Nanohole Arrays Combined with Chemically reduced Graphene Oxide for Sensing

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Abstract

A receptor film for Surface Plasmon Resonance (SPR) technique based on a hybrid gold nanohole array in combination with graphene was created and the plasmonic features analyzed. As a model analyte purines were used.

Surface plasmon resonance depends on the dielectric medium at the vicinity and makes it a quasi-universal detector. Advantages are the capability to determine concentrations in combination with kinetics. Therefore, SPR is a widely used sensing tool for real-time monitoring interactions of various analytes. The label-free nature enables a fast, specific, and sensitive analysis of molecular interactions. However, detection of highly diluted concentrations and small molecules (< 400 Da) is still a major challenge. For enhanced SPR sensing mainly approaches based on a modified sensing substrate or an amplification tag have been developed [1-2].

The performance of standard SPR devices can be improved by hybrid plasmon-graphene systems. It omits any bulk phase and hence enables fast response time. The electromagnetic field is locally enhanced and modulated by the interaction of graphene photonics with the plasmonics of metal nanostructures. Amplification arises from localized surface plasmons at the nanostructures and leads to an increasing capability for sensing [3].

The nanohole arrays were fabricated by nanosphere lithography and their SPR characteristics analyzed using the Kretschmann configuration at a fixed wavelength. Surface sensitivity, defined as the capability of detecting changes in the refractive index occurring in close proximity to the surface, is enhanced for the nanostructured substrates compared to a film of continuous gold. Chemically derived reduced graphene oxide (rGO) is deposited on the substrates, introducing selectivity to the system and enabling the binding of planar molecules with aromatic systems. A binding study of the model analyte adenine verified the enhanced sensitivity by achieving approximately three times lower limits of detection (~2 µM) and a higher signal response.

References

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