Supporting information

Fast Tracking of Adulterants and Bacterial Contamination in Food via Raman and Infrared Spectroscopies: Paving the Way for a Healthy and Safe World

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1. Role of SPR in Detection of Adulterants and Bacterial Contamination in Food

Surface plasmon resonance (SPR) is an optical phenomenon that can be used to monitor the binding of molecules without the need for labels.[1], kinetics, and affinity of molecular interactions.[2,3,4] SPR determines the binding of two proteins, a protein, and an antibody, DNA and a protein, etc. As a label-free technique, SPR does not require additional reagents or laborious sample preparation.[5, 6] In the SPR technique, the signal is generated from the interaction of incident light and a metal nanoparticle layer (such as gold) by producing surface waves. The metal layer is applied normally on a piece of a prism-based on the Kretschmann model.[7] The incident light's angle is regulated by a rotating stage, and reflection from the prism is detected. When the surface wave is generated at a given angle, the reflected light is greatly dampened due to the energy transfer process.[8] The signal drop that corresponds to the refractive index of the target material on the metal nanoparticle layer may be used to examine the characteristics (Figure 1). The SPR signal is very sensitive to changes in the metal layers' refractive index.[9] SPR does not affect the material composition and can be used for examining natural liquids such as honey.[10]

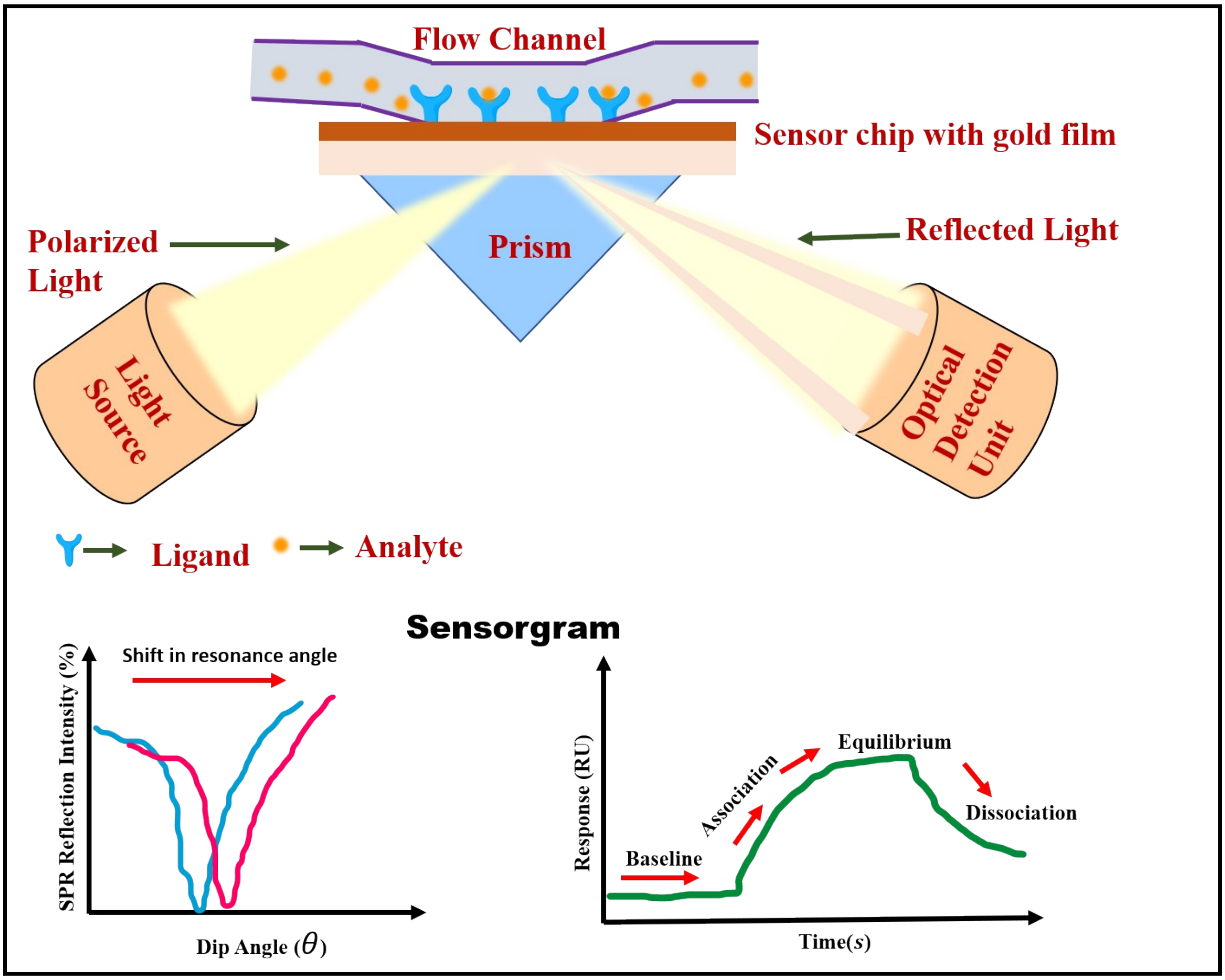

Fig. 1. Schematic illustration of surface plasmon resonance.

The wave vector of an evanescent field (K_{ev}) and the wave vector of a surface plasmon (K_{sp}) is used to describe the propagation in SPR, equations (1) and (2).[11]

$$K_{ev} = \frac{v_o}{C} n_g \sin\theta \quad (1)$$

where v_0 is the frequency of incident light, n_g is the refractive index of the dense medium(glass), θ is the angle of incident light and C is the speed of light in a vacuum[12], and

$$K_{sp} = \frac{v_o}{C}\sqrt{\frac{\varepsilon_m n_s^2}{\varepsilon_m + n_s^2}} \tag{2}$$

where n_s is the refractive index of the dielectric medium and ε_m is the permittivity of the metallic film. When $K_{sp}=K_{ev}$, surface plasmons become resonantly excited, thus causing this phenomenon to happen.[13]

Zainuddin et al.[13] used the SPR technique to identify the adulteration of pure honey. They found that with increasing adulterant concentration the change in resonance angle rises linearly. Pure honey showed a higher refractive index than contaminated honey. For fructose, sucrose, and glucose adulterants, the sensitivity of the sensor was excellent. Lu et al. developed an immunosensor based on the surface plasmon resonance for detecting melamine in milk products and pet foods.[14] Mazumdar et al. developed a quick and simple SPR-based immunoassay for detecting Salmonella in milk. Salmonellosis is a severe health hazard and one of the most common causes of food poisoning. [15] SPR test was able to identify S. Typhimurium down to a concentration of 1.25 x10^5 cells ml^{-1}. Yadav et al. developed silver (Ag) and Ag- graphene oxide (GO) coated fiber optics sensors for detecting adulteration in pure honey following SPR phenomena.[16]

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