Dirección de Formación Académica

CENTRO DE INVESTIGACIONES EN OPTICA, A.C.

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Thesis: "SECOND HARMONIC GENERATION IN NANOSTRUCTURED METAMATERIALS"

Summary:

In this thesis, we conduct a theoretical and numerical study on the second-harmonic (SH) optical response of a nano-structured metamaterial. These metamaterials are composed of a periodic array of both metallic and dielectric inclusions.

The inclusions and their surrounding matrix are made of centrosymmetrical materials, for which SH is forbidden in the dipole approximation. With a proper choice of the shape of the inclusions, we may produce a geometrically non-centrosymmetric system which does allow efficient SH generation. The linear and quadratic spectra of the optical response of the metamaterial can be tunned by simple variations in the geometrical configuration of the inclusions.

A theory that allows the calculation of the non linear polarization from the Geometry of the system and its linear dielectric function at the fundamental and second-harmonic frequencies is developed, and we implement an efficient scheme for its numerical computation. Thus, extending a formalism for the calculation of The macroscopic dielectric function using Haydock's recursion method.

The formalism obtained is used in order to calculate the optical properties of Different periodic arrays of nanostructures within metallic and nonmetallic matrices. It can be applied to any combination of materials and geometry for inclusions, within the long-wavelength regime.