Broadband achromatic wavefront tailoring with high-efficiency reflective metadevices

HAODONG LI[1], SHAOJIE MA[2,3], QIONG HE[1,3], LEI ZHOU[1,3,*] AND SHULIN SUN[2,3,4,*]

[1]*State Key Laboratory of Surface Physics and Key Laboratory of Micro and Nano Photonic Structures (Ministry of Education), Fudan University, Shanghai 200433, China*

[2]*Shanghai Engineering Research Centre of Ultra Precision Optical Manufacturing, Department of Optical Science and Engineering, School of Information Science and Technology, Fudan University, Shanghai 200433, China*

[3]*Shanghai Key Laboratory of Metasurfaces for Light Manipulation, 200433 Shanghai, China*

[4]*Yiwu Research Institute of Fudan University, Chengbei Road, Yiwu City, 322000 Zhejiang, China*

**sls@fudan.edu.cn*

**phzhou@fudan.edu.cn*

Metasurfaces have exhibited unprecedented capabilities to manipulate electromagnetic (EM) waves, but many of them suffer from frequency dispersions which significantly degrade their performances. Although extensive efforts have been devoted to designing achromatic metasurfaces at optical frequencies, their microwave counterparts are less studied, with a few attempts suffering from large thicknesses. Here, based on high-efficiency meta-atoms exhibiting tailored reflection phases of both resonant and geometric origins, we propose a generic scheme to design achromatic metasurfaces for controlling EM far-field wavefronts within a continuous microwave frequency band. We follow the proposed strategy to design and fabricate three achromatic metadevices, and experimentally demonstrate that they can realize anomalous reflection, focusing, and Bessel beam generations, respectively, at every frequency within 8-10 GHz. Our work paves the road for realizing high-performance achromatic metadevices in low-frequency domains, which may find many applications such as radar detection, microwave imaging, wireless communications.

References

1. Sun, S., He, Q., Xiao, S. et al. Gradient-index meta-surfaces as a bridge linking propagating waves and surface waves. Nature Mater 11, 426–431 (2012).

2. Wang, S., Wu, P.C., Su, VC. et al. Broadband achromatic optical metasurface devices. Nat Commun 8, 187 (2017).