Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **36** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Light-matter Interaction in Plasmonic Nanohybrids

Monday, 7 June 2021 12:55 (4 minutes)

The study of plasmonics has the potential to reshape the physics of light-matter interactions in metallic nanohybrids and their applications to nanotechnology. Metallic nanohybrids are mode metallic nanoparticles and quantum emitters such as quantum dots. Recently, there is a considerable interest to study the light-matter interaction in the nanoscale size plasmonic nanohybrids. When an external light falls on the QEs, electrons in the QEs get excited from the ground state to the excited states and electron-hole pairs are created in the QEs. Similarly, when the external light (photons) falls on the MNPs it modifies the plasmonic properties of these particles. We know that there are free electrons on the surface of the MNPs. These free electrons oscillate as the charged waves on the surface. The quantized particles of the charged wave are called plasmons. When external light photons fall on the surface of the MNPs, there is an interaction between the photons and plasmons. This interaction produces new types of quantized quasi-particles called the surface plasmon polaritons (SPPs) It interesting to note that exciton energies and SPP energies can be modified by manipulating the size and shape of the QEs. It is also found that exciton and SPP energies can also be modified by applying an external field such as external control lasers, external stress-strain fields, and magnetic fields. Here we study the light-matter interaction in plasmonic nanohybrids made of an ensemble of metallic nanoparticles and quantum emitters. The study of linear and nonlinear plasmonics has the potential to reshape the physics of light-matter interactions and their applications to nanotechnology and nanomedicine. Further, we include the effect of the dipole-dipole interaction (DDI) on the light-matter interaction in plasmonic nanohybrids. We found that the SPP field also induces dipoles in QEs and MNPs and they interact with each other via that the anomalous dipole-dipole interaction. It is shown that the anomalous DDI is many times stronger than the classical DDI. The nonlinear plasmonics such as two-photon spectroscopy and Kerr nonlinearity is also explored. Finally, we have examined that these nanohybrids can be used to fabricate the nanosensors and nano switches for the applications of nanotechnology and nanomedicine.

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Session Classification: M2-1 Interaction between matter and light (DAMOPC) / Interaction entre matière et lumière (DPAMPC)

Track Classification: Atomic, Molecular and Optical Physics, Canada / Physique atomique, moléculaire et photonique, Canada (DAMOPC-DPAMPC)