新型超透镜：单帧图像即可实现光谱及椭偏度重建

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为了实现集成化和小型化设计，超表面已被应用于偏振和多光谱光学系统的研究。然而，目前仍然缺少一种既能同时实现光谱和偏振态识别功能又具备良好成像性能的超透镜器件。

华中科技大学武汉光电国家研究中心和湖北光谷实验室熊伟教授、夏金松教授和高辉副教授研究团队，提出并实验验证了一种光谱和偏振多焦点超透镜(spectra and polarization muti-foci metalens, SPMM)，可实现光谱和椭圆偏振度的重建。该多焦点超透镜能够通过单次拍摄完成所需光学信息的采集，极大简化了光学信息的收集过程，不仅能实现光谱和椭圆偏振度的识别与重建，还具备超透镜的聚焦和成像功能，非常适用于具有集成化和高速响应需求的光学系统。

SPMM 是由各向异性的亚波长单元结构组成，通过正交圆偏振转换产生附加几何相位，并基于单元结构面内旋转角的变化实现相位的调控。基于设计的氮化硅基多焦点超透镜，研究人员搭建了相应的实验测试系统，分别在相干光源下和非相干光源下实现了光谱和偏振态的识别与重建，同时验证了 SPMM 具备多光谱成像、光谱重建以及偏振成像功能。实验结果表明，SPMM 不仅能在相干光源下工作，也能够在宽谱非相干光源下实现光谱和偏振态的重建，具有普遍适用性。

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Multi-foci metalens for spectra and polarization ellipticity recognition and reconstruction

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To realize integrated and compact designs, metasurface elements have been used in polarization and multispectral optical systems. However, there remains a lack of metalens devices that can achieve both spectra- and polarization-resolved functionalities simultaneously while keeping a good imaging performance with a large numerical aperture (NA).

The research groups of Prof. Wei Xiong, Prof. Jinsong Xia, and Prof. Hui Gao from Huazhong University of Science and Technology proposed a spectra- and polarization ellipticity resolved multi-foci metalens (SPMM) methodology to realize the spectra- and polarization ellipticity resolved imaging without the requirement of any moving parts or bulky spectral and polarization optics. In this SPMM design, the positions and intensities of foci/images on the focal/imaging plane can be changed by tuning the polarization ellipticity and/or spectra of incident light beams. Therefore, the as-developed SPMM device possesses both detection and reconstruction abilities of specific polarization ellipticity and discrete wavelengths (or spectral bands) while keeping normal functions of metalens such as focusing and imaging. And the SPMM has a sharing aperture design which possesses superior imaging performance due to the larger NA than that of the as-reported micro-metalens array design with the same fabrication size and focal length.

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