PAPER

Optical properties of single silver triangular nanoprism

François K Guedje[1,2,3], Mircea Giloan[2], Monica Potara[2], M N Hounkonnou[3] and Simion Astilean[2]

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francois.guedje@uac.bj

[1] Ecole des Sciences et Techniques du Bâtiment et de la Route (ESTBR), Université d'Abomey-Calavi, 072 BP 50, Cotonou, Republic of Benin

[2] Nanobiophotonics and Laser Microscopy Center, Interdisciplinary Research in Bio-Nano-Sciences, and Faculty of Physics, Babes-Bolyai University, Treboniu Laurian Street 42, 400271 Cluj-Napoca, Romania

[3] International Chair in Mathematical Physics and Applications ICMPA-UNESCO Chair, University of Abomey-Calavi, 072 BP 50, Cotonou, Republic of Benin

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Abstract

The ability to provide large electric field enhancements renders triangular nanoprisms and branched nanoparticles very attractive for applications in surface-enhanced Raman spectroscopy (SERS). Theoretical studies on the optical properties of triangular prisms in a water solution are presented in this paper to determine how structural modifications and incident field polarization affect the extinction spectrum and

enhanced local electric fields (*E*-field) around particles in the wavelength range of 300–1000 nm. The near-field properties, such as the *E*-field close to the particle, determine the electromagnetic enhancements in SERS. The optical response of a triangular nanoprism can be fully characterized using three different orientations of the incident field polarization. The orientations where the polarization vector is parallel to the triangular cross section are the most important for the overall extinction, rather than those where the polarization vector is perpendicular to the plane. The extinction spectrum presents three distinct localized surface plasmon resonances (LSPRs) for a silver triangular nanoprism. These are assigned as in-plane dipolar and quadrupolar plasmon excitations using electrodynamic modeling based on the finite difference time domain. The dipole resonance is found to be very intense, and its peak wavelength is extremely sensitive to the thickness and edge length of the nanoprism. In contrast, the intensity of the quadrupole resonances is much weaker relative to the dipole resonance. The distribution of the local field around the particle at specified wavelengths, showing the values of the peak field, is presented. All the LSPRs are clearly resolved in the visible. The experimental data are used for comparison. These new spectral features are very promising in the field of nano-optics and for bio-sensing applications.

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