Plasmonic Nanoantennas as a Nanoscale Platform to Enhance Light-Matter Interactions

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1. Extended Abstract

The research area of plasmonics promises devices with ultrasmall footprint operating at ultrafast speeds and with lower energy consumption compared to conventional electronics. These devices will operate with light and bridge the gap between microscale dielectric photonic systems and nanoscale electronics. Recent research advancements in nanotechnology and optics have led to the creation of a plethora of new plasmonic designs. Among the most promising are nanoscale antennas operating at optical frequencies, also called nanoantennas [1].

Plasmonic nanoantennas are the optical counterparts of the well-established antennas in RF wireless communications. They can be used to tailor, enhance, control, and manipulate the electromagnetic radiation in unprecedented ways and at nanoscale regions. In addition, they can provide enhanced and controllable light-matter interactions and coupling between far-field radiation and localized sources at the nanoscale. Interestingly, nanoantennas placed on array formations can form metasurfaces [2] leading to resonant transmission and reflection responses. The large field enhancement in the vicinity of these systems due to localized or collective resonances ensures a significant boosting of optical nonlinear effects [2], spontaneous emission rates [3], fluorescence [4], and other quantum effects at the weak and strong coupling regime. In addition, two dimensional (2D) materials, such as MoS_2 [5], can be integrated in these resonating systems and hybrid reconfigurable optical devices can be obtained with new functionalities.

The field of plasmonic nanoantennas is poised to have fundamental implications in nanoscale light-matter interactions, especially in the nonlinear and quantum regimes. In my talk, I will present recent theoretical and experimental advances towards demonstrating new designs based on these technologies. Several future optical devices are envisioned, such as low-power nanoswitches, compact ultrafast light sources, nanosensors and efficient energy harvesting systems.

2. References

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