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Plasmonic-coupling-based advanced optical biosensing models

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Abstract

Surface plasmon resonance (SPR) has been widely applied to observe the surface binding processes due to the fact that it is sensitive to changes in the refractive index of the dielectric medium close to metal surface. Thus, it is recognized that SPR-based sensing is considered one of the most powerful and efficient platforms for label-free biomolecular detection. Numerous researches have been conducted to develop SPR sensors practically useful for target-oriented applications. In this study, we introduce selected approaches for the fabrication of unconventional plasmonic-coupling-based sensors. Synergistic coupling effects between propagating and localized SPs were demonstrated by incorporating arrays of Au nanoparticles (Au NPs) in-between DNA sensing assays. Hierarchical structures for detection of target DNA were constructed by a simple immobilization of probe DNA on Au thin films using mixed self-assembled-monolayers (SAMs) and streptavidin-biotin coupling as a “bridge” between SAMs and probe DNA. Au NPs of different sizes were incorporated on the top of the basal Au film and the streptavidin layer, respectively, and their effects on the coupling-induced sensitivity enhancement were systematically compared. A surface plasmon coupling-mediated sensor system is developed based on Au nanoparticles tagged with a coordinative dipycolylamine and lipoyl anchored naphthalimide derivative. The AuNPs with tailored ligands exhibit distinct sensing activity via sequential assembly into nanoparticle aggregates induced by metal ion complexing and diassembly in the presence of pyrophosphate anion, during which a swift color change is reversibly accompanied due to surface plasmon resonance coupling effect.

Biography

Dong Ha Kim received his Ph.D. degrees at Seoul National University in Korea. He carried out his postdoctoral research activities at the University of Massachusetts at Amherst and at the Max Planck Institute for Polymer Research. He joined Ewha Womans University in 2006 and assumed a faculty position. Currently he is an associate professor in the Department of Chemistry and Nano Science of School of Natural Sciences. His research interests include development of multi-functional hybrid nanostructures for applications in energy storage and conversion, environmental remediation, memory devices, display devices, and biosensing. Surface Plasmon resonance mediated biosensing, photovoltaics, light emission and photocatalysis are also his lasting interests. He has authored or coauthored 87 peer-reviewed publications and holds 28 issued Korean patents (12 registered).