Colored Vortex Beams Based on Nanoscale 3D Printed Nanofins

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The control of complex-amplitude (*i.e.*, amplitude and phase) of light beams is essential for wavefront shaping, optical holography, metalenses, and structural color prints [1-2]. However, such complex-amplitude modulation encounters impenetrable obstacles in the case of incoherent white light illumination, limited by the requirements of spatio-temporal coherence of light source [3]. Due to the randomness of incoherent light sources and the extension of the ideal point source, the characteristics of light field cannot only be determined by the wavefronts. Thus, the control of complex-amplitude and incoherent white light illumination are contradictory in the usual sense.

Here, we proposed a 3D printed nanofin based metasurface, realizing complex-amplitude modulation under incoherent white light illumination in a cross-circular polarization optical system. By simply rotating the orientations of the nanofins, our nanofins based metasurface can control the complex-amplitude simultaneously. On the plane of sample surface, it shows a continuous brightness-controlled color print (Fig. 1(a)). Furthermore, on the predesigned focal plane, the colored vortex beams are presented, as shown in Fig 1(b). Based on two-photon polymerization 3D printed nanofins, we simultaneously incorporate the Pancharatnam-Berry phase and continuous spectrum control with a cross-circular polarized white light system. Our results would benefit research on optical encryption, dual-channel display for virtual/augmented reality, and high-dimensional structured light.

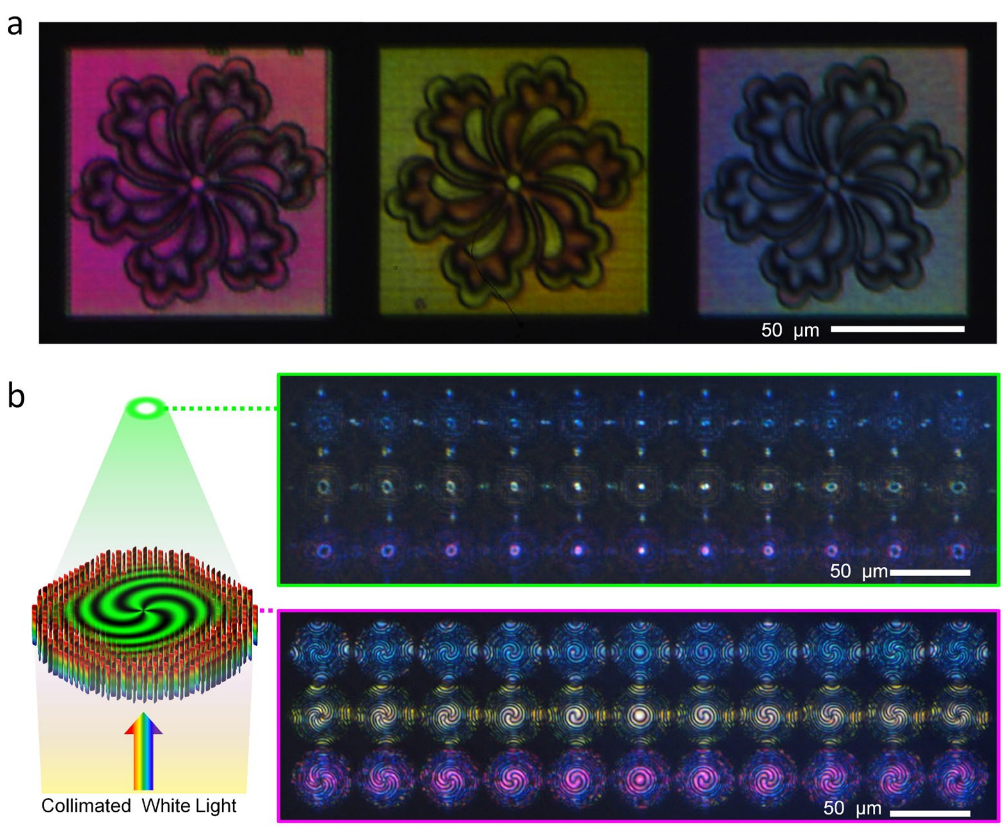

Fig. 1 Complex-amplitude control through nanofin based metasurface. (a) continuous brightness-controlled color prints. (b) colored vortex beams generated from nanofin based metasurface with incoherent white light illumination. Inset with blue border shows the doughnut shaped intensity profiles on the designed focal plane, while inset with pink border shows the interference-like spiral patterns on the sample surface.

References

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