**HYBRIDIZED OPTICAL ANAPOLES IN VERTICALLY STACKED AlGaAs NANODISK ARRAYS**

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Abstract

The ability of sub-wavelength all-dielectric nanostructures to confine light in the visible and infrared spectral regions through Mie resonances is promising for enhancing light matter interaction for optoelectronic and non-linear optics applications [1]. In this aspect, optical anapole modes in AlGaAs/GaAs nanodisks not only provide high optical field confinement but also offer novel ways for manipulating light scattering [2,3]. Additionally, by stacking the disks vertically the field confinement can be enhanced further [4].

In this work, the anapole states in a 3-layer stack of AlGaAs nanodisks are analyzed using quasi-normal modes and the coupling mechanisms between the disks. The stacked AlGaAs nanodisk structures are fabricated from pre-designed AlGaAs/GaAs epitaxial multilayers using a combination of e-beam lithography, dry etching and selective under-etching of GaAs. The geometrical parameters (disk dimensions, vertical spacing and arrays) are designed for anapolar resonances in the visible-NIR wavelength region. At the anapolar resonances, characteristic sharp dips in the reflectance are evidenced both in simulations and in spectrally resolved reflectance measurements. We show that the electric dipole anapole state in the disks is hybridized in the vertical stack owing to an avoided resonance crossing. This leads to increased energy confinement in each disk up to a factor of 5 in the 3-layer stack as compared to a single isolated disk.

Optical anapoles in such stacked AlGaAs based Mie resonators are promising as building blocks for optoelectronic and nonlinear frequency conversion applications and the principles can easily be adapted to other spectral regions and dielectric material systems.

References:

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