Au photonic crystals for high-sensitivity SERS molecular sensing

Simón Roa
Centro Atómico Bariloche, Instituto de Nanociencia y Nanotecnología (CONICET - CNEA), Argentina.

Goekalp Engin Akinoglu
ARC Centre of Excellence in Exciton Science, University of Melbourne, Australia.

Carolina Redondo
Facultad de Ciencia y Tecnología, Universidad del País Vasco (UPV/EHU), España.

Rafael Morales
Facultad de Ciencia y Tecnología, Universidad del País Vasco (UPV/EHU), España.

María Laura Pedano
Centro Atómico Bariloche, Instituto de Nanociencia y Nanotecnología (CONICET - CNEA), Argentina.

In recent years, noble metal nanoparticle-based periodic nanoarrays (photonic crystals) have received special attention due to their gross potential to achieve exceptionally high Electric-Near Field Enhancement (ENFE) factors for visible light and their prospects as candidates for the fabrication of ultra-sensitive Surface-Enhanced Raman Spectroscopy (SERS) substrates [1 - 3]. In this work, we report a simple but exhaustive theoretical analysis of the ENFE in Au nanodisks-based photonic crystals by Finite-Difference Time-Domain (FDTD) method and experimental validation of their potential for SERS-based molecular sensing. Nanostructures with arrays periodicities from 200 to 1000 [nm], nanodisks diameters from 100 to 500 [nm] and thicknesses from 20 to 200 [nm] were studied. Results show that the ENFE is strongly dependent on each one of these geometrical parameters, observing electric field amplification factors that can reach up to 1200 for the visible light spectrum. Our research provides relevant insights on the design optimization of this kind of photonic crystals to maximize the ENFE effects, which is a critical issue to assess the future fabrication conditions of efficient SERS substrates.

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