. As a result of the simulation, we found that a high sensitivity was realized using a combination of an antigen analogue and an antibody with a small association constant or a combination of an antigen and an antibody with a large association constant. This means that the equilibrium constants affect the sensitivity of an SPR displacement immunoassay, which is one of assays under nonequilibrium conditions. In addition, we investigated the relationship between association equilibrium constants and the sensitivity using conjugates and a hapten to detect 2,4,6-trinitrotoluene (TNT). The result of the experiment supported the theoretical inferences.

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