**Plasmonic and graphene-based plasmonic metamaterial nanostructure: A new approach**

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**Mr. Promod Kumar** received his M.Tech. degree in Nanotechnology in 2010 from Guru Gobind Singh Indraprastha University, Kashmere Gate, New Delhi, India. He obtained his Ph.D. degree in Nano Science and Technology from Department of Physics, National Institute of Technology, Hazratbal, Srinagar (J&K), India. His fields of the research interests are plasmonic and optoelectronics properties of metallic nanostructures and graphene based noble metal nanoclusters for superior photovoltaics applications. He has also received best oral presentation award in the National/International Conferences. Promod Kumar is also awarded the certificate of Merit in the National Seminar on Recent Advances On Luminescent Materials (RALM-2015) organized by the department of Chemistry, Annamalie University, Annamalaienagar- 608 002 during January 23-24, 2015.

He is presently working as a Post-doctorate fellow at Department of Physics, University of the Free State, Bloemfontein, South Africa.

The field of plasmonics has been established as an interdisciplinary area in which researchers coming from different backgrounds such as physics, chemistry and engineering strive to discover and exploit new and exciting phenomena associated with surface plasmons. When electromagnetic radiation interacts with nano-sized metal/metal-oxide particles which are much smaller than the wavelength, their conduction electrons could be displaced from their nuclei. Hence, opposite charges will be built up on the metal nanoparticles' surfaces, which acts as a restoring force for the oscillating electrons. Such oscillations are maximized when the frequency of the incoming light matches the inherent oscillation frequency of the fluctuating conduction electrons which is responsible for plasmon resonance.

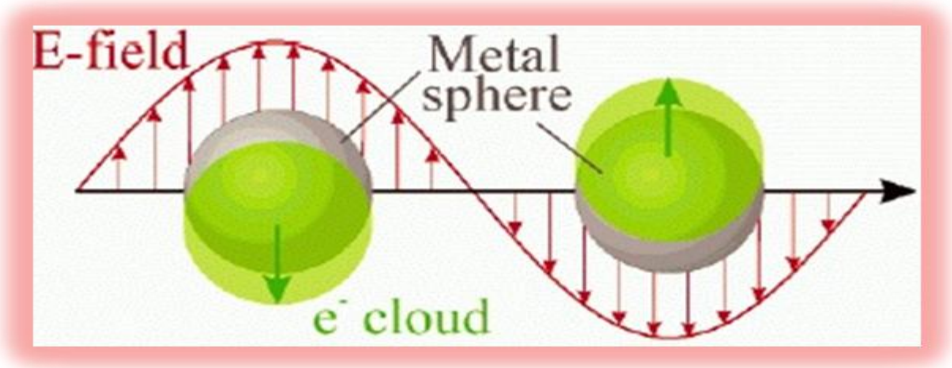


**Figure1: Localized surface plasmons on metal nanoparticles excited by free-space light.**

The plasmonic behaviors of metallic nanostructures have drawn enormous scientific interest due to their unique and unusual physicochemical properties and functionalities compared to their bulk counterparts. These properties make them attractive in various applications such as plasmonics, nanoelectronics, biotechnology and nanophotonics. The electromagnetic coupling between metal nanoparticles, which opens up a new horizon at the nanoscale for advanced bio-molecule sensing, cancer treatment, plasmonic solar cells and various other practical applications, is of essential importance in materials science. Plasmonic materials with large third-order optical nonlinearities and fast nonlinear response times are usually considered promising candidates for potential applications in optoelectronics, photovoltaic and photonic devices including flat screen TVs, electronic book readers, optical computing, optical data storage, all-optical switching devices, organic thin film transistors, organic photovoltaic devices, biosensors, optical telecommunications, solid state lighting and also in harmonic generation and photodynamic therapy.

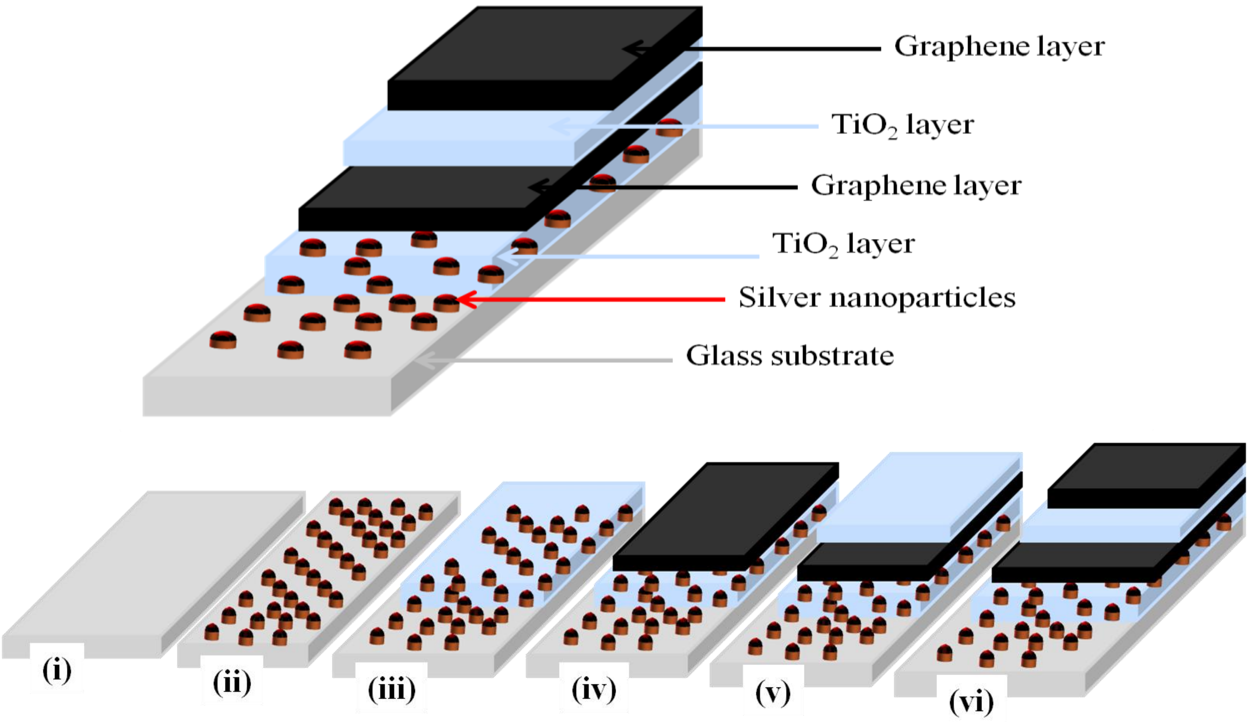


**Figure 2: The schematic illustration for $TiO_2$ based plasmonic semiconducting thin film.**

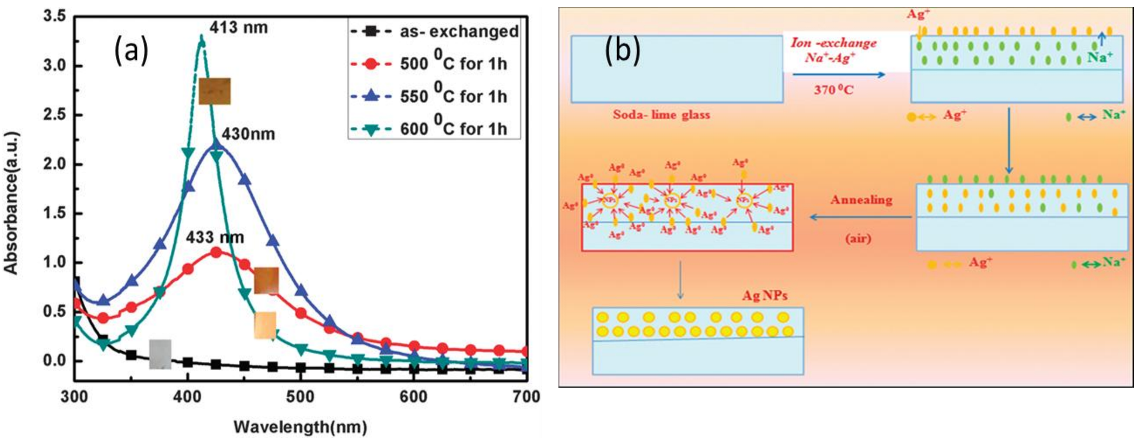


**Figure 3: (a) : Optical absorption spectra with color photographs of the thermal evolution of Ag nanocomposite glass.;(b) : Thermal evolution of the Ag nanoclusters in an ion exchanged soda-lime glass**

The strong electrical coupling of reduced graphene oxide (RGO) decoration with Ag-doped TiO2 nanocrystals improves the optical properties. Thus metal-doped, semiconductor-decorated, reduced graphene hybrid layers could be a promising material for superior photovoltaic, photo catalytic activity and energy harvesting devices.