基于码分复用超表面的彩色全息视频显示

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超表面全息具有诸多优势，尽管已经有各种尝试，但其百纳米级的特征尺寸增加了制备加工难度，如何利用超表面元件实现动态可调依然是一个重大挑战。针对彩色全息显示，要求超表面元件能够对不同频率的入射光进行特异的调制，进一步增加实现了难度。

北京理工大学王涌天教授团队的黄玲玲教授、李昕副研究员与哈尔滨工业大学 (深圳) 的肖淑敏教授进行合作，借鉴信息通信领域的码分复用技术，并在此基础上结合各向异性超表面，提出了多波长码分复用超表面全息。根据码分复用技术，利用选定的基础码为“钥匙”对目标信息进行混叠编码与解码读出，对全息中的参考光信息进行“改造”，并引入了多波长信息通道，以不同的编码参考光与目标场景的光波信息共同编码到一个超表面全息元件上，从而实现超多通道的信息记录与重建。研究团队利用提出的多通道迭代合成优化算法，对红绿蓝三组图像信息进行编码。针对彩色显示在可见光波段的情况，设计了 TiO_2 的纳米立柱，通过各项异性调控实现额外提供水平与竖直双偏振通道。通过扫描优化微纳结构不同几何参数的电磁响应，从而生成加工数据，并利用电子束曝光 (EBL) 与反应离子束刻蚀 (RIE) 制备出所需的样品。

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Color holographic video display based on code division multiplexing metasurface

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It is one of biggest challenges to realize dynamic modulation by metasurfaces, specially for color holographic display, which requires the element can offers different manipulation at the working wavelengths of R, G and B.

To solve the problems, the joint research group of Prof. Yongtian Wang, Prof. Lingling Huang and Dr. Xin Li from Beijing Institute of Technology and Prof. Shumin Xiao from Harbin Institute of Technology (Shenzhen) proposed multiwavelength code division multiplexing (CDM) metasurface holography via combining birefringent metasurface and introducing the concept of CDM from communication technology. According to the basic principle of CDM, a series of codes are selected as "keys" to encode and decode the information. The research group optimized the coded reference and introduce multi-wavelength channels to encode the information of both references and target scene into a single metasurface for optical data recording and reconstruction in a large number of channels. A multichannel iterative optimization algorithm is presented and utilized to encode three groups of images and color code reference into the metasurface hologram. They designed titanium dioxide nanorods to provides two linear polarization channels working at visible range because of the birefringence of the structures. The geometric sizes of nanorod are scanned to optimized the electromagnetic response of nanostructure, and then the sample data can be obtained for fabricating the metasurface by electron beam lithography and reactive ion etching.

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