

Supplementary information

Copper Antimony Sulfide thin films for visible to near infrared photodetector application

V. Vinayakumar,^a S. Shaji,^{a,b} D. Avellaneda,^a J.A. Aguilar-Martínez,^{a,c} B. Krishnan ^{#a,b}

^a Facultad de Ingeniería Mecánica y Eléctrica, Universidad Autónoma de Nuevo León, San Nicolás de los Garza, Nuevo León, 66455, México.

^b Centro de Innovación, Investigación y Desarrollo en Ingeniería y Tecnología (CIIDIT)- Universidad Autónoma de Nuevo León, Parque de Investigación e Innovación Tecnológica, Apodaca, Nuevo León, 66600, México.

^c Centro de Investigación e Innovación en Ingeniería Aeronáutica (CIIA); Facultad de Ingeniería Mecánica y Eléctrica, Carretera a Salinas Victoria, km. 2.3, Apodaca, Nuevo León, 66600, México.

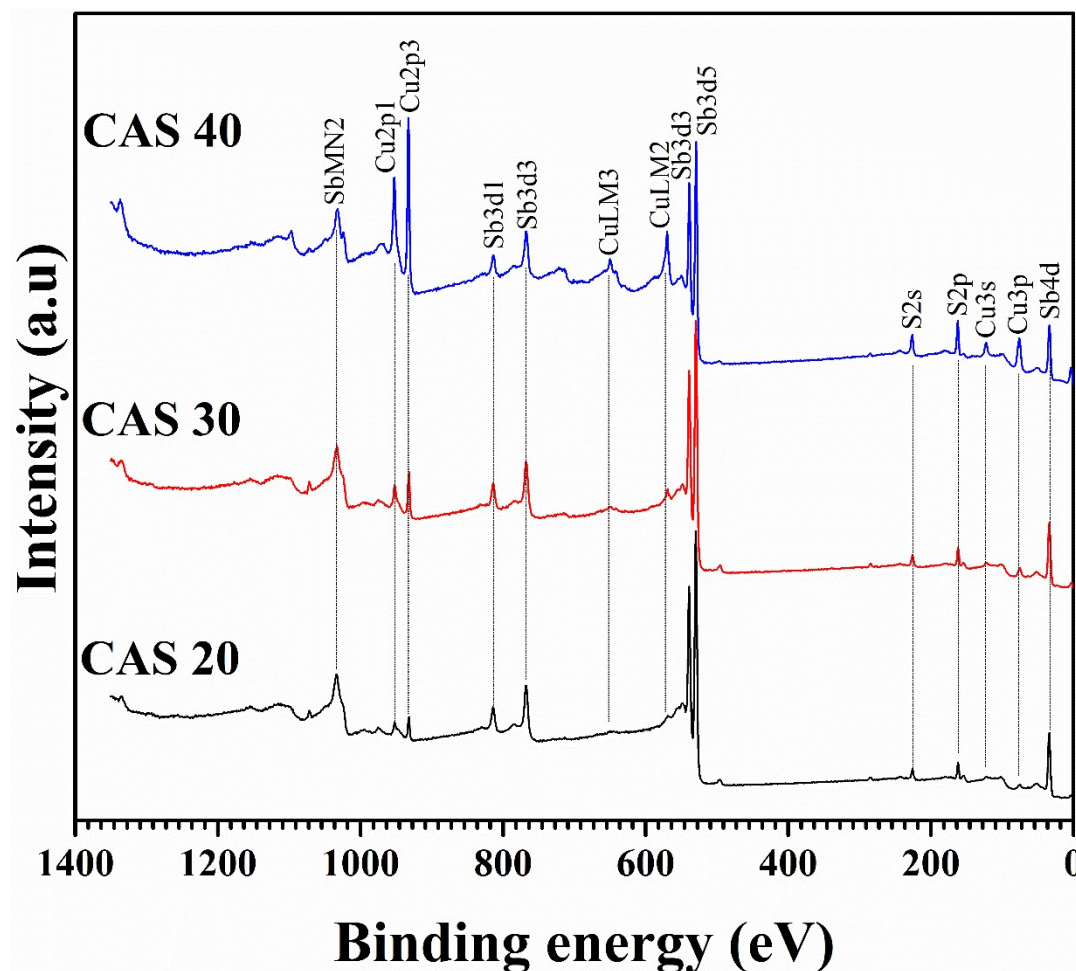


Figure S1. XPS survey spectra of CAS 20, CAS 30 and CAS 40 films.

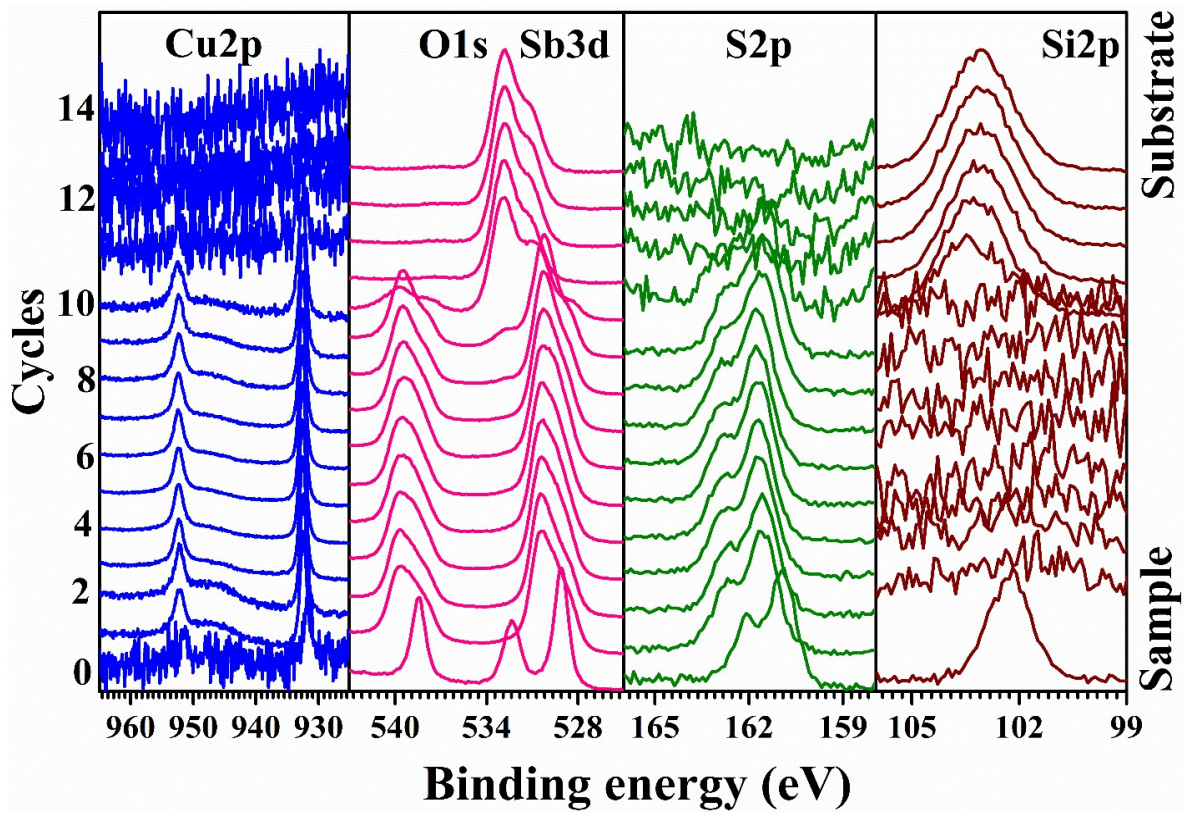


Figure S2. depth profile for composition of CAS 20 thin film.

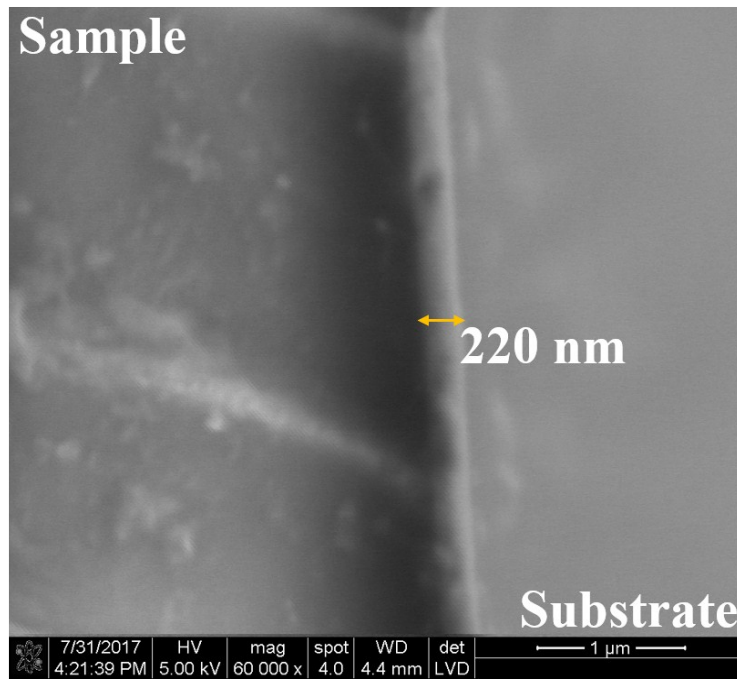


Figure S3. Cross-sectional SEM image of CAS 20 thin film.

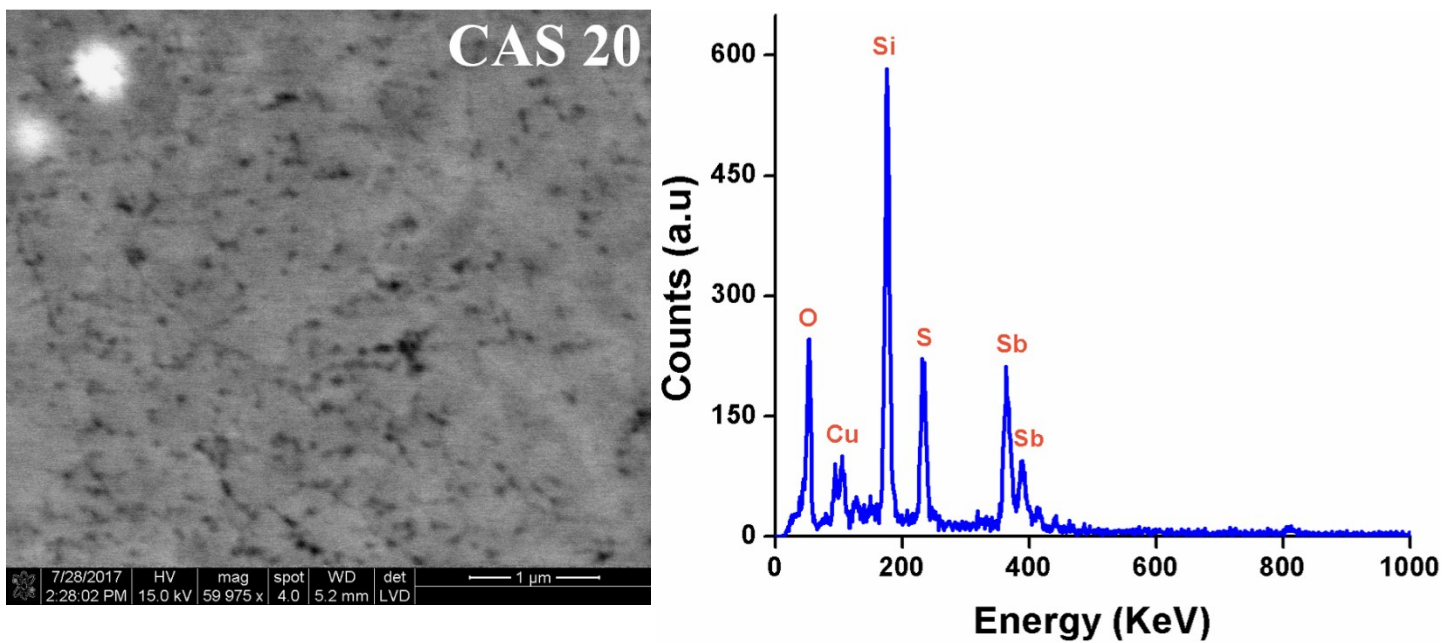


Figure S4. SEM and EDX results of CAS 20 thin film.

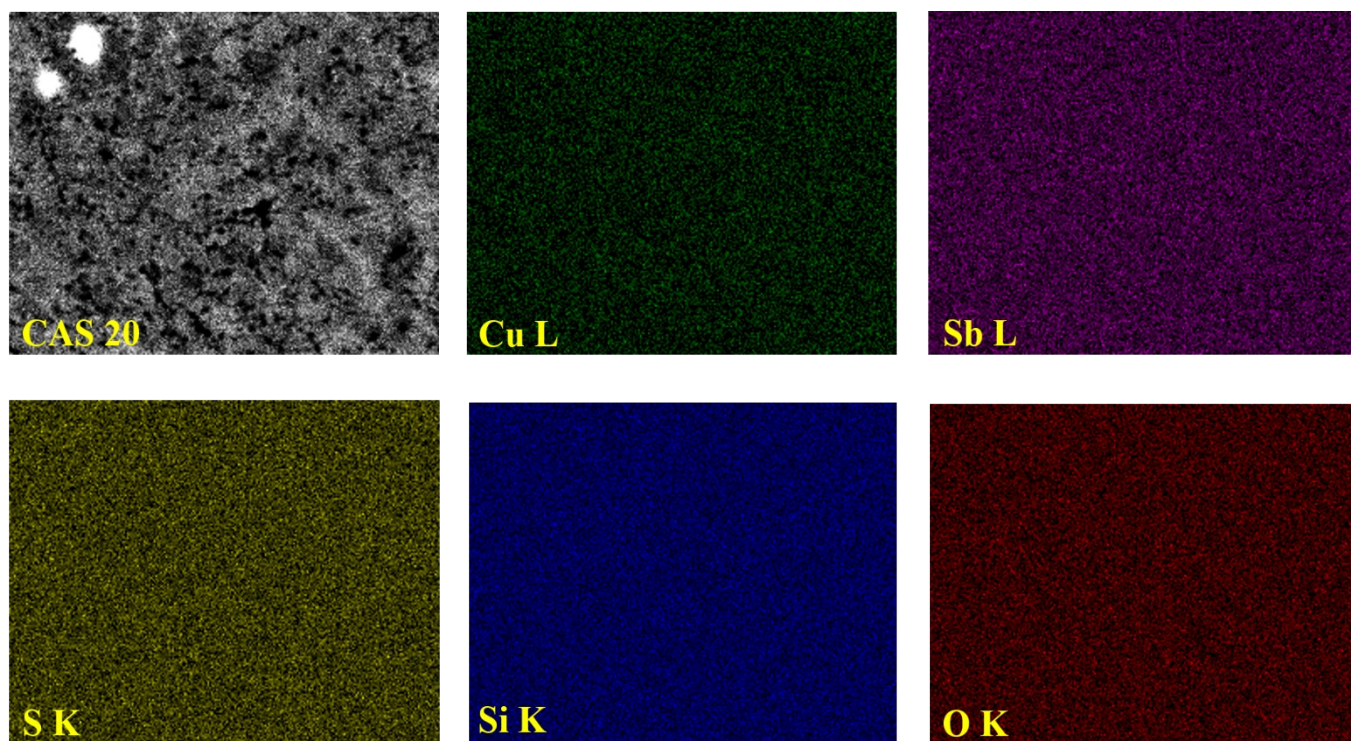


Figure S5. EDX elemental mapping of CAS 20 thin film.

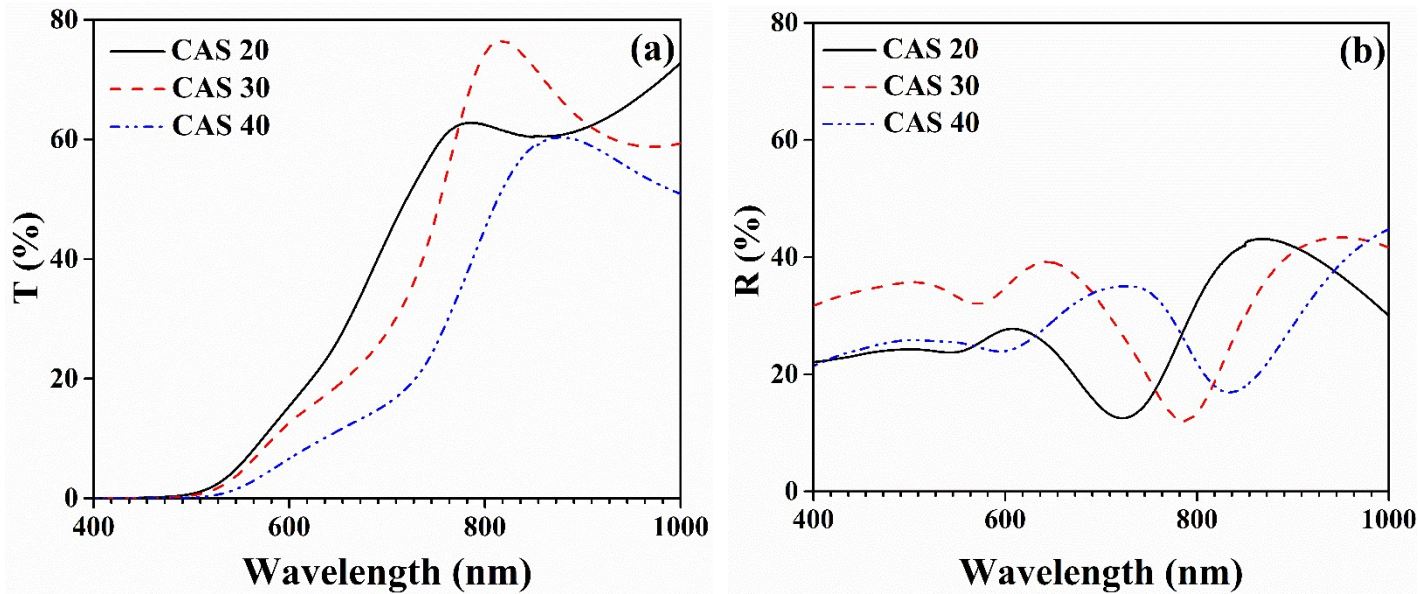


Figure S6. Transmittance (R) and Reflectance (R) spectra of CAS 20, 30 and 40 thin films

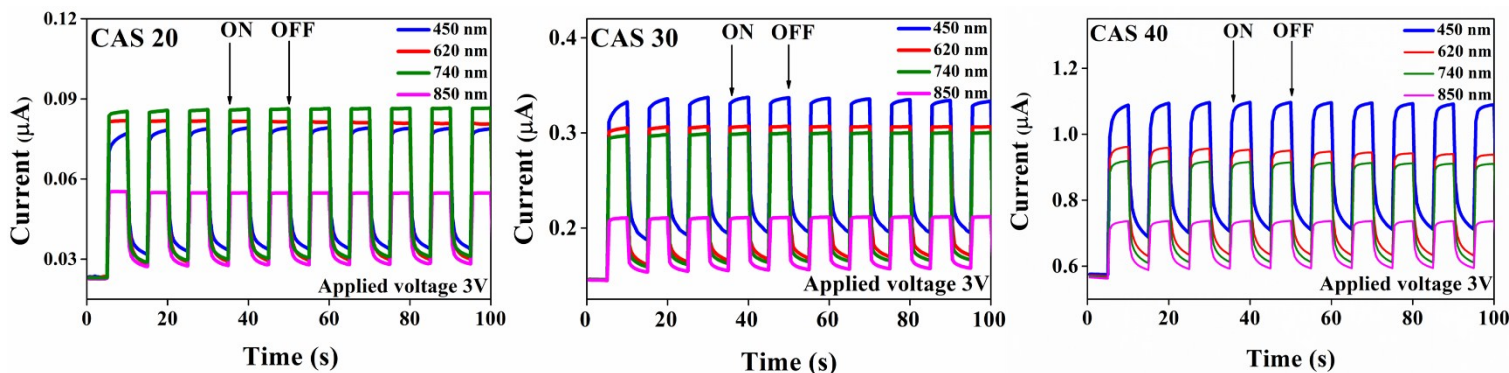
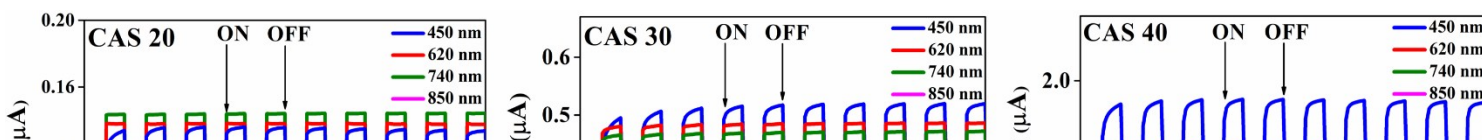


Figure S7. Switching behavior of CAS photodetector (CAS 20, CAS 30 and CAS 40) under illumination with LEDs having wavelengths 450, 620, 740 and 850 nm for bias voltage 3V.

Figure S8. Switching behavior of CAS photodetector (CAS 20, CAS 30 and CAS 40) under illumination with LEDs having wavelengths 450, 620, 740 and 850 nm for bias voltage 5V.



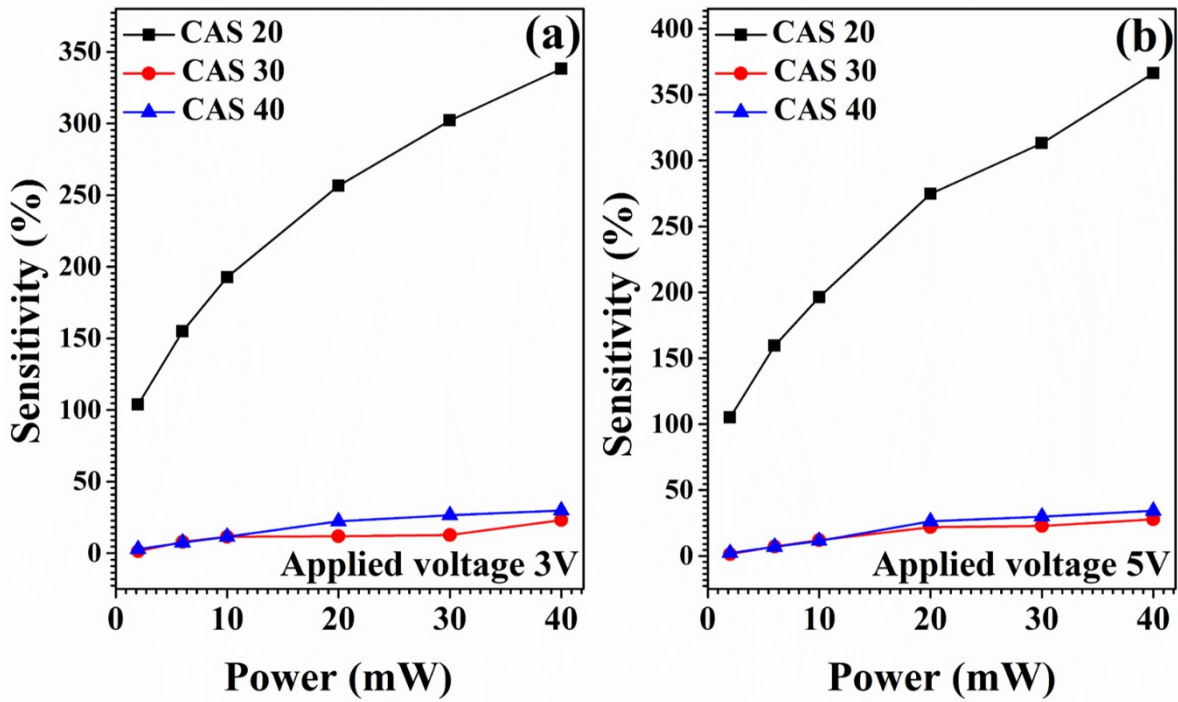


Figure S9. Laser power vs sensitivity graphs of CAS 20, CAS 30 and CAS 40 samples at applied bias voltage (a) 3V (b) 5V

Table ST1. Sensitivity measurements of CAS 20, 30 and 40 using LEDs at applied voltage 3V.

Sample	Wavelength (nm)	I_{dark} (nA)	I_{light} (nA)	Sensitivity (%)
CAS 20	450	23.31	74.79	220.85
	620	23.17	81.73	252.74
	740	22.97	84.84	269.35
	850	22.65	55.21	143.75
CAS 30	450	145.47	325.22	123.56
	620	145.30	303.68	109
	740	145.63	295.95	103.22
	850	145.04	210.61	45.21
CAS 40	450	575.04	1064.03	85.03
	620	570.93	952.79	66.88
	740	567.68	910.68	60.42
	850	564.34	730.13	29.36

Table ST2. Sensitivity and responsivity measurements of CAS 20, 30 and 40 at various laser power and applied voltage 3V.

Sample	Power density (mW/cm ²)	I _{dark} (nA)	I _{light} (nA)	Sensitivity (%)	Responsivity (AW ⁻¹) *10 ⁻⁵
CAS 20	0.8	13.3	27.1	103.75	7.01
	2.4	13.5	34.4	154.81	3.54
	3.9	13.5	39.5	192.59	2.64
	7.9	13.8	49.2	256.52	1.80
	11.8	13.6	55.5	302.17	1.41
	15.8	13.3	59.6	338.23	1.17
CAS 30	0.8	213	216	1.41	1.52
	2.4	215	232	7.90	2.88
	3.9	219	244	11.41	2.54
	7.9	228	255	11.84	1.37
	11.8	229	258	12.36	0.98
	15.8	234	288	23.07	1.37
CAS 40	0.8	588	604	2.72	8.12
	2.4	631	676	7.30	7.67
	3.9	641	715	11.38	7.51
	7.9	636	777	22.16	7.16
	11.8	642	813	26.47	5.79
	15.8	651	845	29.80	4.93

Table ST3. Sensitivity measurements of CAS 20, 30 and 40 using LEDs at applied voltage 5V.

Sample	Wavelength (nm)	I _{dark} (nA)	I _{light} (nA)	Sensitivity (%)
CAS 20	450	43.23	130.19	201.16
	620	42.55	137.85	223.85
	740	43.03	143.38	233.29
	850	42.37	91.82	116.71
CAS 30	450	220.15	478.31	117.27
	620	219.55	476.68	117.11
	740	219.74	461.96	110.23
	850	219.88	327.10	48.76
CAS 40	450	944.99	1823.82	93
	620	943.68	1617.62	71.42
	740	952.06	1534.40	61.17
	850	949.96	1236.11	30.12

Table ST4. Sensitivity and responsivity measurements of CAS 20, 30 and 40 at various laser power and applied voltage 5V.

Sample	Power density (mW/cm²)	I_{dark} (nA)	I_{light} (nA)	Sensitivity (%)	Responsivity (AW⁻¹) *10⁻⁴
CAS 20	0.8	23.7	48.6	105.06	1.26
	2.4	24.2	62.8	159.50	0.65
	3.9	24.2	71.7	196.28	0.48
	7.9	23.7	88.8	274.68	0.33
	11.8	24.3	100.5	313.16	0.26
	15.8	23.4	109.2	366.23	0.22
CAS 30	0.8	358	363	1.39	0.25
	2.4	358	384	7.26	0.44
	3.9	369	413	11.92	0.45
	7.9	366	446	21.85	0.41
	11.8	391	479	22.82	0.30
	15.8	386	493	27.72	0.27
CAS 40	0.8	979	1002	2.24	1.15
	2.4	1060	1134	6.98	1.25
	3.9	1066	1189	11.53	1.25
	7.9	1076	1359	26.30	1.44
	11.8	1090	1416	29.90	1.10
	15.8	1084	1455	34.22	0.94

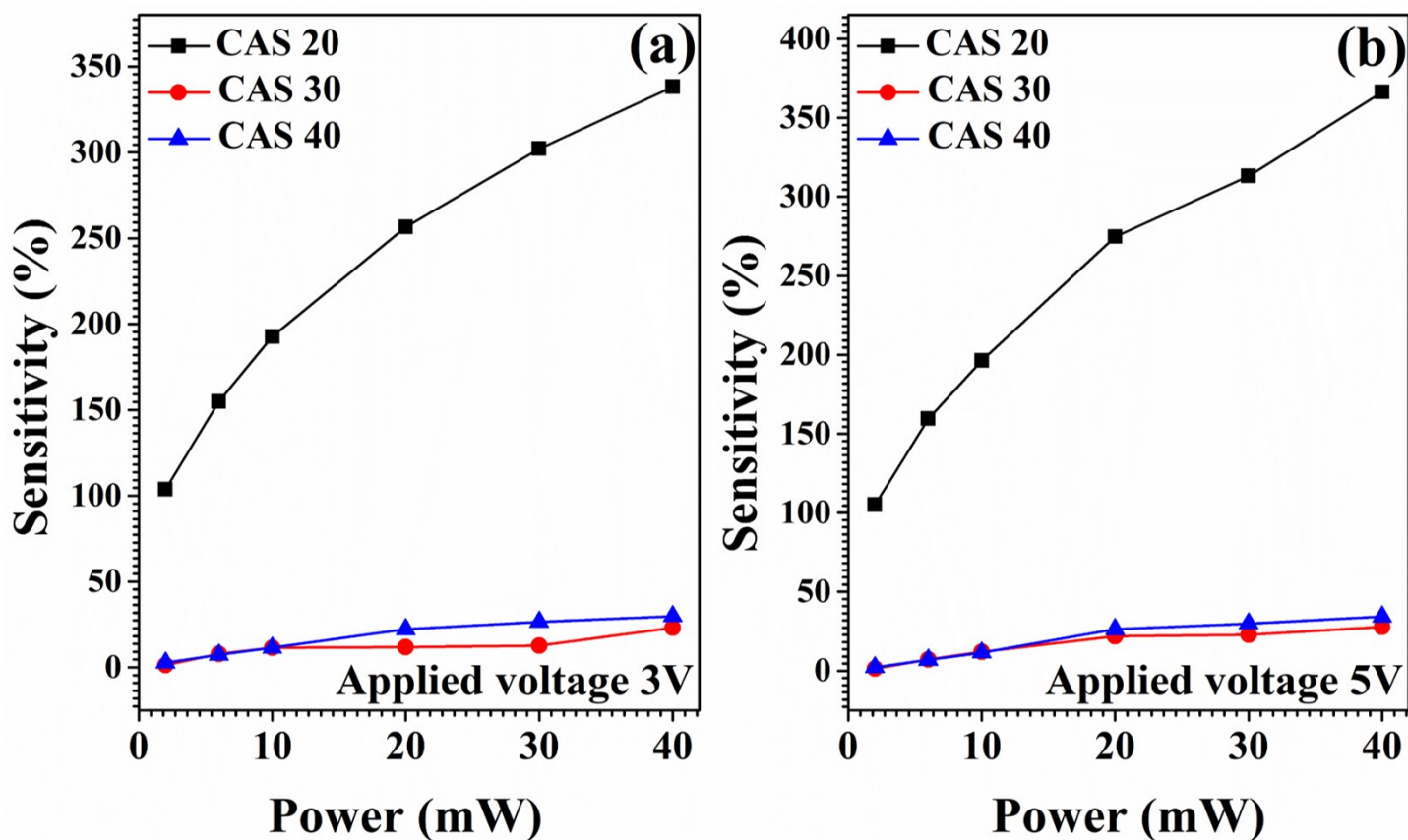


Figure S10. (a) Laser power Vs sensitivity graphs of CAS 20, CAS 30 and CAS 40 samples at applied bias voltage 3V (b) Laser power Vs sensitivity graphs of CAS 20, CAS 30 and CAS 40 samples at applied bias voltage 5V.

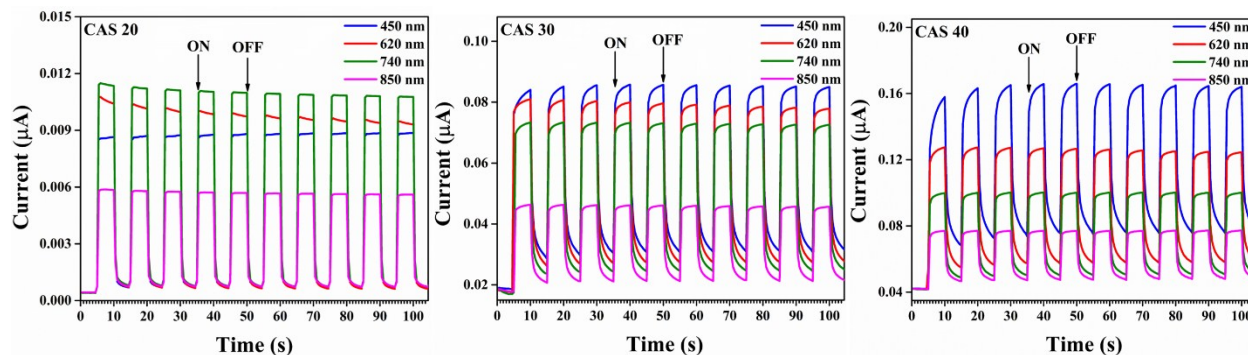


Figure S11: The switching behavior of CAS photodetector (CAS 20, CAS 30 and CAS 40) after 20 weeks, measured under 1V bias using LEDs having wavelengths 450, 620, 740 and 850 nm.