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Near-field Mapping of Fabry-Pérot Resonances in Dielectric Nanoantennas

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A topic of considerable interest, Fabry-Pérot (FP) resonances of rod-shape plasmonic nanoantennas have been tackled with many techniques, with scanning near-field optical microscopy (SNOM) being the most insightful one [1,2]. Emerging as an alternative to plasmonic nanostructures, all-dielectric resonant nanoantennas [3] demonstrate similar light concentration and manipulation capabilities yet benefiting from negligible Ohmic losses [4]. However, strongly localized FP modes in high-refractive-index dielectric nanoantennas [5,6] lack thorough experimental description.

In this work, near-field mapping of TM and TE optical FP modes of silicon nanorods with rectangular cross-section is demonstrated by aperture-type SNOM. High-contrast coupling of the probe near fields with the FP modes of nanorods is demonstrated experimentally and supported by finite-difference time-domain (FDTD) calculations, with the probe taken into account. Scanning nanorods with the probe results in SNOM maps with hotspots and dark areas. By comparing the experimental data with the simulation results, we have found that the bright spots of SNOM images correspond to efficient coupling of the probe near-field to the FP modes of the nanorods. We show that the maximum and minimum numbers of FP antinodes of the TM and TE resonances are strongly defined by the nanorod length, which enables versatile control over electromagnetic hotspots in all-dielectric nanoantennas.

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