Polarization Control Devices using Cascaded Subwavelength Dielectric Gratings

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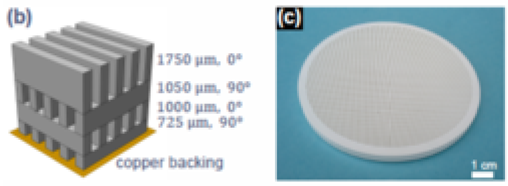

OVERVIEW

A class of polarization control devices that consist of multiple stacked dielectric gratings

- Allow for thinner metasurface devices with greater control and precision than existing devices
- Creates devices that are broadband, multiband, or multifunctional and reflective or transmissive

BACKGROUND

Metasurfaces are artificial surfaces which manipulate the propagation of electromagnetic waves for applications involving communications, aerospace engineering, and manufacturing. One of the most promising applications of metasurfaces involves the development of polarization control devices, which can efficiently and precisely manipulate the polarization state of light or radio waves. They can therefore be used to improve the quality and reliability of wireless communication systems by enabling better control over signal polarization, reducing interference and signal degradation. In aerospace settings, metasurfaces can be used to design and optimize radar systems for detecting objects in variable weather conditions. In manufacturing, they can be utilized to produce high-quality, precisely calibrated optical components. Still, while state-of-the-art polarization devices utilize stacked birefringent plates or subwavelength grating dimensions to produce high quality photonics devices, these approaches are hindered by sharp spectral resonance peaks, and tend to be lossy. So, a need exists for improvements in metasurface technology that minimize the formation of spectral resonance peaks.

INNOVATION

Researchers have created a class of polarization control devices that consist of multiple stacked dielectric gratings which allow a thinner metasurface devices with greater control and precision

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Category

Hardware
Engineering & Physical Sciences
Semiconductor and Electronics

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than existing devices. The inventors have created methods and computer software to efficiently and accurately compute the response of layered grating structures at arbitrary incidence angles, taking multiple reflections into account. These advancements allow for rapid synthesis of new devices through numeric optimization techniques which can be applied to multiple manufacturing methods and corresponding frequency ranges. The grating period in each layer is much smaller than the wavelength of light, so that the layer can be regarded as effectively a homogeneous, anisotropic medium. By adjusting the grating materials, filling fraction, thickness, and orientation for each layer, a variety of useful polarization control devices can be realized. The devices can be broadband (operating over a wide frequency range), multiband (operating over several distinct frequency ranges), or multifunctional (providing different polarization responses over different frequency ranges). Furthermore, the devices can operate in reflection or transmission. The improved methodologies can be applied to a variety of situations including three-dimensional printing, ceramic stereolithography, and the creation of dry-etched silicon wafers.

References

1. Ranjbar A, and Grbic, A. , Multiband, and Multifunctional All-Dielectric Metasurfaces, Phys. Rev. Applied, vol 11, issue 5, 2019 10.1103/PhysRevApplied.11.054066