Electronic Supplementary Information

Filter-free, junctionless structures for color sensing

Keng-Te Lin,[a] Hsuen-Li Chen,*[a] and Yu-Sheng Lai*[b]

[a] Department of Materials Science and Engineering, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, Taipei, 10607, Taiwan. E-mail: hsuenlichen@ntu.edu.tw

[b] National Nano Device Laboratories, National Applied Research Laboratories, No. 26, Prosperity Road I, Science-based Industrial Park, Hsinchu, 30078, Taiwan. E-mail: yslai@narlabs.org.tw

The effect of the structural shape on the optical behavior

At first, we based on the titled shape of real device measured from the SEM images (Fig. 3c and Fig. 3d) to set up the structural parameters of CSSTTM structure for simulation. We simulated the optical absorbance spectrum of the real CSSTTM structure (based on the SEM images), which having a hole width at the top surface of 270 nm, a hole width at the bottom surface of 100 nm, a period of 600 nm, a depth (*D*) of 1000 nm, and a uniform Al film having a thickness (*t*) of 50 nm (inset to Fig. S1). As displayed in Fig. S1, the absorption band of the real H027P06 CSLISTTM structure was slightly narrower than that of the H027P06 CSSTTM structure with vertical sidewalls. Here, with the same structural period, but different shapes of the trench-like metallic cavities, the maximum absorbance of the tilted H027P06 CSLISTTM structure was slightly lower than that of the H027P06 CSLISTTM structure with vertical sidewalls. The shape of absorbance spectrum and the value of peak absorbance of the real H027P06 CSLISTTM structure were similar to the measured results (the red line in Fig. 3f). Besides, we attribute the measured absorbance in short wavelength regime differing from the simulated values to the surface roughness of Al film. Therefore, we suggest the color-selective absorption spectra would match the simulated results more exactly if we could control each fabrication process more precisely.

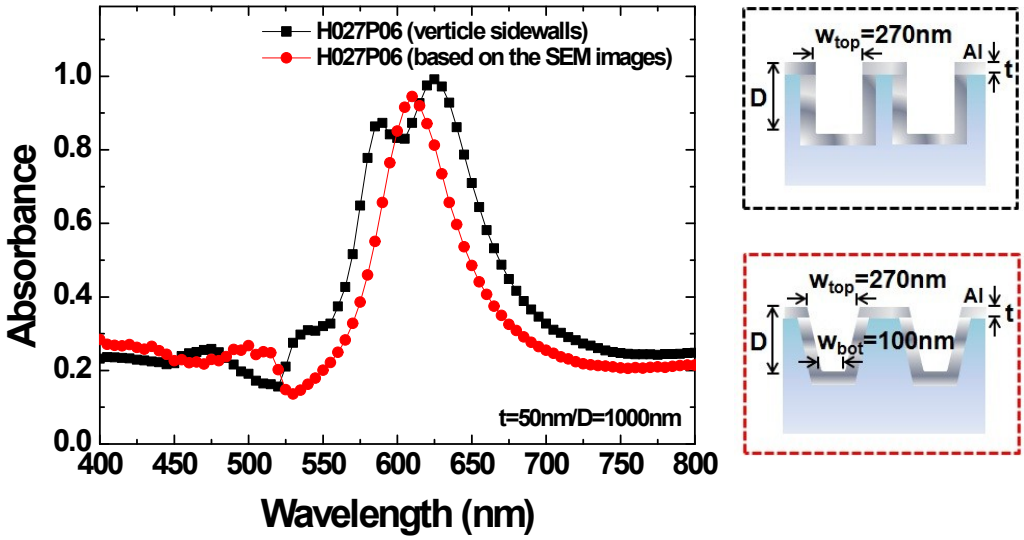
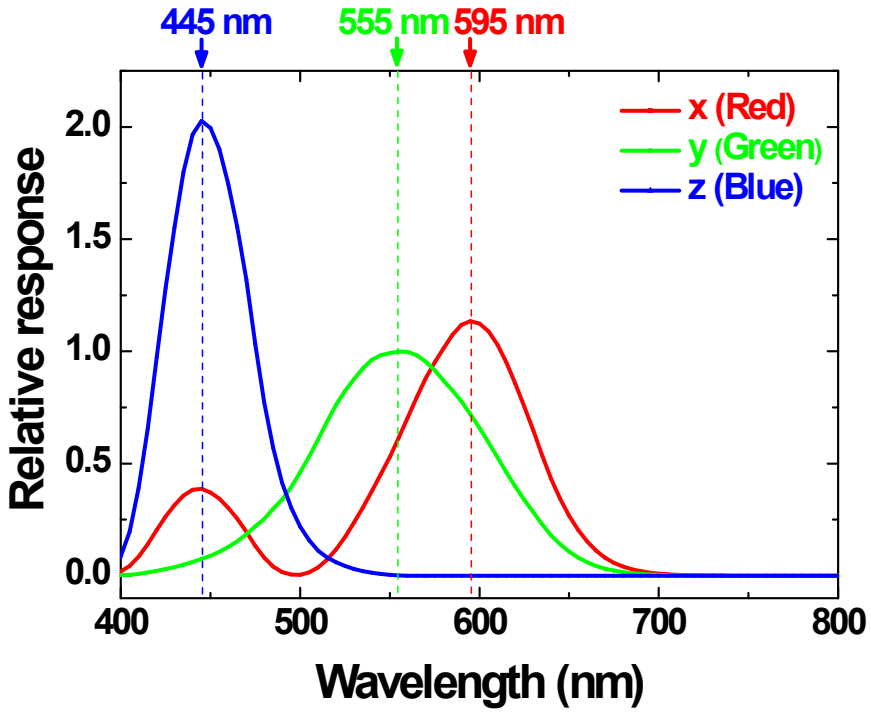


Figure S1. Simulated absorbance spectra of the H027P06 CSSTTM structure with vertical sidewalls and the real H027P06 CSSTTM structure (based on the SEM images of Fig. 3c and Fig. 3d).

CIE 1964 color-matching functions and simulated absorbance spectra of CSSTTM devices

(a)



(b)

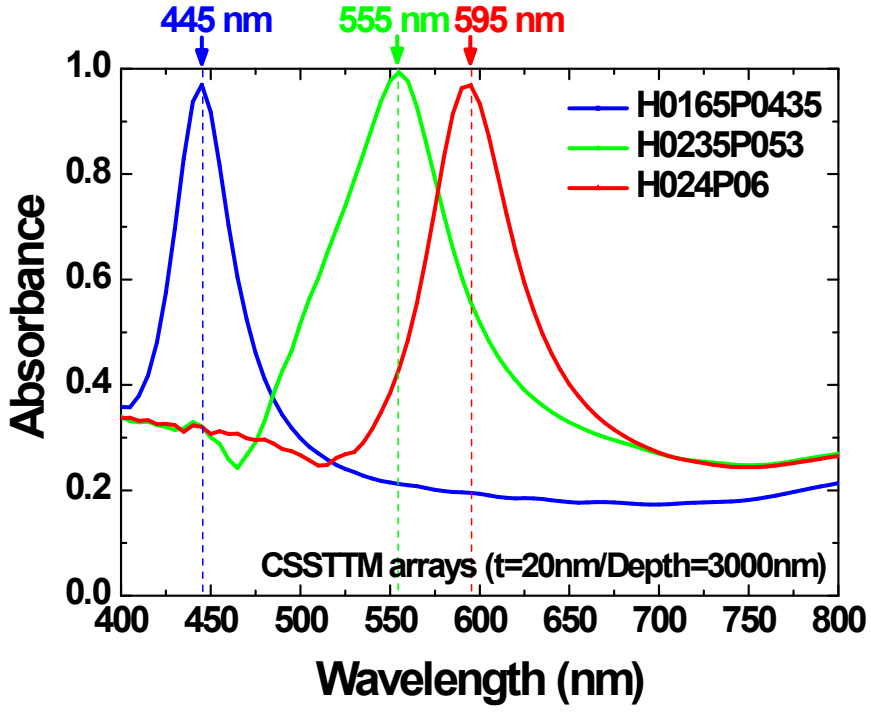


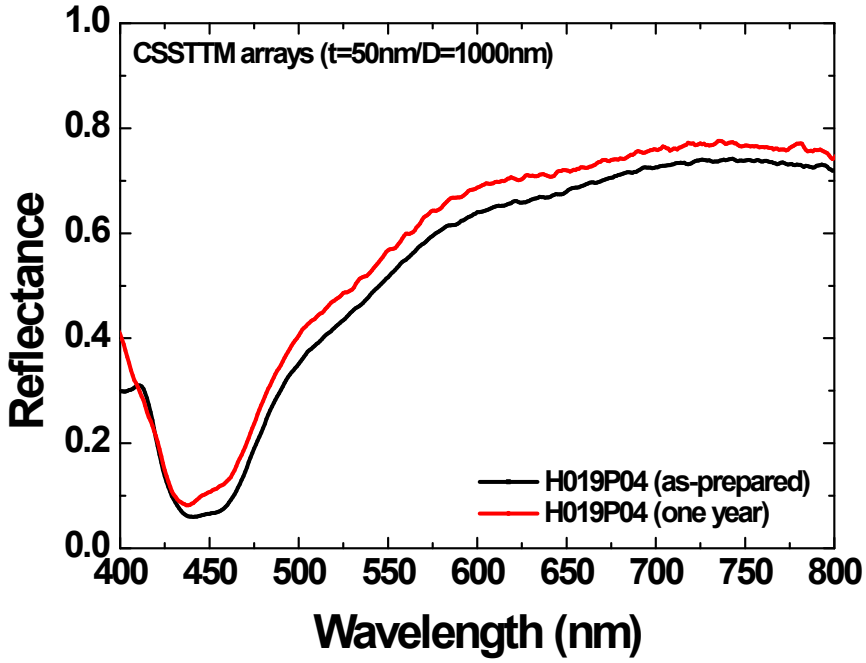
Figure S2. (a) CIE 1964 XYZ color-matching functions. (b) Simulated absorbance spectra of the CSSTTM devices H0165P0435, H0235P053, and H024P06 having an Al film thickness (*t*) of 20 nm and a cavity depth (*D*) of 3000 nm for matching of the CIE 1964 XYZ color-matching functions.

Table S1. Peak positions and FWHMs of the red, green, and blue lines in Figures S1a and S1b; maximum absorbances of the CSSTTM devices H0165P0435, H0235P053, and H024P06 having an Al film thickness (*t*) of 20 nm and a cavity depth (D) of 3000 nm.

		Blue (B)	**Green (G)**	**Red (R)**
Peak position (nm)	CIE 1964	445	555	595
	CSSTTM arrays	445 (H0165P0435)	555 (H0235P053)	595 (H024P06)
FWHM (nm)	CIE 1964	50-60	105-115	75-85
	CSSTTM arrays	50-55 (H0165P0435)	100-110 (H0235P053)	75-80 (H024P06)
Absorbance	CSSTTM arrays	0.97 (H0165P0435)	0.99 (H0235P053)	0.97 (H024P06)

The stability of CSSTTM device

(a)



(b)

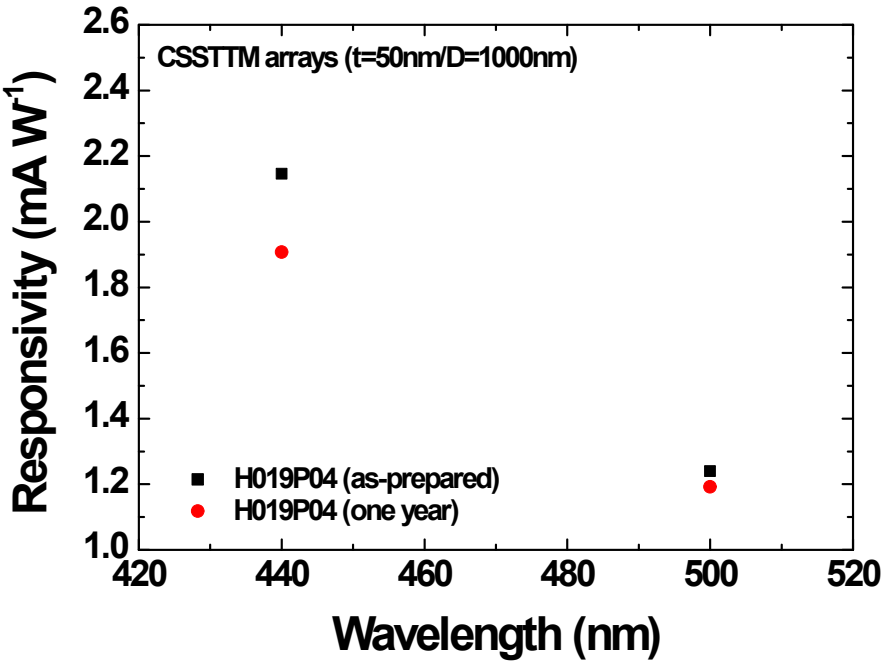


Figure S3. (a) Optical absorbance spectra and (b) electrical responses at wavelengths of 440 nm and 500 nm of the as-prepared H019P04 CSSTTM device and the H019P04 CSSTTM device after one year of storage under ambient conditions.