Bird's Eye Inspired Hyperuniform Disordered TiO_2 Meta-atoms Based High-Efficiency Metalens: Electronic Supplementary Information

S1. PERIODIC METALENS STRUCTURE

We placed TiO_2 MAs on SiO_2 substrate according to the radius profile of our target focal length and analyzed the performance of the periodic metalens structure. This ordered metalens was consisted of 2609 MAs. Moreover, we compared the simulated phase shift with the target phase shift, as shown in Fig. S1(a). We achieved similar phase shifts, which were desired, for the

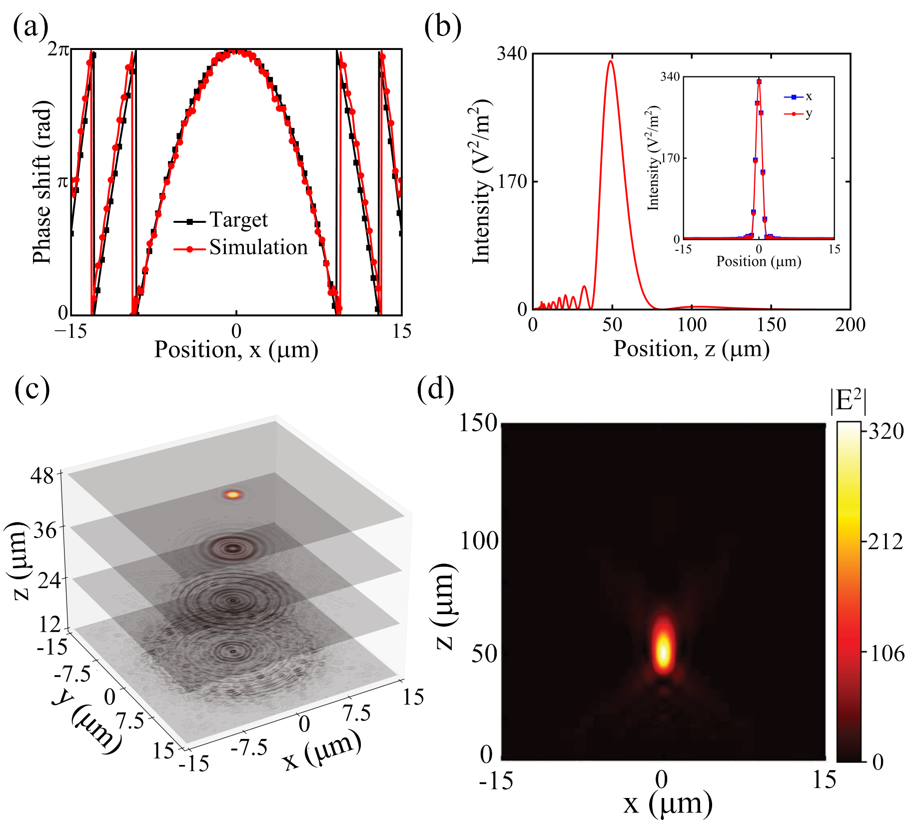

Fig. S1. (a) The analytically calculated target and numerically obtained phase shifts for the periodic metalens structure. (b) The xy-view of the electric field's far-field intensity at the wavelength of 820 nm where the focal length was set to be 50 μm. The inset shows the electric field's far-field intensity at the wavelength of 820 nm for the x- and y-axis. (c) The electric field distributions of periodic metalens structure for different focal distances. (d) The xz-view of the electric field distributions at the focal length. We achieved the highest intensity at the focal distance of 48.12 μm.

target and simulated calculations of periodic metalens structure. Moreover, we studied the far field intensity for our proposed MA periodic metalens structure. The generalized Snell's law of refraction suggests the angle of refraction can be controlled by altering the phase gradient, which results in light confinement at the focal length of the metalens. To implement the law in our proposed structures, we modulated the phase gradient of our metalens structures by adjusting the effective refractive index by changing the MA's radius. Hence, our proposed structures confined the light at the focal length of 48.12 μm, as shown in Fig. S1(b); however, we designed our proposed metalens structures for achieving the light confinement at the focal length of 50 μm. This discrepancy arose due to inadequate MAs in our proposed metalens structures. The metalens structure was symmetrical in the x- and y-axis, as the intensities of the x- and y-axis were the same, as shown in the inset of Fig. S1(b). The full-width half-maximum (FWHM) of 1.507 μm was calculated for our proposed periodic metalens structure. Moreover, we analyzed the light confinement at different focal distances for our proposed periodic metalens structure, as depicted in Fig. S1(c). The spatial electric field distributions at different focal distances revealed the light converges at the focal point with the highest intensity. The maximum intensity lay at the focal length of the proposed periodic metalens structure, as depicted in Fig. S1(d).

S2. ELECTRIC FAR-FIELD INTENSITY OF PERIODIC AND DISORDERED METALENS STRUCTURES

Figures S2(a) and (b) depict the electric far-field intensity of periodic and hyperuniform disordered metalens structures when we varied the wavelength of incident light. The focal length of metalens structures shifted with varying incident light wavelengths.

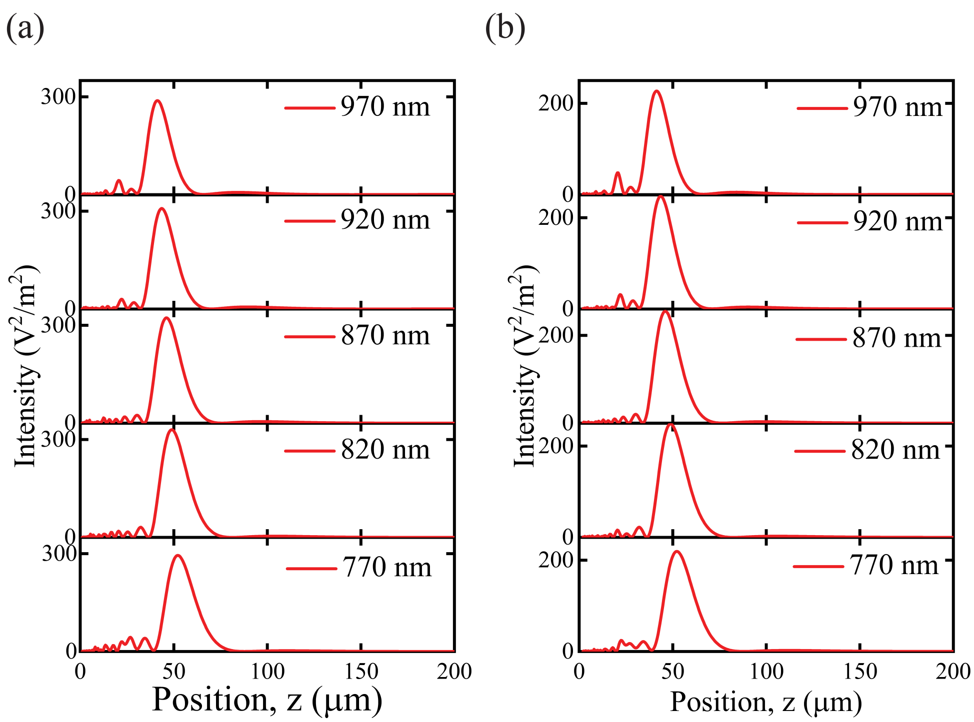

Fig. S2. Electric far-field intensity of (a) periodic and (b) disordered metalens structures for various wavelengths of the incident light.