高效金属超构表面矢量全息

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使用介质超构表面可以容易地实现高效的矢量场调控，但在太赫兹波段的介质超构表面器件厚度较大，导致加工的成品率较低。使用多层金属超构表面也可以获得高效的调控性能，通过创新性地构建由金属光栅和金属劈裂环天线构成的三层超构表面，可以实现对透射太赫兹波相位和偏振态的独立调控。这种三层金属超构表面为太赫兹波段高效矢量器件的研究提供了新的思路。

近日，哈尔滨工业大学的刘树田教授团队和首都师范大学张岩教授团队合作，提出了一种高效三层金属超构表面矢量全息器件。该器件创新性地使用三层金属超构表面实现了透射太赫兹波的相位和偏振的独立调控。该工作设计了两种高效矢量器件，第一种为偏振控制的图像隐藏器件，在圆偏振太赫兹波的入射下，该器件在 8 个不同通道内产生不同偏振的太赫兹矢量全息图像，分别为数字 1-8，通过选择探测的偏振态，实现特定通道内的信息隐藏。此外，还实现了一种太赫兹波线偏振检偏器，该器件由三层金属超构表面组成，不同于传统的依赖强度区分偏振态的检偏器，该器件可以通过透过器件光斑的成像结果简单的识别出射太赫兹的线偏振态，适用于瞬态强脉冲的线偏振检测。

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Highly efficient vectorial field manipulation using a transmitted tri-layer metasurface

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Highly efficient modulation performance can also be achieved using a multilayer metallic metasurface. The innovative construction of a tri-layer metasurface consisting of two metallic gratings and a metallic split-ring antenna enables independent modulation of the phase and polarization state of transmitted THz waves. The tri-layer metallic metasurface can be easily processed using conventional UV lithography and lift-off techniques, which can reach a theoretical efficiency up to 90%.

A joint research group of Prof. Shutian Liu from Harbin Institute of Technology and Prof. Yan Zhang from Capital Normal University has proposed an efficient tri-layer metallic metasurface vectorial holographic device. This innovative device uses a tri-layer metallic metasurface to achieve independent modulation of the phase and polarization state of transmitted THz waves. The work designs two efficient vector devices, the first being a polarization-controlled image hiding device, which can generate hologram images “1” to “8” with different polarizations state in eight different channels under the incidence of circularly polarized THz waves. Different image in a specific channel can be hidden by selecting the detected polarization state. A THz polarization analyzer was designed and fabricated using the proposed metasurface. This device can be used to characterize the incident polarization angle through a single-shot image with high accuracy.

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