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An Overview of Metallic Nano-cylinder Coated Grapheme-based Ultrasensitive Biomolecules Sensor

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EDITORIAL

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EDITORIAL

Sensors based on guided electromagnetic waves travelling along a metal and dielectric contact are known as surface Plasmon resonance (SPR). The detection process is due to the resonant coupling between the conduction electrons and the out medium in both mediums, where light decays exponentially. SPR biosensors have piqued curiosity and have been the subject of extensive theoretical and experimental research. They are highly sensitive to changes in refractive index due to their miniaturisation performance Changes in the effective refractive index come from the connection between the sensing region and the ambient medium. As a result of this change, the resonance wavelength shifts, allowing the sensitivity to be measured. More SPR sensors, such as Bragg gratings nano-disk resonator photonic crystal cavities directional couplers, photonic crystal fibres, ring resonators [hexagonal cavity have been proposed to measure refractive index changes.

A highly sensitive surface plasmon resonance biomolecules sensor using a metallic hollow nano-cylinder coated with graphene is presented. The cylindrical shape enhances the concentration of the electric fields allowing the detection of small changes in the refractive index of analyses (biomolecules). The sensor consists of three patterns coupled to the light source; each one is formed by a hollow metallic cylinder surrounded by a layer of graphene all in a metallic matrix. The sensing process is performed by mediation of the SPR between the surface plasmon polarities and the core guided modes of the patterns, which are later filled with analytes to be measured. Due to the important optical properties of Nano-cylinder in nanoscale confinement, the width of the nano-cylinders is optimized to obtain high sensitivity. The sensitivity is greatly enhanced to reach 185 μm/RIU. The three cylindrical channels have distinctive responses to different analyses at a wide range of incidence angle, which enables simultaneous sensing of various biomolecules. These excellent properties pave the way for a wide range of applications varying from chemical to biological sensing and for realizing compact several refractive indices sensing device Surface plasmon resonance (SPR) sensors are optical devices that are based on guided electromagnetic waves propagating along a metal and dielectric interface. In both mediums the light decay exponentially, the detection process is duo to the resonant coupling between the conduction electrons and the out medium.

The SPR biosensors have attracted interest and intensive study theoretically and experimentally. Due to their performance in miniaturization, are high sensitive to refractive index changes. The coupling between the sensing region and environment medium, results in changes in the effective refractive index. This change leads to a shift in resonance wavelength therefore the sensitivity can be the measured. More SPR sensor have been proposed to measure the refractive index changes, such as Bragg gratings nano-disk resonator photonic crystal cavities directional couplers photonic crystal fibers ring resonators, hexagonal cavity M. Li have proposed a sensor made of a waveguide and nano cavity with high sensitivity of 1000-2000 nm (RIU). In a plasmonic silicon waveguide for gas detection with sensitivity of 458 nm/RIU has been demonstrated, also L. Zhou have also presented miniaturized microring resonator sensor using hybrid plasmonic waveguide with sensitivity of 580 nm/RIU. Additionally, metal-insulator-silicon waveguide sensor has been theoretically investigated with sensitivity of 430 nm/RIU. Nagiyalo have demonstrated fiber-tip plasmonic resonators for label-free detection Further, an ellipsoidal Al nano shell based sensor with spectral sensitivity of 4111.4 nm/RIU and minimum detectable refractive index of 2.45 × 10-5 nm/RIU was reported. A hybrid-plasmonic mode sensor with the sensitivity of about 1080 nm/RIU to detect the changes of refractive index.

Many sensors based on photonic crystal fibers with high sensitivity of about 13750 nm/RIU are demonstrated Metallic elements are most useful in sensing applications duo to their elevated electronic conductivity. To detect substances at very low concentrations, equipment that provides high detection limits and high sensitivity is required. Plasma metal nanoparticles, especially metal nanoparticles made of gold and silver, offer a significant promise for rapid detection of substances down to the single-molecule level. Local surface plasmon resonance property enables nanoparticles to efficiently absorb and scatter light when exposed to electromagnetic radiation. By designing nanoparticles with high sensitivity, they can detect accurately the unknown biological molecules that are not detectable using other detection techniques. In this work, it is shown that a biosensor made of metallic hollow nano-cylinder coated with graphene with small volume filled with molecules can improve the sensitivity of the detector to the variations of the refraction coefficient. Determining the proper gap between coupled metal nanoparticles causes the electromagnetic field to be enhanced in this gap and improves detector sensitivity. Although conductive overlap decreases field enhancement, the energy of gap plasmons can have higher shift.