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AlGaAs on insulator second-order nonlinear nanophotonics

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All-dielectric nonlinear meta-optics is attracting a great deal of interest thanks to the feasibility of high refractive-index contrast nanostructures available with semiconductor lithography. While $\chi^{(3)}$ effects have been reported in silicon-on-insulator nanoantennas the AlGaAs-on-insulator platform has recently enabled the demonstration of second harmonic generation (SHG) in $\chi^{(2)}$ nanoantennas. When one excites them with a plane wave at normal incidence, they exhibit efficient SHG driven by a magnetic-dipole resonance at the pump frequency in the optical telecom range and a polarisation behaviour dominated by a high-order multipole resonance at the second harmonic. Here we will illustrate our recent activity on $Al_{0.18}Ga_{0.82}As$-on-AlOx nonlinear nanoantennas, where AlOx is obtained from selective wet etching of micrometer-thick aluminium-rich AlGaAs epitaxial layer. Such a low refractive index substrate allows to effectively decouple the nanoantenna modes from the underlying GaAs (100) wafer. After an introduction on the technology, we will get across the SHG performance of single nanoantennas with circular Bragg gratings, hybrid nanoantennas, and nanoantenna dimers exhibiting an anapole behaviour. All our experimental results are obtained with a pump excitation around 1.55μm on nanostructures of different size. The measured SHG conversion efficiency, in excess of 10-5 for a 1.6GW/cm^2 pump intensity, as well as the related polarization and radiation diagram properties, paves the way to the engineering of nanoantennas towards nonlinear meta surfaces.

Speaker Biography

Giuseppe Leo coordinates the Nonlinear Photonics Group of the MPQ Laboratory at Paris Diderot University. Besides editing 1 book and registering 4 patents, he has published more than 100 articles on peer-reviewed journals, 10 book chapters and about 250 conference papers, giving several invited presentations at major international conferences. His h-index is 26, for a total number of collected citations of more than 2000.

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