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EDITORIAL
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Editorial: Theory and Applications of Electromagnetic Metamaterials

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Editorial on the Research Topic

Theory and Applications of Electromagnetic Metamaterials

Metamaterials, a kind of artificially structured materials made of subwavelength composites, are endowed with a plethora of intriguing properties that do not exist in nature. For decades, metamaterials have flourished and been kept redefining the boundaries of fundamental and applied sciences. In particular, the emerging concept of metasurfaces, a two-dimensional form of metamaterials, provides a versatile solution to manipulating electromagnetic waves with almost arbitrary amplitudes, phases, polarizations, and frequencies, facilitating the implement of novel integrated microwave and photonics devices with greatly enhanced performances. This special issue holds original research and review articles on several topics of metamaterials including reconfigurable metasurfaces, perfect metamertial absorbers, topological metamaterials, and thus highlights the latest developments in the electromagnetic metamaterials both in the theory and applications.

In Zahra et al., Zahra provided a comprehensive introduction of metasurfaces, especially their applications in the modulations of the amplitudes, phases, and polarizations of electromagnetic waves. Special emphasis was given on the newly developed smart metasurfaces that possess the active, reconfigurable, and programmable characteristics *via* the electrical, optical, thermal and mechanical ways. An outlook of the development trend was also made for this fascinating area. In another review article, Ma et al. overviewed the recent advances in metamaterial-based temperature sensing. They comprehensively analyzed the enhanced sensing performances of typical metamaterial designs, in terms of the sensitivity and resolution, which may shed light on the solution toward the future high-precision sensing.

Significant interests have been devoted on the manipulations of electromagnetic waves using metasurfaces through phase modulations. Bai et al. proposed a facile structure composed of hexagonal-ring to efficiently generate the orbital angular momentum waves. This metasurface is insensitive to the polarization of the illumination and holds a great promise for radio communications and radar applications. Cao et al. presented a high efficient and cost-effective programmable metasurface that achieve a real-time scanning pencil beams with desirable directions. Yang et al. presented a theoretical framework for the modulation of WiFi signals, where reconfigurable metasurface loaded with varactor diodes is use to effectively control the in-band transmission and reflection coefficients for maintaining different far-field electromagnetic characteristics. Ahamed et al. numerically presented a reconfigurable metamaterial filter for THz waves, based on the binary response by controlling the plasmatic electron packet in electric split-ring resonators. Such a binary filter could be digitally encoded for the information processing systems.

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Apart from phase modulations, metamaterials/metasurfaces allow extreme control of the electromagnetic waves' magnitudes. One of the key applications for such a modulation is perfect metamaterial absorbers. Wang et al. proposed a graphene-based metamaterial absorber that shows merits of broadband high absorption, polarization insensitivity, and immune to wide incident angle. Deng et al. presented a stereo perfect metamaterial absorber based on standing gear-shaped resonant structure, which shows wide-incident-angle stability for both TE and TM modes. Liu et al. reported a dual-band optical metamaterial absorber with peak absorptivities of 99.986% at 1,310 nm and 99.421% at 1,550 nm. The potential application as a refractive index sensor was also numerically discussed.

The research of topological insulators is another hot topic in metamaterials. While conventional topological insulators typically made of either dielectric or metallic materials in the previous references, Du et al. proposed a hybrid topological model consisting of both metal and dielectric materials, offering a new method for achieving topological edge states.

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