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Editorial: Advanced Photonics Metasurfaces: Design, Fabrication, and Applications

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Editorial on the Research Topic:

Advanced Photonics Metasurfaces: Design, Fabrication, and Applications

Metasurface refers to an artificial layered material with a thickness than the wavelength, which can be considered as a two-dimensional metamaterial [1–10]. Due to the novel properties that natural materials do not have, metasurfaces have shown great application potential in many fields such as optical integration, optical communication, micro-nano optics, stealth, super-resolution imaging and sensing, etc., [11–20] and are a hot research field [21–30]. The metasurface was first proposed in the field of optics, it has been rapidly expanded to many fields, such as acoustic wave, elastic wave, thermal field, etc. [31–33]. Metasurface can realize flexible and effective regulation of electromagnetic wave characteristics such as polarization, amplitude, phase, polarization mode, and propagation mode [34–40]. According to the types of regulated electromagnetic waves, metasurfaces can be divided into optical, acoustic, and mechanical metasurfaces. Optical metasurface is the most common type, which can regulate the characteristics of polarization, phase, amplitude, and frequency of electromagnetic wave through the subwavelength microstructure. It is an emerging technology that combines optics and nanotechnology.

In terms of polarization regulation, the metasurface can realize polarization conversion, optical rotation, vector beam generation, and other functions [41–43]. In terms of the amplitude regulation of the metasurface, the metasurface can realize asymmetric transmission of light, anti-reflection, increased transmission, magnetic mirror, EIT-like effect, etc. In terms of frequency regulation of the metasurface, researchers can realize free regulation of the color of the metasurface by changing geometric parameters such as the size and shape of its structural units, which can be used in high pixel imaging, visual biosensors, and other fields [44–46]. Phase is a core property of electromagnetic wave. The phase plane determines the propagation direction of the electromagnetic wave, and the phase of an image contains its three-dimensional information. By controlling the phase of electromagnetic waves, functions such as beam deflection, meta-lens, hyperholography, vortex generation, coding, cloaking, and phantom can be realized [47–50]. In addition, metasurface can control the phase, amplitude, and polarization of electromagnetic waves simultaneously. For example, by adjusting the phase and amplitude of electromagnetic waves, stereo super holography can be realized. By adjusting the phase and polarization of electromagnetic waves, vector vorticity can be realized. By adjusting the phase and frequency of electromagnetic waves, some functions such as non-linear superlens can be realized.

Through this Research Topic, our purpose is to show the progress of metasurface in the design, fabrication, and applications of metasurfaces. With the continuous development of semiconductor

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technology, metasurface technology has found some important applications which are expected to transform the research into practical products. In turn, metasurfaces will also become a new opportunity for the semiconductor industry, thus changing the design flexibility of some important devices. It is our hope that the contributed papers to this Research Topic will contribute to international cooperation in the field of metasurfaces and accelerate progress in their design, preparation, and application.

One of the sub-topical areas of this topic covers a review on metasurfaces from principle to smart metadevices. The paper by Hu et al. follows current trends on advanced photonics metasurface, and they demonstrate the concepts of anomalous reflection and refraction, applications of metasurfaces with the Pancharatanm-Berry Phase, and Huygens metasurface. The progress of soft metasurface has also been discussed in this review. Zhang et al. show that a systematic scheme for fabricating spiral-structure metasurface is proposed by employing the metal mold making with diamond-based ultra-precision turning technique and then molding replication method. Finally, Xu et al. numerically and experimentally demonstrated double Fano resonances in a simple S-shaped plasmonic metasurface in the terahertz frequency range.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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