Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **4471** Type: **Oral Competition (Undergraduate Student) / Compétition orale (Étudiant(e) du 1er cycle)**

(UG*) Second and Third Harmonic Generation in Metallic Nanohybrids

Monday 27 May 2024 15:00 (15 minutes)

One of the major discoveries resulting from the invention of the laser was the existence of nonlinear optical processes: phenomena only described by nonlinear dependencies of a material's electric polarization on the electric field of incident light. Two of these processes are second harmonic generation (SHG) and third harmonic generation (THG), which are frequency-doubling and frequency-tripling processes respectively. Metallic nanoparticles (MNPs) are a promising host for these effects as they exhibit surface plasmon resonance which can enhance the harmonic generation signals. In this project, we develop a theory for SHG and THG in nanohybrids of gold, aluminum, and copper sulfide MNPs. We utilize a semi-classical theory in which the coupled-mode formalism of Maxwell's equations is used to describe the input and output light and the quantum mechanical density matrix formulation is used to calculate the nonlinear susceptibilities of the material. This theory agrees with recent experiments. Furthermore, a hybrid system including quantum dots is considered, where the harmonic generation signals are further enhanced by the dipole-dipole interaction between the MNPs and quantum dots. The enhanced harmonic generation in MNPs allows for a wide array of potential applications spanning several areas of science and technology including photothermal cancer treatments in nanomedicine.

Keyword-1

Third Harmonic Generation

Keyword-2

Metallic Nanohybrid

Keyword-3

Second Harmonic Generation

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Session Classification: (DAMOPC) M2-8 Scattering & Spectroscopy | Diffusion et spectroscopie (DPAMPC)

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