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Abstract

Plasmonic oligomers, which consist of novel assemblies of metal nanostructures, provide new ways to tailor nonlinear optical effects, such as second-harmonic generation (SHG), through collective resonance effects. Traditional approaches to study collective SHG effects in such nanostructures, however, have relied on experimental conditions that use either plane wave or focused beam excitation with homogenous, e.g., linear, states of polarization.

Here, we probe collective SHG effects in plasmonic oligomers using SHG microscopy with focused cylindrical vector beams (i.e., radial and azimuthal polarizations) [1]. We also utilized rotationally symmetric radial and azimuthal, arrangements of gold nanorods with varying number of rods that were prepared using electron beam lithography. The constituent nanorods were designed so that their longitudinal plasmon resonance falls near the fundamental excitation wavelength used in the nonlinear experiments. We observed that the efficiency of SHG from the oligomers is strongly influenced by the input beam polarization and interparticle coupling. These experimental results agree well with our surface-SHG calculations based on the boundary element method. The work describes a new way to study coupling effects in arrangements of nanostructures and to manipulate the efficiency of nonlinear optical effects at the nanoscale.

Reference

[1] G. Bautista, C. Dreser, X. Zang, D. P. Kern, M. Kauranen, and M. Fleischer, "Collective Effects in Second-Harmonic Generation from Plasmonic Oligomers," Nano Lett., 18 (4), 2571–2580 (2018)