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Biography

Benfeng Bai received his B.Sc. degree and Ph.D degree in Optical Engineering from Tsinghua University, China, in 2001 and 2006, respectively. He is now leading a nanophotonics research group in the Department of Precision Instrument, Tsinghua University, China. His research interests focus on plasmonics, metamaterials, and nanometrology. He has published more than 60 research papers in journals including Nature Commun., Light: Sci. & Appl., Nano Lett., Small, etc. He is currently a member of the WG5 of the National Nanotechnology Standardization Committee of China. He is also serving as a Topical Editor for Optics Letters since March, 2014.

Efficient steering and wavefront shaping of surface waves by metasurfaces

Efficient manipulation of surface waves, such as surface plasmon polaritons (SPP), is a vital issue in various nanophotonic applications, such as plasmonic circuitry. In plasmonic devices, SPP sources and launchers have important roles, which are required not only to generate directionally propagating SPPs efficiently, but also to be able to shape the distribution of the SPP field. Here, we present simple approaches to realizing versatile directional excitation and wavefront shaping of SPPs based on metasurfaces consisting of a special type of Δ-shaped plasmonic optical nanoantennas (Δ-POAs). We first demonstrate the special radiation properties of the Δ-POAs, including the directionality of SPP excitation and the phase control mechanism. Then, by using such Δ-POAs to compose metasurfaces, we present two approaches that can realize effective and versatile control of the SPP wavefront. We first propose a general method that can control the complex excitation ratio of any two linearly independent SPP modes just by controlling the incident polarization state of the incident light. With this method, an efficient dual-function SPP launcher is realized, which can achieve both tunable directional SPP excitation at an arbitrary wavelength and the unidirectional SPP excitation over an ultra-broad bandwidth. Then, we present a simple method to generate unidirectionally propagating SPP beams with arbitrary amplitude and phase profiles. As an example, a high-order Hermite–Gauss SPP beam generator is designed and realized, validated by near-field characterization.