All-Dielectric Nanoantennas: Basics and applications

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Abstract

Plasmonic nanoantennas have shown as a versatile tool to control light beyond the conventional diffraction limit. However, they are known to suffer relatively large losses and absence of magnetic response at optical frequencies. Nanoparticles made of High Refractive Index (HRI) dielectric materials, such as Si, Ge, or other semiconductor compounds have been proposed recently as an alternative to metals, driven by their low-losses and presence of magnetic response in spite of being non-magnetic materials [1]. In this talk, I will introduce the origins and recent advances of this rapidly developing field of dielectric nanophotonics, discussing some of the main significant contributions (see [1]) we have done in the field to boost its progress. Special attention will be paid to applications like light directivity [2, 3], optical switching [4], beam steering [5], surface enhanced spectroscopies [6], enhancing chiral sensing [7] or non-linear optics [8]. See figures 1, 2 and 3 for some examples. On the other hand, I will show how all these properties can be extended to the ultraviolet [9], where their application in fields like photocatalysis or biosensing can be of extraordinary relevance.

References

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[6] Caldarola, M. et al. Nat. Commun. 2015, 6, 7915.
[7] Reyes-Gomez, F. et al. ACS Omega 2019, 4, 25, 21041-21047
[8] Shibanuma, T. et al. Nano Lett. 2017, 17, 4, 2647-2651.
[9] Gutierrez, Y. et al. Applied Sciences 2018, 8, 2065.

Figures

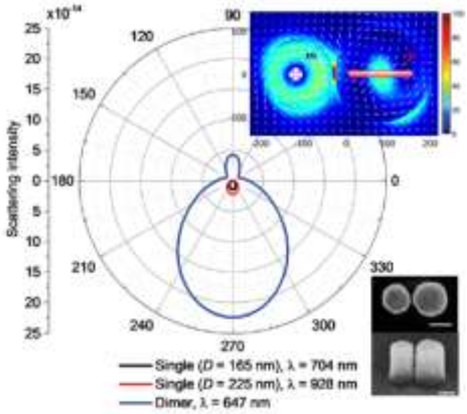

Figure 1: Scattering pattern of single Si spheres and of dimer configuration. Inset shows the field intensity and coupling between resonances.

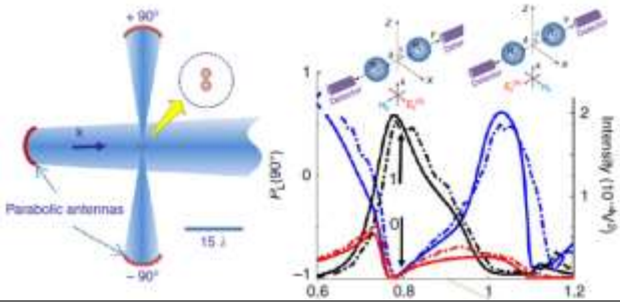

Figure 2: scattered intensity at 90° can be null or maximum by depending on the polarization of a single frequency excitation.

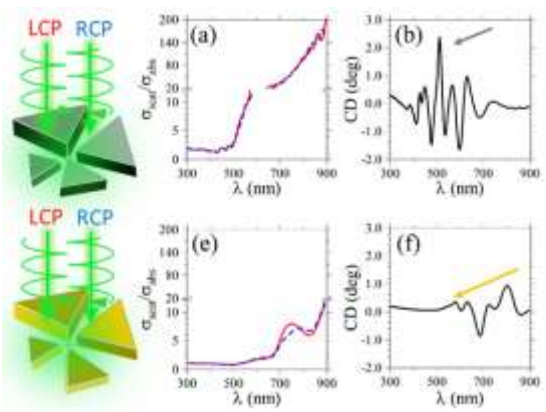

Figure 3: Comparison of scattering to absorption ratio and CD spectrum, for systems made of Si and Au.