Abstract Summaries

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7192-36, Poster Session

Experimental study on the influence of the metal film thickness on surface plasmon resonance biosensors

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Surface Plasmon resonance (SPR) is a promising technology in chemical and biology sensing. In a SPR sensor, a glass slide is coated with a metal film, whose thickness , density and dielectric constant deadly affect the measurement sensitivity and precision in detection. The optimum thickness of gold film in SPR sensors is 45nm without adhesive film, according to calculations based on multilayer refection model cited in lots of papers. But experimental study on the optimum film parameters is still lacking for the limitation of film coating technology and high-precision thickness measurement. The optimum gold film thickness observed in our detection is not 45nm, and the property of adhesive film, which needed for enhancing the adhesion of metal film, affects the SPR responsive bandwidth and minimum value. In this paper, the strictly experiment study on the gold film and adhesive film of SPR sensors is described using high precision SPR detection system, X-ray diffraction and magnetron sputtering technology. Film density and structure are controlled by magnetron sputtering process and measured by Atomic Force Microscopy (AFM). Their influences on SPR are also discussed. We combine the experiment result with the multilayer reflection theory to optimize the SPR calculation model.

7192-37, Poster Session

High-performance compact multi-channel sensor based on spectroscopy of surface plasmons

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Surface plasmon resonance (SPR) is a label-free biosensing technique with a large number of existing and potential applications in medical diagnostics, environmental monitoring, food safety and security. There is a continuous effort to bring detection capabilities of laboratory SPR systems to the field. However, performance of current portable SPR biosensors is typically two orders of magnitude behind that of their laboratory counterparts. In this paper, we report a new compact multi-channel SPR sensor suitable for the use in the field. The sensor utilizes special diffraction grating which performs coupling of light into the surface plasmon via one diffraction order and its simultaneous wavelength dispersion through another order of diffraction. This approach to spectroscopy of surface plasmons allows integration of excitation and interrogation of surface plasmons on a single plastic SPR chip produced by hot embossing. The resulting SPR sensor has a footprint of about 10x10 cm and incorporates optical bench, microfluidics with six independent sensing channels, temperature stabilization module, and supporting electronics. In model refractometric experiments, it is demonstrated that the sensor is capable of resolving refractive index changes as small as 3E−7. This performance is comparable with the best laboratory SPR sensors.

7192-38, Poster Session

Detection of Avian influenza-DNA hybridization using surface plasmon resonance sensor

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Avian influenza (AI) is an acute respiratory disease causing varying degrees of clinical symptoms and illness. To date, several techniques have been developed for avian influenza virus (AIV) detection. However, most of these techniques involve painstaking and time-consuming laboratory procedures and also require expensive and huge equipments to detect the viral infection. In this study, we proposed an improved and simplified surface plasmon resonance (SPR) biosensor for rapid, direct and accurate quantification of AI-DNA. We implemented an SPR system optimized for hybridization reaction of AI-DNA with high sensitivity so that AI-DNA could be detected without the amplification of real AI-DNA sample. In this study, we used oligonucleotide probe originated from avian influenza A virus (A/avian/NY/73-63-6/00(H7N2)) hemagglutinin sequences. We first studied the immobilization of oligonucleotide probe onto an Au surface in order to compare the probe surface coverage and hybridization. The oligonucleotide probe with thiol was directly bound onto an Au surface for detecting both the oligonucleotide target and the real AI-DNA. The immobilized probe was sufficient to induce the dose-dependent SPR wavelength shift. The possibility of SPR-based biosensor for the detection of AI-DNA was demonstrated by the selective and sensitive hybridization reaction. We believe that the developed SPR biosensor is feasible for a real-time AI diagnosis as well as for the investigation of AIV infection.

7192-42, Poster Session

Plasmonics enhancement of metal nanospheres and nanospheroid linear chain systems

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We have developed a semi-analytical method for computing the plasmonics enhancement of the electric field surrounding a finite linear chain of metal nanospheres and nanospheroids. The described method avoids the use of addition theorems, which are not applicable to spheroidal chains. The standard treatment of chains or clusters of spheres generally use the spherical harmonic addition theorem to relate the multipole expansion coefficients between different spheres. Numeraical simulations are performed to illustrate the large field enhancements that can occur in the nanoscale gaps between the silver nanoparticles arising from plasmon resonances.

7192-20, Session 4

Optimization and characterization of gold layered nanoparticles for multiplexed optical imaging

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Metallic nanoparticles coupling strong surface plasmons with a light emitting molecule and/or a magnetic core have been developed for application in multiplexed optical imaging. Of interest to our work is the ability of the nanoparticles to serve as surface enhanced Raman spectroscopy (SERS) agents. We have optimized the chemical synthesis and characterized these two types of gold layered nanoparticles. In the first case, the physicochemical interaction between the adsorbate dye and the gold nanoparticle is probed. Rhodamine dye has been covalently linked to 5 nm gold nanoparticle ‘seeds’. Gold layers were then iteratively deposited on the dye labeled seeds forming a rhodamine labeled gold core/gold shell inclusion nanoparticle. We will present data on the influence of dye concentration, gold outer shell thickness, nanoparticle size and shape on both the SERS and fluorescence activity. Experimental evidence indicating the presence of dye in the nanoparticle core, utilizing X-ray photoelectric spectroscopy, fluorescence/plasmon resonance energy transfer and quenching studies, will also be presented. Secondly, rhodamine dye was covalently linked to a magnetic, amine-functionalized, 5 nm iron oxide colloid. Gold layers were again iteratively deposited on the dye-labeled seeds. These fluorescently labeled iron oxide core/gold shell nanoparticles could be ‘tuned’ during synthesis to display enhanced surface plasmon resonance or fluorescence intensity. Characterization of the nanoparticles’ SERS, fluorescent and mag-