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**Title:** Hybrid Metasurfaces for Simultaneous Focusing and Filtering

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Hybrid Metasurfaces for Simultaneous Focusing and Filtering - Supplemental Document

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1. EXPERIMENTAL SETUP

The optical setup for filter characterization is shown in Fig. S1. The light source is halogen-deuterium fiber coupled source from Ocean Optics. Two types of camera were used: a color camera (Amscope MU100) and gray-scale camera (Ximea-xiQ). The spectrophotometer is a UV-NIR model (HR4000CG-UV-NIR) from Ocean Optics.

![Experimental setup for filter characterization](image)

**Fig. S1.** Experimental setup for filter characterization

2. FABRICATION PROCESS

The filters were fabricated on fused silica substrates of 0.7mm thickness with IP-DIP resist (Nanoscribe GmbH). After exposure the sample was developed for 20 min with 2-Methoxy-1-methylethyl acetate (PGMEA from J.T. Baker) then rinsed for 3 min in IPA and 30 seconds in 3M Novec 7100 Engineered Fluid (2-(Difluoromethoxymethyl)-1,1,2,3,3-heptafluoropropane).
3. SUPPLEMENTARY SIMULATIONS

A. Higher diffracted orders
As noted in the main text, the diffracted light from the filter is removed by angular or spatial
filtering. Figure S2 shows the simulated far-field projections of a green filter alongside the NA of
the objective. In all cases the higher diffracted orders fall outside the NA of the objective.

B. Filter simulations
The simulation model of the focusing filters was based on single pixel filter with perfectly matched
layers (PML) on all boundaries (x = y = −25µm : +25µm, z = −4µm : +55µm) and total scattering
field source (TSFS). The lower boundary of the source was placed 2µm below the filter pixel
inside the substrate. A frequency domain power monitor was placed in the focal plane of the
filter. The focusing efficiency was calculated by integrating the Poynting vector over a circular
area of 5µm radius and dividing by the source power. The area was chosen with this size to match
the experiments. Figures (S3 & S4) show the incident angle effect on the optical power profile
and focusing efficiency.
Fig. S2. Far-field profiles (log scale) for the green filter normalized to the minimum field at 450nm wavelength. The wavelengths are (a) 450 nm, (b) 550 nm, and (c) 650 nm. The acceptance angle of the objective is shown in orange, and all diffracted orders but zero fall beyond the objective’s NA.
**Fig. S3.** Optical power profile of a green filter in the xz-plane at different angles of incidence and different wavelengths as labeled on the figure. A change in the angle of incidence moves the focused spot as expected, and reduces the overall transmission, but has little effect on the relative transmitted power among the three wavelengths.

**Fig. S4.** Simulated focusing efficiency of green filter at different angles of incidence. Although the overall transmission changes, the shift in the filter spectrum, and thus the color, is small.
4. SPECTRAL RESPONSE OF THE PHASE PLATE ALONE

In addition to the complete filter fabrication (phase plate + pillars), we fabricated the phase-plate only and measured the focusing efficiency to study the effect of phase-plate on the filtering process. The results are shown in Fig. S5.

**Fig. S5.** Focusing efficiency of phase-plate layer without pillars on top for the three main filters. The phase plate has a relatively weak effect on the green and red filters, but influences the blue filter significantly.