Single-Layered Phase-Change Metasurfaces Achieving Polarization- and Crystallinity-Dependent Wavefront Manipulation

(Supporting Information)

Table S1 Geometric parameters and corresponding optical responses at A- and C- state

i \ *j*		1	2	3	4	5	6
1	L(μm)	4.4	4.4	4.3	3.7	3.5	3.2
	W(μm)	1.9	1.8	1.85	1.95	2.15	2.2
	φ_a(deg)	-163	-143	-149	-138	-163	-150
	$Cross\text{-}A_a$	0.94	0.96	0.96	0.9	0.74	0.61
	$Co\text{-}A_a$	0.15	0.03	0.10	0.33	0.62	0.74
	φ_c(deg)	-125	-54	-4	61	123	173
	$Cross\text{-}A_c$	0.47	0.41	0.34	0.31	0.69	0.5
	$Co\text{-}A_c$	0.54	0.65	0.26	0.33	0.27	0.5
2	L(μm)	2.85	2.7	2.75	3.7	1	2.85
	W(μm)	3.8	2.1	2	1.45	2	4
	φ_a(deg)	-76	-99	-90	-71	-109	-85
	$Cross\text{-}A_a$	0.29	0.62	0.74	0.97	0.21	0.34
	$Co\text{-}A_a$	0.89	0.72	0.61	0.22	0.97	0.86
	φ_c(deg)	-127	-50	-16	55	119	180
	$Cross\text{-}A_c$	0.56	0.41	0.4	0.53	0.72	0.66
	$Co\text{-}A_c$	0.66	0.4	0.43	0.38	0.67	0.28
3	L(μm)	2.5	4.6	2.3	2.9	3.6	3.5
	W(μm)	3.4	1.05	3	1.55	1.3	1.25
	φ_a(deg)	-27	-35	-30	-34	-41	-30
	$Cross\text{-}A_a$	0.41	0.93	0.58	0.91	0.98	0.98
	$Co\text{-}A_a$	0.89	0.13	0.37	0.35	0.03	0.09
	φ_c(deg)	-120	-52	5	66	120	169
	$Cross\text{-}A_c$	0.58	0.76	0.5	0.41	0.67	0.63
	$Co\text{-}A_c$	0.78	0.43	0.5	0.62	0.32	0.36
4	L(μm)	1.95	2.15	2.2	1.9	1.8	1.85
	W(μm)	3.7	3.5	3.2	4.4	4.4	4.3
	φ_a(deg)	42	17	30	17	37	31
	$Cross\text{-}A_a$	0.9	0.74	0.61	0.94	0.96	0.96
	$Co\text{-}A_a$	0.33	0.62	0.74	0.15	0.03	0.1
	φ_c(deg)	-119	-57	-7	55	126	176
	$Cross\text{-}A_c$	0.31	0.69	0.5	0.47	0.41	0.34
	$Co\text{-}A_c$	0.33	0.27	0.5	0.54	0.65	0.26
5	L(μm)	1.45	2	4	3.8	2.1	2
	W(μm)	3.7	1	2.85	2.85	2.7	2.75
	φ_a(deg)	109	71	95	104	81	90
	$Cross\text{-}A_a$	0.97	0.22	0.34	0.29	0.62	0.74
	$Co\text{-}A_a$	0.22	0.97	0.86	0.89	0.72	0.61

	φ_c(deg)	-119	-61	0	53	130	164
	Cross-A_c	0.53	0.72	0.66	0.56	0.41	0.4
	Co-A_c	0.38	0.67	0.28	0.66	0.4	0.43
6	L(μm)	1.55	1.3	1.25	3.4	1.05	3
	W(μm)	2.9	3.6	3.5	2.5	4.6	2.3
	φ_a(deg)	146	139	150	153	145	150
	Cross-A_a	0.91	0.98	0.98	0.41	0.93	0.58
	Co-A_a	0.35	0.03	0.09	0.89	0.13	0.37
	φ_c(deg)	-114	-60	-11	60	128	175
	Cross-A_c	0.41	0.67	0.63	0.58	0.76	0.5
	Co-A_c	0.62	0.32	0.36	0.78	0.43	0.5

where *Cross-A_a* and *Cross-A_c* are the cross-polarized amplitude at A- and C- state. *Co-A_a* and *Co-A_c* are the co-polarized amplitude at A- and C- state.

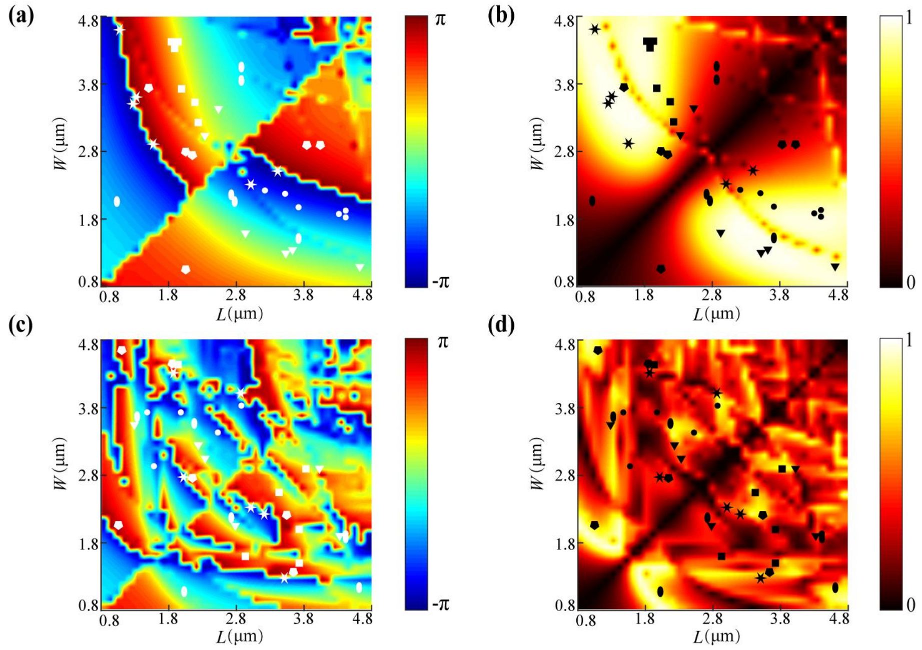

Figure S1. Optimization graphs of the simulated unit cells with different geometries. Phase (a) and amplitude (b) responses when GSST is in A-state. Phase (c) and amplitude (d) responses when GSST is in C-state. The same symbol indicates the same *i* in Table S1. It can be inferred that for a given phase shift at A-state, six kinds of meta atoms can be chosen that can fully cover 0-2π at C-state.

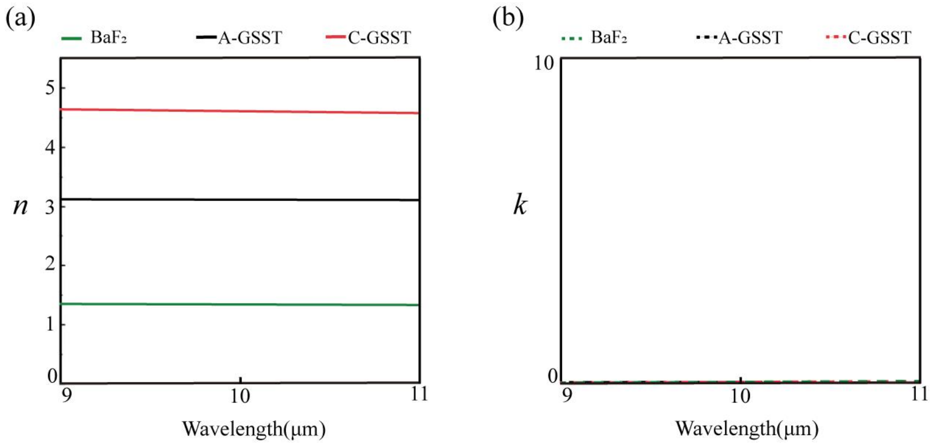

Figure S2. Optical constants data of used materials. (a) Real part of the refractive index. (b) Imaginary part of the refractive index. The Optical constants are obtained from measured results in [1,2].

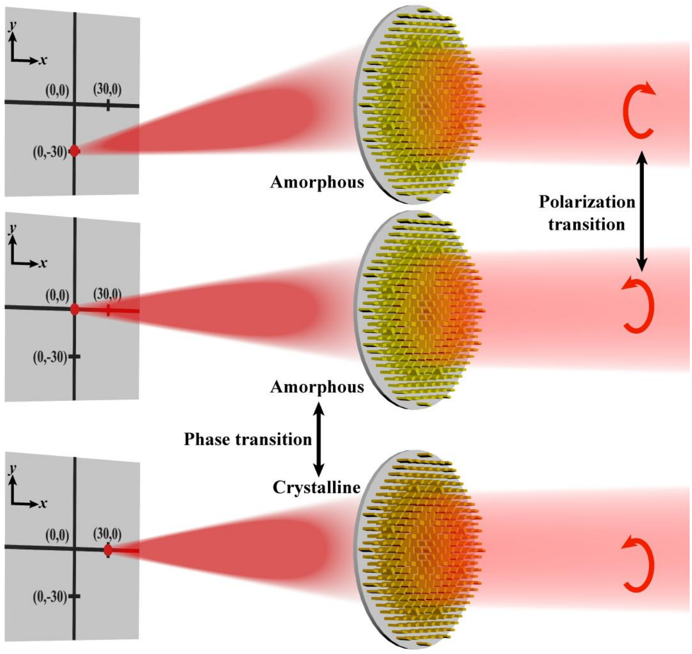

Figure S3. The schematic illustration for the multi-focus metalens.

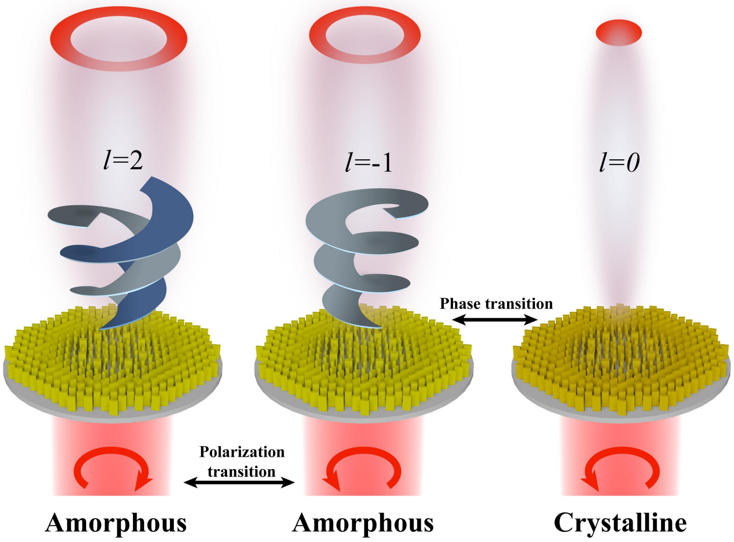

Figure S4. The schematic illustration for the multistate vortex beam generator.

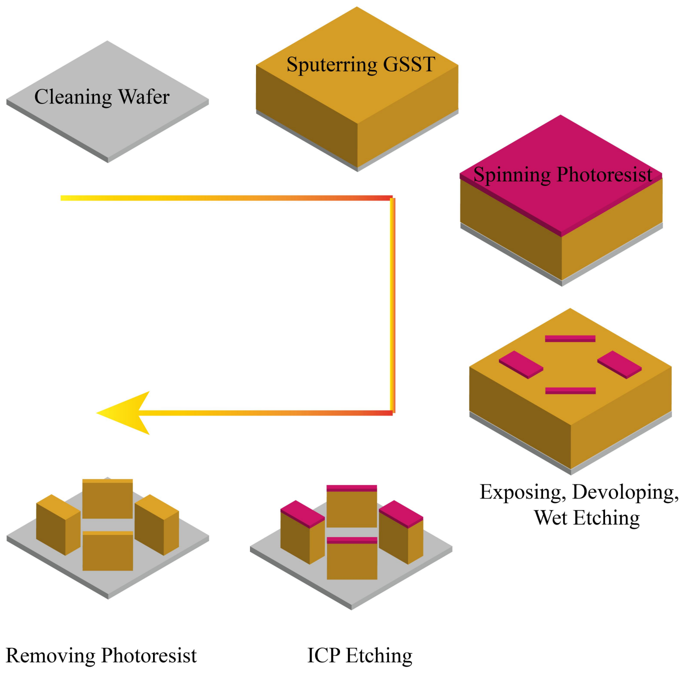

Figure S5. A feasible fabrication process for the designed sample.

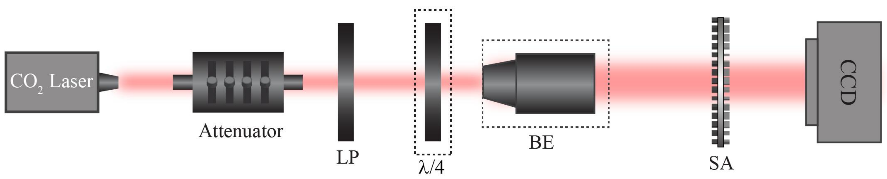

Figure S6. Schematic illustration of the measurement setup. LP: linear polarizer. λ/4: quarter wave plate. BE: beam expander. SA: sample.

Reference

1. Zhang, Y.; Chou, J.B.; Li, J.; Li, H.; Du, Q.; Yadav, A.; Zhou, S.; Shalaginov, M.Y.; Fang, Z.; Zhong, H.; et al. Broadband Transparent Optical Phase Change Materials for High-Performance Nonvolatile Photonics. *Nat. Commun.* **2019**, *10*, 4279, doi:10.1038/s41467-019-12196-4.
2. Palik, E.D. *Handbook of Optical Constants of Solids*; Academic press, 1998; Vol. 3; ISBN 0-12-544423-0.