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Ultrathin, Planar, Plasmonic Metalenses

A high-performance Babinet-inverted metalens design uses nanoscopic holes in gold film to achieve large numerical apertures and improved signal-to-noise ratios for advanced light manipulation in optics, manufacturing, and machining applications.

The light bending in a traditional optical lens depends on the refractive index of the lens material. This dependency makes it exceedingly difficult to create a lens with a large aperture and a short focal length with traditional fabrication. In the last few years, a new type of lens has been created that uses plasmonic nanoantennas to focus light on a microscopic scale. Arrays of these nanoantennas can be used to create metalenses, which are able to bend and manipulate light in unusual ways.

Researchers at Purdue University have developed a new type of plasmonic metalens that uses a Babinet-inverted design for improved performance. Babinet's principle states that the diffraction pattern of an opaque object is the same as a screen with an identical hole in it except that the pattern is inverted. The new lens design uses this principle to shrink its size and improve performance. The new lens uses nanoscopic holes in a gold film to focus the light instead of nanoantennas on a transparent substrate. The lens has wavelength-controllable focal lengths of a few micrometers with very large effective numerical apertures. The Babinet-inverted design has a signal-to-noise ratio at least an order of magnitude higher than previous metallic nanoantenna designs, and it works for two orthogonal linear polarizations of the incident light.

Advantages:

-Improved signal-to-noise ratio

-Focal length on order of wavelength

Potential Applications:

-Optics

-Manufacturing

Technology ID

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Category

Materials Science & Nanotechnology/Nanomaterials & Nanostructures

Computing/Photonic & Optical Computing Technologies

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