Motion Detection and Bio-sensing Using Plasmonic Structures

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Plasmonics, the study of interaction between light and metal-dielectric structures (generally sub-wavelength), has been exploited significantly in the past for various applications. This is greatly accentuated by the fact that plasmonic effects can be observed from the UV to the Mid-IR spectral ranges. Always such effects are associated with large local field enhancement which forms the basis for applications like SERS, sensing, fluorescence enhancement, super-resolution imaging etc. During this presentation, I will present results dealing with two distinct applications of plasmonics, namely, bio-sensing and made-to-order tailored light.

In the first part, I will demonstrate motion sensing using plasmonic structures supporting a tunable resonance. The tunability of the plasmon resonance is achieved by incorporating a single-layer *graphene* under the plasmonic structure. The presence of *graphene* allows us to electrically control (by means of a gate voltage) the plasmon resonance wavelength at potentially ultra-fast speeds. Exploiting this electrical control, an active control of optical phase of reflected light is demonstrated experimentally. I will demonstrate how a slight modification of the experimental scheme enables us to determine the motion of an object with high precision. Additionally, the same structure can also be used for electrically controlling the polarization of the reflected light, which is another of its vital properties.

The second part of this talk will be devoted to bio-sensing with plasmonic structures. Specifically, I will show that IR bio-sensing can be used for analyzing the presence of different analytes (eg. ethanol and acetone) in an aqueous solution and further identify the type of analyte. Subsequently, the potential use of these IR plasmonic structures for cancer diagnosis (distinguishing cancerous from non-cancerous cells) will be also shown. In the last part of my talk, I will demonstrate how plasmonic nanostructures (with resonance in the visible domain) are able to detect and measure the size of individual gold nanoparticles. It will be shown that this optical approach can also be used for distinguishing solid gold nanoparticles from gold nanoshells (with a hollow core).