Observation of polarized multiphoton emission from resonant Al, Ag and Au nanoantennas

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Optical antennas have gained major importance as coupling elements between near and far field in nanoscale photonics. Although nanoantennas are already widely being used, their fabrication and characterization are still challenging and no systematic experimental comparisons between antennas of different metals have been made.
We present an experimental study of optical rod antennas of three different metals: Aluminum, Silver and Gold. We identify the first and third resonance modes by two-photon luminescence (TPL) analysis and their relative shift due to their different plasmon characteristics. Whereas plasmonic studies are usually performed on gold, here we show that Al is a suitable metal for the fabrication of optical antennas due to its strong resonances.
Furthermore, a polarization analysis gives new insights into the nature of optical resonances of nanostructures. We see the TPL signal is unpolarized in the case of gold, while aluminum follows the polarization of the excitation (along the rod). On the other hand, when the polarization of the incident light is orthogonal (perpendicular to the rod) the TPL signal drops to almost zero for the three metals.
We expect that a better understanding of the properties of different metallic antennas will lead to more efficient designs for nanooptical elements and plasmonic structures.

References

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Figures

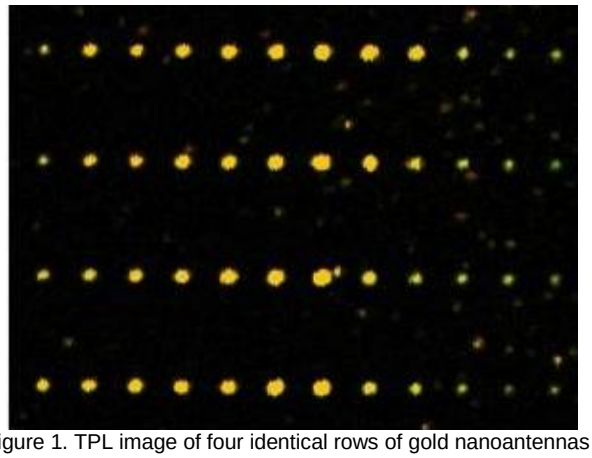

Figure 1. TPL image of four identical rows of gold nanoantennas with lengths between 50 nm (left) and 160 nm (right). The structures exhibit a clear resonance upon excitation with an ultrashort pulse at central wavelength 780 nm.