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Editorial

Electromagnetic metasurfaces: from concept to applications

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Electromagnetic or optical metasurfaces, as a kind of quasi-two-dimensional artificial interface, are patterned subwavelength structures within ultrathin thickness that interact strongly with electromagnetic waves. The history of metasurface was traced back to the two-dimensional electromagnetic bandgap structure [1], which may be regarded as the beginning of metasurface research. Such metasurface with high impedance has been widely used in reducing the size of antennas and improving their performance. Recently, generalized Snell's laws [2] have been coined and widely applied to various designs of metasurfaces [3], which pave a clear-cut physical foundation for metasurfaces. Thereby, the metasurfaces have been widely deployed in designing new devices to regulate and control the electromagnetic wavefronts. For example, 600-nm-thick TiO_2 metalens have been demonstrated to focus the light [4], 10^5 times thinner than the optical traditional lens with similar performance. Such a metasurface lens is believed promising to replace the traditional optical lens in the future. Hence, functional structured surfaces have become the subject of several rapidly-growing research areas, and demonstrated a lot of useful properties of structure-based devices with customized electric and magnetic responses.

Most recently, the metasurface becomes more intelligent and programmable. In this connection, digital coding and programmable metasurfaces [5,6], which are described by digital elements 0 and 1 with opposite electromagnetic responses (e.g. anti-phases), have emerged [5]. By designing different coding sequences of the digital elements, the electromagnetic waves can be controlled by the metasurface in real time. Therefore, a single metasurface can now power up many different functions in a programmable way, leading to new information systems.

The metasurface has become a rapidly developing field, which fuses new physics, functions and applications, and showcases wide potentials. We have invited reputed scientists in this field to contribute original articles, review papers and research news, aiming to promote the rapid development of this field. Our project will present an influential and timely overview of many ongoing cutting-edge research efforts in this field. This special topic includes selected featuring highlights, such as transformation-optics-based metasurface [7], hybrid metalens [8] and 3D Weyl meta-structures [9]. This topic also features the latest original developments in metasurfaces: conversion of surface plasmons to propagating waves by plasmonic discontinuity [10], graded-index meta-devices for asymmetric transmission [11], topological edge state in photonics [12], and coupled meta-atom concept for high-performance multilayer metasurfaces [13]. In the Progress, Koshelev et al. [14] introduced the recent advances in meta-optics and nanophotonics associated with the physics of bound states in the continuum (BICs). They presented the original results on nonlinear high-Q metasurfaces and predicted that the frequency conversion efficiency can be boosted dramatically by smart engineering of the asymmetry parameter of dielectric metasurfaces in the vicinity of the quasi-BIC regime. In the Review article, Zhang et al. [15] reviewed the progress in spoof surface plasmon polaritons (SPPs) with a special emphasis on their applications in circuits from transmission lines to passive/active devices in microwave and terahertz regimes. They also discussed the integration of versatile spoof SPP devices on a single platform, which is compatible with established electronic circuits.

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SPECIAL TOPIC: Electromagnetic Metasurfaces: from Concept to Applications.

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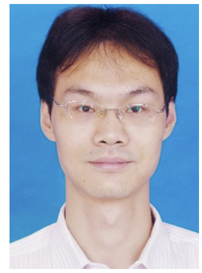

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