J Nanomed Nanotechnol 2013, 4:6
http://dx.doi.org/10.4172/2157-7439.S1.015

OMICS Group Conferences
Accelerating Scientific Discovery
3rd International Conference on
Nanotek & Expo
December 02-04, 2013 Hampton Inn Tropicana, Las Vegas, NV, USA

The study of surface plasmon polaritons in graphene hybrid nanomaterials

Mahi R. Singh
The University of Western Ontario, Canada

There has been growing interest in developing nanoscale optoelectronic devices by combining nanomaterials with complementary optical properties into composite (hybrid) structures. The number of possible composite systems that can be built from already existing nanostructures is simply enormous. A significant amount of research on exciton-plasmon interactions has been devoted to the study of metal-semiconductor nanostructures, which offer a wide range of opportunities to control light-matter interactions and electromagnetic energy flows on nanometer length scales. Strong exciton-surface plasmon coupling in semiconductor quantum dot (QD)-metal nanoparticle systems could lead to efficient transmission of quantum information between qubits for applications in quantum computing and communication. These nanostructures also have applications in biophotonics and sensing, where nonradiative energy transfer between a QD and metal nanoparticle can be used to detect biological molecules. In this paper, we study the dipole-dipole interaction (DDI) and energy transfer between a QD and a graphene nanodisk. Here the QD-graphene system is embedded in a photonic crystal, which acts as a tunable photonic reservoir for the QD. Photonic crystals are engineered, periodically ordered microstructures that facilitate the trapping and control of light on the microscopic level. Applications for photonic crystals include all-optical microchips for optical information processing, optical communication networks, sensors and solar energy harvesting. In our investigation we consider a nonlinear photonic crystal, which has a refractive index distribution that can be tuned optically. The nonlinear photonic crystal surrounds the QD-graphene system and is used to manipulate the interaction between the QD and graphene nanodisk. Surface plasmon polaritons are created in the graphene nanodisk due to the collective oscillations of conduction band electrons. They arise due to the dielectric contrast between graphene and the surrounding dielectric medium. Plasmonics is widely studied due to applications in ultrasensitive optical biosensing, photonic metamaterials, light harvesting, optical nanoantennas and quantum information processing. Generally, noble metals are considered as the best available materials for the study of surface plasmon polaritons. However, noble metals are hardly tunable and exhibit large Ohmic losses which limit their applicability to optical processing devices. Graphene plasmons provide an attractive alternative to noble-metal plasmons, as they exhibit much tighter confinement and relatively long propagation distances. Furthermore, surface plasmons in graphene have the advantage of being highly tunable via electrostatic gating. Compared to noble metals, graphene also has superior electronic and mechanical properties, which originate in part from its charge carriers of zero effective mass. We show that the intensity and frequencies of the peaks in the energy transfer spectra can be modified by changing the number of graphene monolayers in the nanodisk or the separation between the quantum dot and graphene. Our results agree with existing experiments on a qualitative basis. The principle of this system can be employed to fabricate nano-biosensors, optical nano-switches, and energy transfer devices.

msingh@uwo.ca

Graphene-based low-carbon nanocomposite for harsh environment applications

Mohamed Saafi
University of Strathclyde, UK

In this talk, preliminary findings related to the electrical and mechanical properties of a new graphene-based nanocomposite will be presented. The new material is composed of graphene and recycled materials, synthesized through *in-situ* self-assembly and reduction of graphene oxide (GO). Electrical, mechanical and SEM tests were conducted to quickly validate the concept of combining waste materials with GO for the production of multifunctional nanocomposites for various engineering applications for various applications including electrochemical and mechanical sensors, coatings and super-capacitors for large-scale energy storage. In this talk, I will show that the *in-situ* reduced graphene (rGO) increased the conductivity, tensile fracture strength, Young's modulus and toughness of the nanocomposite specimens. The findings will provide a promising base for the development of multifunctional nanocomposites using waste materials.

Biography

Mohamed Saafi is an associate Professor of Civil Engineering. He obtained his Ph.D. in 2001 from the University of Alabama in Huntsville. His research interests include nanotechnology-based materials, advanced sensing technologies and smart materials. He published over 30 papers in refereed journals and proceedings.

m.bensalem.saafi@strath.ac.uk