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Deflection enabled multifunctional operation of a simple meta-grating at near-infrared

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Deflection, a general wavefront manipulation functionality, which is often considered as a characteristic attribute of gradient metasurfaces, is numerically and experimentally investigated at near-infrared for a simple reflection-mode meta-grating comprising just one Si nanorod per period. Different deflection scenarios are demonstrated that enable different functionalities and multifunctional scenarios in one structure. In particular, single-wave, high-efficiency, ultra-wideband and simultaneously wide-angle deflection is achieved due to the ultimate conversion of the linearly-polarized incident wave to the -1st diffraction order. The working region in the wavelength – incidence-angle plane nearly coincides with the region, in which the -1st order is the only propagating nonzero order. It extends nearly from 850 to 2000 nm and is up to 70 degrees wide. The total thickness of the designed structure does not exceed 0.6 of the free-space wavelength. The obtained results justify the usefulness of the orders higher than the -1st order. Spatial filtering of several types can be achieved by utilizing deflection for one of nonzero orders or the specular-reflection (zero-order) regime. Dual-beam splitting that is yielded by deflection is also demonstrated. Moreover, on-off switching of deflection, spatial filtering, and splitting is possible owing to polarization state change. The proposed device is simple-to-fabricate and only uses cost-effective materials, so it is appropriate for the large-area fabrication by using nanoprint lithography. The possibility of either multifunctional operation or the use of only one functionality makes it a great candidate for various applications in the areas of optical communications, laser optics, sensing, detection, and imaging.

Topics

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