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EDITORIAL
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Editorial: Plasmonic Metamaterials and Electromagnetic Devices

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Editorial on the Research Topic

Plasmonic Metamaterials and Electromagnetic Devices

Plasmonic metamaterials, relying on surface plasmons, exhibit novel optical properties that don't exist in natural materials. The rise of plasmonic metamaterials has revolutionized the entire field of optics and photonics, owing to the impacts that they bring to both the fundamental physics and practical applications. Moreover, the recent emerging spoof surface plasmons (SSPs) have extended the plasmonic metamaterials to lower frequency band, enabling intriguing applications ranged from microwave and terahertz devices. Their spatial confinement features have contributed to the development of the miniaturization of electromagnetic devices. The present Research Topic on plasmonic metamaterials compiles work on several of these aspects including plasmonic sensor, antenna, filters, and thus highlights current new interesting developments:

Spoof surface plasmon polaritons (SSPPs) are novel guiding modes excited on the surface of periodic metamaterial structures. A series of passive and active functional devices based on SSPPs were reported. Pan et al. studied a high-efficient leaky-wave antenna based on SSPPs loaded with parasitic patch array is proposed. Sinusoidal modulation is used for the radiation of SSPPs, while parasitic array mitigates the open stopband (OSB) effect. The device shows stable gain distribution within the whole operating band, which is available for conformal applications and other kinds of radiation systems. Pan et al. also explored a novel unequal bandpass filtering power divider based on hybrid mode of half mode substrate integrated waveguide (HMSIW) and SSPPs. In addition, defected ground structures (DGSs) are etched on the bottom of the substrate to improve out-of-band suppression. The design provides a stable power division within wide frequency range from 6.5 to 9. 5 GHz. Another paper in this Research Topic by Chen et al. presented a wideband controllable band-pass filter based on the SSPPs and slip ring resonators (SRR). The reconfigurable passband can be controlled by using varactor diode. Besides SSPPs, spoof localized surface plasmons (SLSPs) is another kind of SSPs, which mimic the localized oscillations of electrons in the lower frequency band. Due to the strong confinement of the electromagnetic fields, the SLSPs are sensitive to the surrounding environment. Wang et al. presented a high-Q-factor and high-sensitivity hybridized SLSPs sensor and a mixed-resolution algorithm. This may open new directions for generation of future high-frequency on-chip resonators and sensors.

Plasmonic materials and their emerging applications serve as a starting point for this Research Topic. Many efforts have also been devoted to the development of metasurfaces. Metasurfaces are thin-films composed of individual elements that provide a solution to the limitation of the conventional metamaterials. Over the past few years, metasurfaces have been employed for the design and fabrication of electromagnetic elements and systems with abilities that surpass the performance of conventional diffractive electromagnetic elements. An et al. presented a double-layer complementary transmitarray structure for linear and circular polarizations. Combining the cross

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and slot-type structure, a double-layer frequency-selective element has been designed, which should have broad application prospects in the future. Dong et al.proposed a novel low-profile broadband polarization conversion metasurface antenna using a partially chamfered symmetric triangular unit structure. In this paper, the resonance characteristics and radiation characteristics of the metasurface antenna are analyzed by characteristic mode analysis (CMA). Moreover, the characteristics of simple structure and easy processing is suitable for C-band satellite communications. Yang et al. found that the active control to the local resonant mode of metasurface is a promising route for improving the operation bandwidth limitation of metasurface. They have experimentally demonstrated the active tunabilities in a frequency-agile Fano-resonant metasurface, which may facilitate the development of high-performance active photonic applications. Metasurface is also an important route of optical manipulation in far-infrared range. Tamim et al. proposed an anisotropic metasurface for efficient polarization conversion, which is a potential candidate for advanced THz applications.

Increasing demand for the high-performance telecommunication system is mainly boosting technical innovation. The development of electromagnetic devices for high performance, compact size, low-consumption and low-cost systems such as filters, and antennas are urgent. Shen et al. presented a comprehensive design of dual-band filtering power dividers (FPDs) with arbitrary phase distribution based on the topology of inverter-coupled L/C resonators, which will be very attractive in future multi-functional wireless communication systems. Zhang et al. studied a tunable low pass filter adopting tunable input/output impedance technology, which can be generalized to other types of filters and filter designs with other properties. Wang et al. proposed a novel dual-band bandpass filter (BPF) with independently controllable transmission zeros (TZs), which is attractive for application in high-selectivity filter designs. In telecommunications, millimeter wave is used for a variety of services on mobile and wireless networks, as it enables higher data rates than at lower frequencies. Liu et al. presented a compact 60-GHz on-chip BPF using gallium arsenide (GaAs) technology. The miniaturization is achieved by the (HMSIW) structure. The proposed HMSIW BPF can be easily integrated with other GaAs components and circuits in millimeter-wave (mmW) systems such as vehicle-mounted radar and 5G communications. Li et al. explored a new triple-band four-way filtering power divider (FPD) with greatly improved frequency selectivity and in-band isolation.

In parallel to filter, antenna also plays a vital role in many fields such as communications, military applications, wearable systems, and power industry. A number of articles present recent advances in antennas in this Research Topic. Xiao et al. presented a dual-polarized corrugated horn antenna using turnstile orthomode transducer (OMT) operating within the full Ka-band, which can realize dual-linear polarization and provide high isolation. The proposed antenna system is a promising candidate for future 5G applications. In recent years, antennas with a wideband low radar cross section (RCS) have drawn significant attention in the low-observable needed platforms, such as military aircraft and missiles. By combing of a e circularly polarized (CP) antenna with a chessboard polarization conversion metasurface, Zhou et al. designed a low-profile CP meta-antenna with a broadband low-RCS feature. Wang et al. proposed a dual-band flexible antenna using a combined technique of liquid metal (LM) filling and polydimethylsiloxane substrate for wearable applications. To realize a resource-saving and environment-friendly society, it is preferable to combine solar cells and antennas for green communication. An et al. reported a single-port dual-band antenna integrated with solar cells for wireless local area network (WLAN) applications. As the RF energy around us increases sharply, the rectenna becomes one of the key devices for harvesting RF energy. Wang et al.studied an output power reconfigurable rectenna array, which can be used to capture abundant RF energy with high conversion efficiency in a wide range of input power levels.

With regards to optimizing design process in this ongoing field, predictive analytics have been always mentioned. Analogously, Peng proposes a universal approach to alleviate the problem of individual variability in epileptic seizure prediction.

This Research Topic contains 19 articles devoted to the recent progress in plasmonic metamaterials and electromagnetic devices. Much more efforts are still ongoing in this fascinating area. We expect that this field will attract more and more attentions and benefit potential electromagnetic applications.

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