2:15 PM - O11.03

UV Plasmonic Metamaterial from Vertical Non-Conventional Nanoantennas

Alexander Cuadrado[2], Johann Toudert[2], Javier Alda[1], Rosalia Serna[2].

1, Applied Optics Complutense Group, Universidad Complutense de Madrid, Madrid, Madrid, Spain; 2, Optical institute, Laser Processing Group, CSIC, Madrid, Madrid, Spain.

Hide Abstract

Metallic nanoantennas have been used as nanophotonic detectors of infrared and visible radiation [1] [2]. The extension of these elements to the ultraviolet (UV) range has not been satisfactory due to the poor optical absorption showed by metals at these frequencies. The low values of electrical conductivity of metals at UV frequencies compromise the generation of currents along the resonant geometries. In change, several non-conventional materials show a larger value of electrical conductivity, increasing notably the absorption of nanoantennas in the UV [3]. This electrical conductivity increment is more noticeable in liquid semimetals as Bismuth or Gallium. Another way to improve optical absorption of these resonant elements is to arrange them with a high spatial density of semimetal nanoantennas.
In this contribution we evaluate numerically, using multiphysics simulation, the light to heat conversion performance of a vertical nanoantenna arrangement embedded in a dielectric matrix. The so-obtained UV metamaterial enabling strong electromagnetic plasmonic absorption and heating effects. The use of nanoantennas allows a polarization and frequency selectivity that can be adequate to generate ultraviolet sensors. These selectivities are strongly related with the shape of the resonant elements. Furthermore, since the vertical antennas are embedded within a robust dielectric matrix, this arrangement allows to change from solid to liquid phase maintaining the nanoantenna geometry. This is possible for materials as Bismuth or Gallium which show a lower melting temperature than dielectric substrates [4]. This phase transition makes the metamaterial active upon control of temperature.
[1] L. Novotny and N. van Hulst, "Antennas for light," Nat. Photon. 5 (2), 83-90, (2011).
[2] A. Cuadrado, E. Briones, F.J. González, J. Alda, "Polarimetric Pixel using Seebeck Nanoantenna". Opt Exp, 22, No 11, 13835-13845, (2014).
[3] J.Toudert, R.Serna, and M. Jiménez de Castro, "Exploring the optical potencial of nano-Bismuth: Tunable surface Plasmon resonances in the near Ultraviolet-to-Near Infrared range", J. Phys. Chem. C, 116 (38), pp 20530-20539, (2012).
[4] M. Jiménez de Castro, F. Cabello, J. Toudert, R. Serna and E.Haro-Poniatowski, "Potential of bismuth nanoparticles embedded in a glass matrix

for spectral-selective thermo-optical devices" Appl. Phys. Lett. 105, 113102 (2014).

2:30 PM - O11.04