“Seeing” and controlling the modes in dielectric resonators

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All-dielectric optical nano-resonators, exhibiting exotic near-field distributions upon excitations, have emerged as low-loss, versatile and highly adaptable components in nanophotonic structures for manipulating electromagnetic waves and enhancing light-matter interactions. However, achieving experimental full three-dimensional characterization of near-fields within dielectric nano-resonators poses significant challenges. Here, we develop a novel technique using high-order sideband generation to image near-field wave patterns inside dielectric optical nano-resonators [1]. By exploiting the phase-sensitivity of various harmonic orders that enables the detection of near-field distributions at distinct depths, we achieve three-dimensional tomographic and near-field imaging with nanometer resolution inside a micrometer-thick silicon anapole resonator. Furthermore, our method offers high-contrast polarization sensitivity and phase-resolving capability, providing comprehensive vectorial near-field information. With the near-field distribution of different modes in dielectric resonators fully understood, we experimentally demonstrate dynamic modulation on THz waves with a dielectric metasurface in mode-selective or mode-unselective manners through pumping the system at different optical wavelengths [2]. The physics is governed by the spatial overlap between wave functions of resonant modes and regions inside resonators perturbed by pump laser excitation at different wavelengths

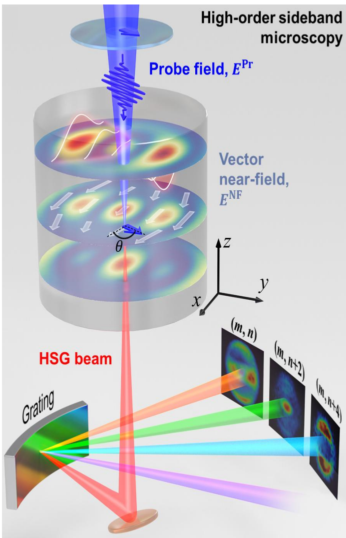

Fig. 1 Schematics of the proposed near-field detection technique

References

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2. Haoyang Zhou, et al., **Advanced Photonics 5**, 026005 (2023)