Supporting Information

Near Infrared Laser–Annealed IZO Flexible Device as a Sensitive H_2S Sensor at Room Temperature

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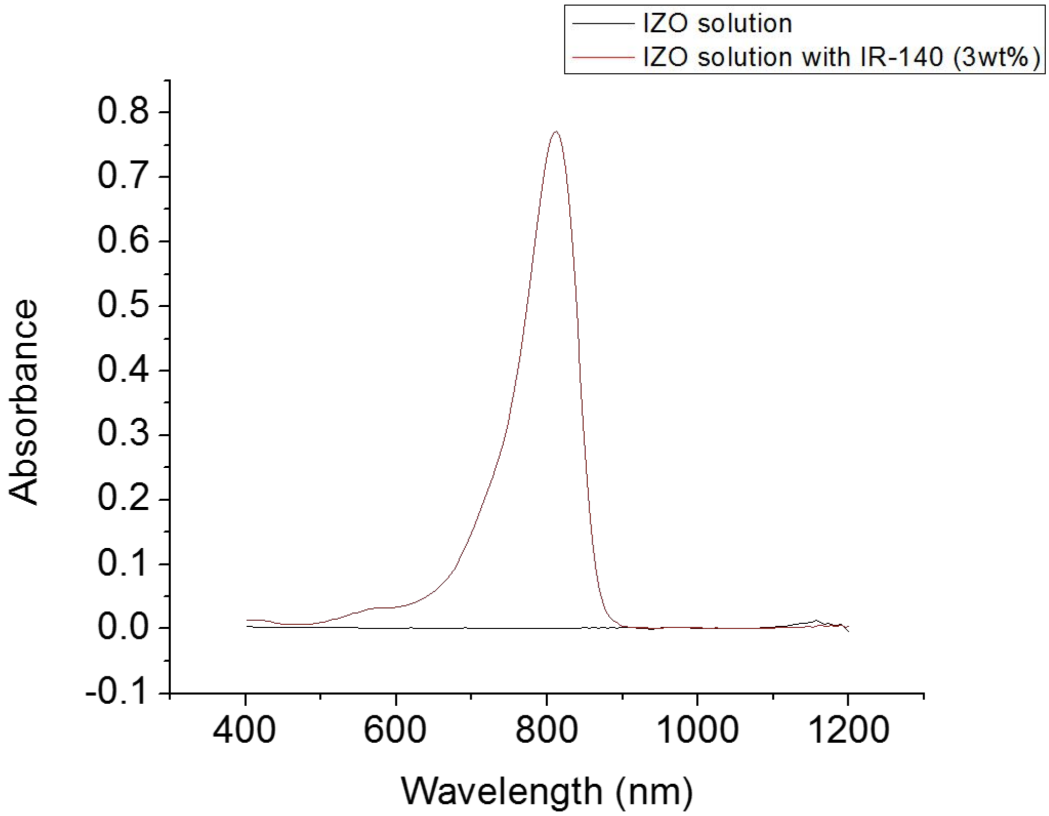


Figure S1. Absorbance spectra of IZO solution w/ and w/o IR-140 laser dye (1 cm length cell). The solution with IR-140 was prepared from a 3 wt% of IR-140 and diluted in isopropanol (1000 x) for clearly observe the position of the absorption peak.

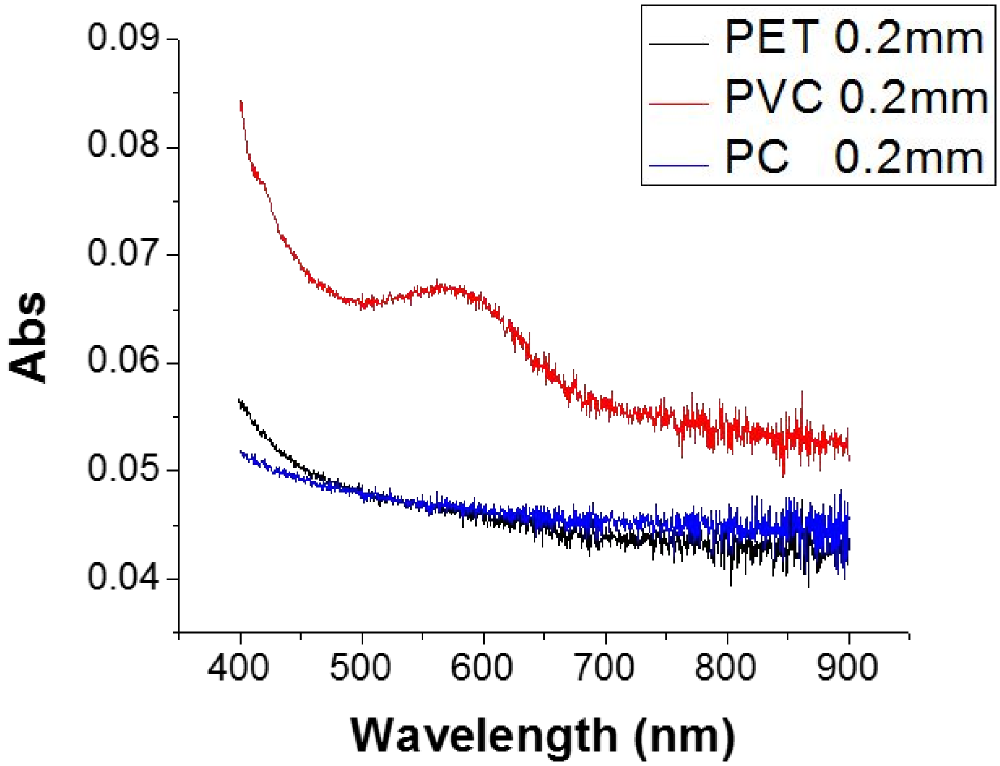


Figure S2. Absorbance spectra of plastic substrates (PET/PVC/PC).

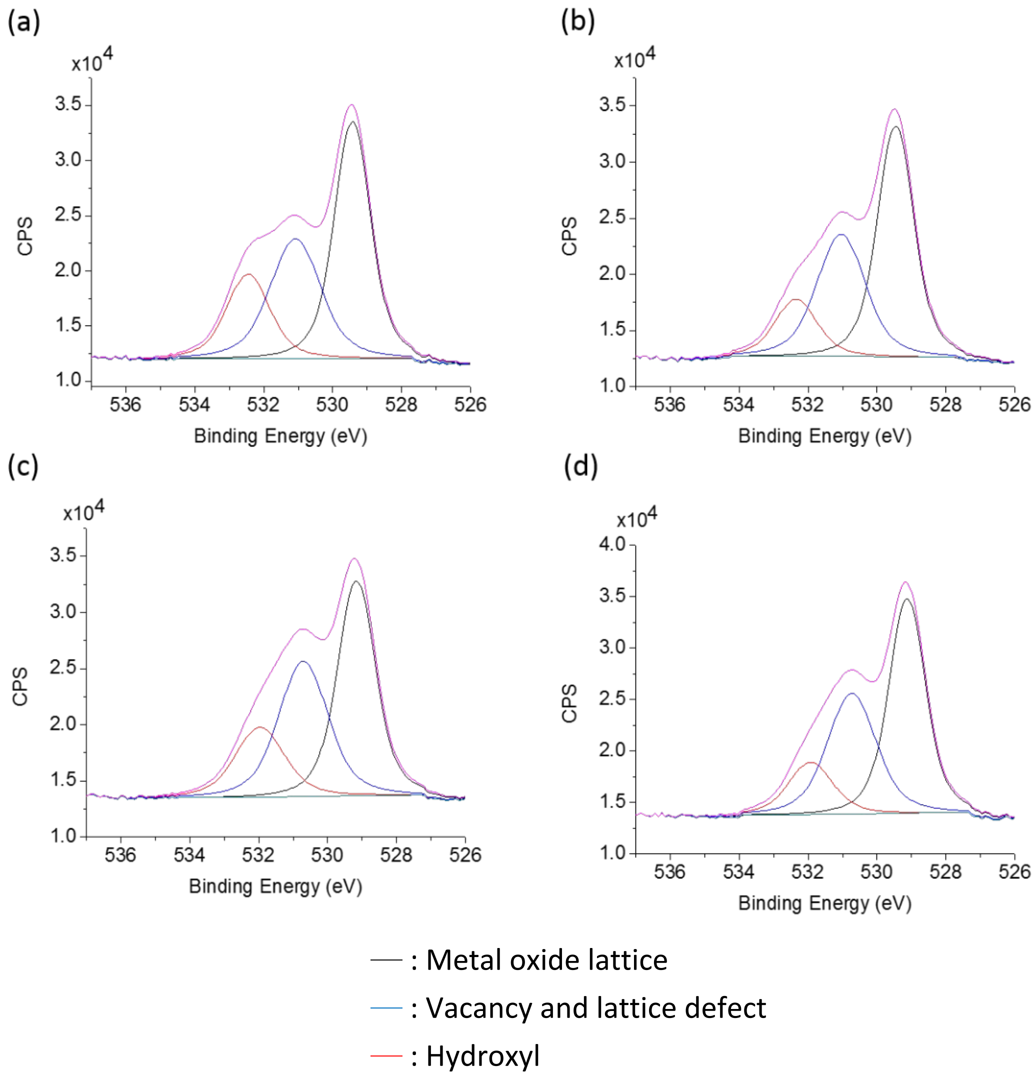
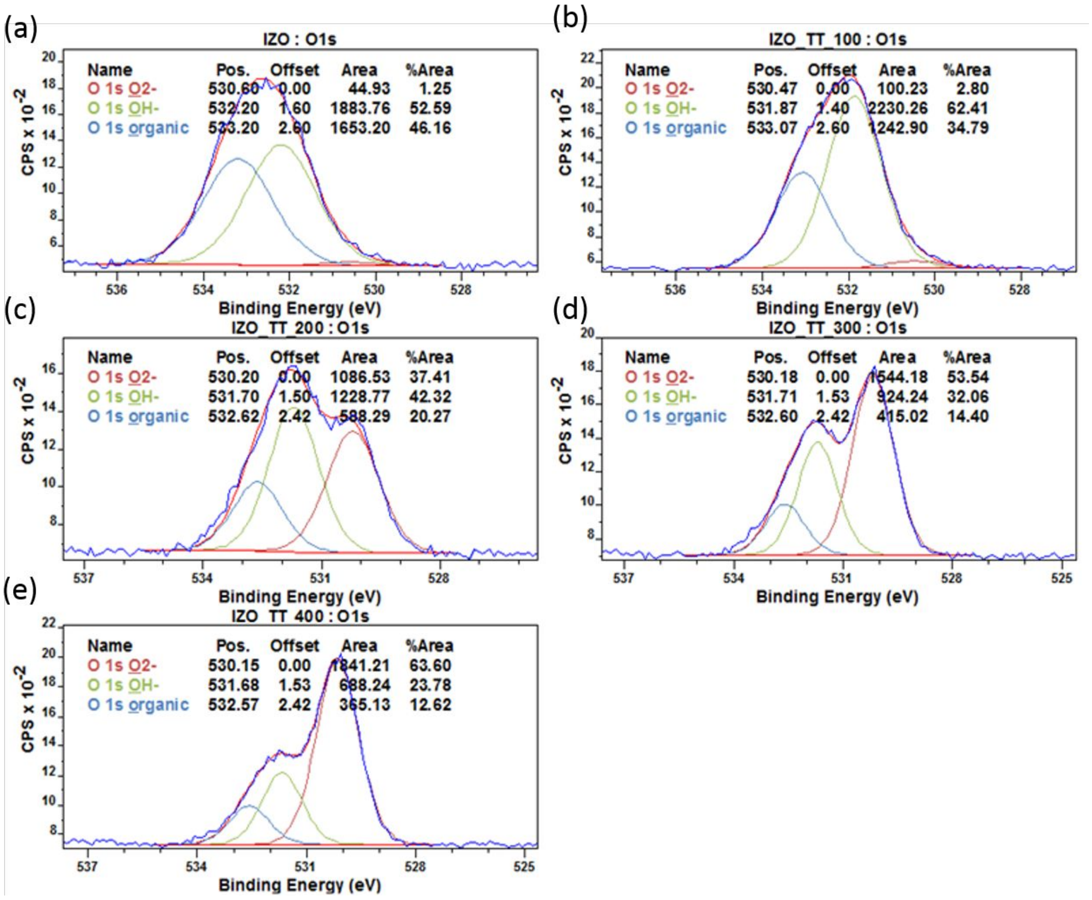


Figure S3. XPS analysis of NIR laser-annealed IZO film. The power density used in (a), (b), (c) and (d) was 93 W/cm^2, 105 W/cm^2, 127 W/cm^2, and 157 W/cm^2, respectively. The XPS data was acquired with PHI Quanterall, ULVAC-PHI (P < 2.0 × 10^{-7} Pa).



O2- : Metal oxide lattice

OH- : Vacancy and lattice defect

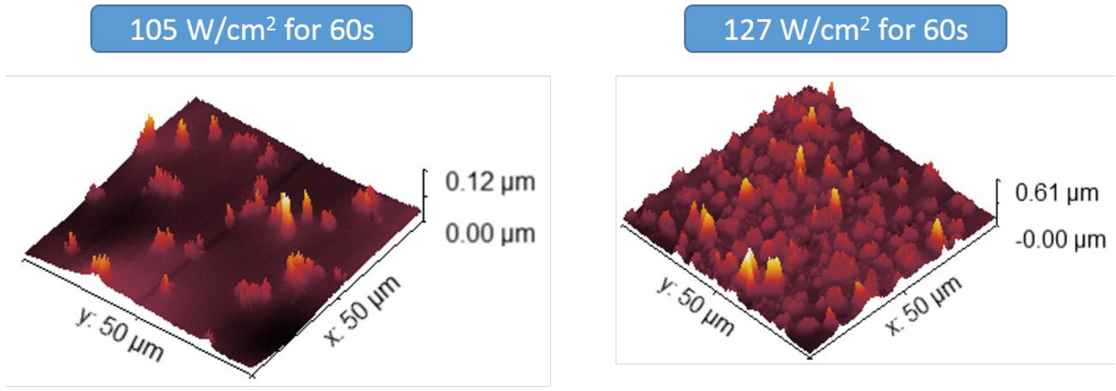
Organic : Hydroxyl

Figure S4. XPS data for thermal annealed IZO film. (a) is the IZO film only treated by 50°C for 20 minutes after film deposition. (b), (c), (d), and (e) are the thermal annealing at 100°C, 200°C, 300°C, and 400°C, respectively. The XPS data was acquired with Gammadata Scienta (Uppsala, Sweden) SES 200-2 X-ray photoelectron spectrometer under ultra-high vacuum (P < 10^{-9} mbar).

Table S1. Values of the M-O-M, M-OH, and M-O_{vac} ratios for thermal annealing and NIR laser annealing samples.

	M-OH (530.4 eV)	M-Ovac (529.2 eV)	M-O-M (528.6 eV)
IZO film as-spun	46.16	52.59	1.25
Thermal annealing			
100°C 1hr	34.79	62.41	2.8
200°C 1hr	20.27	42.32	37.41
300°C 1hr	14.4	32.06	53.54
400°C 1hr	12.62	23.78	63.6
Laser annealing			
93 W/cm^2 60s	14.24	35.24	50.52
127 W/cm^2 60s	18.77	36.50	44.73
157 W/cm^2 60s	14.44	36.56	49.00

The value is in percentage (%).



Surface roughness = 9 nm

Surface roughness = 50 nm

Figure S5. The AFM images IZO thin films irradiated with NIR laser (power density = 105 W/cm^2 and 127 W/cm^2).

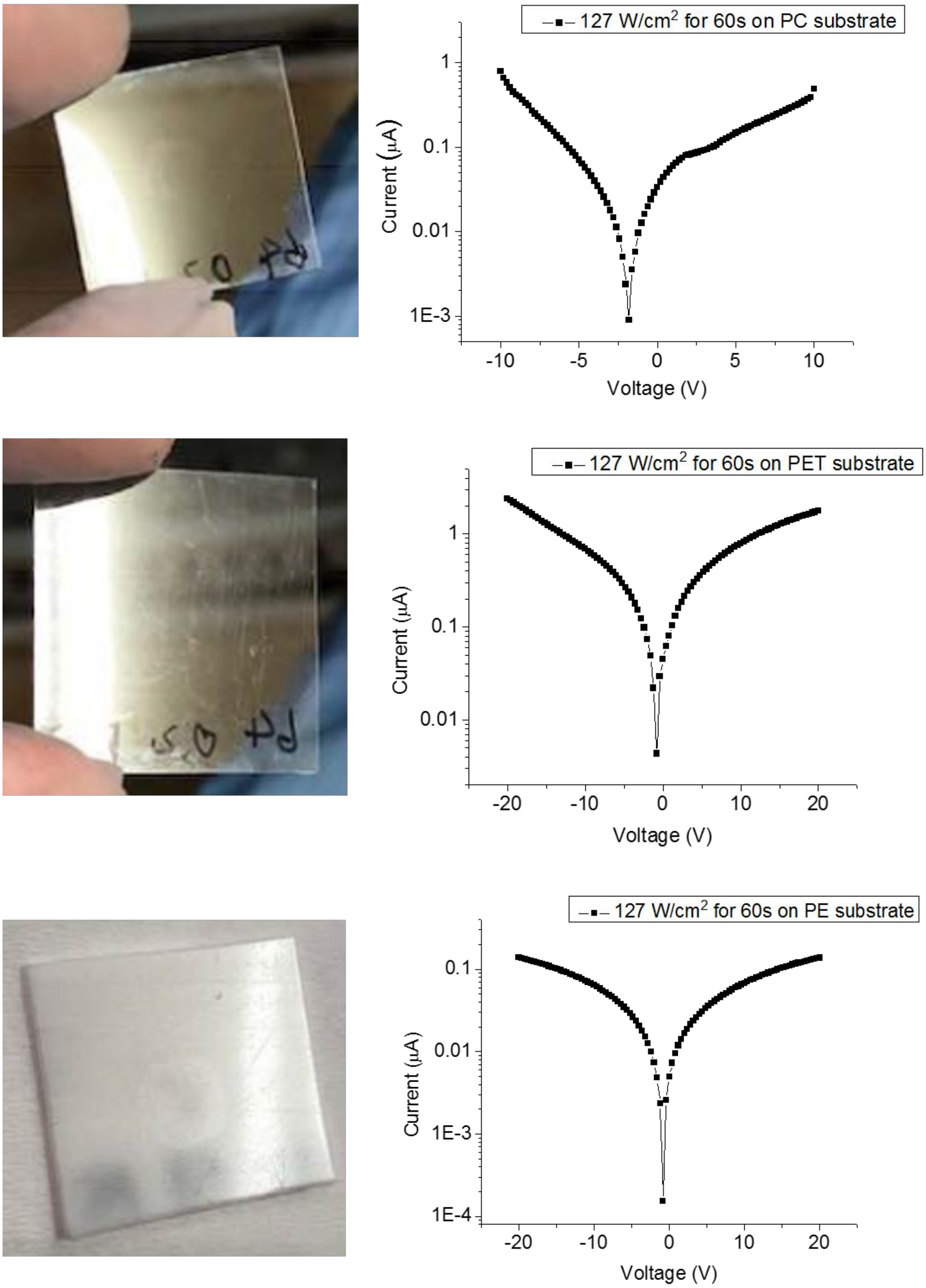


Figure S6. Photographs of samples and their electrical characteristics for PC, PET and PE substrates. NIR laser irradiation with power density of 127 W/cm^2 .

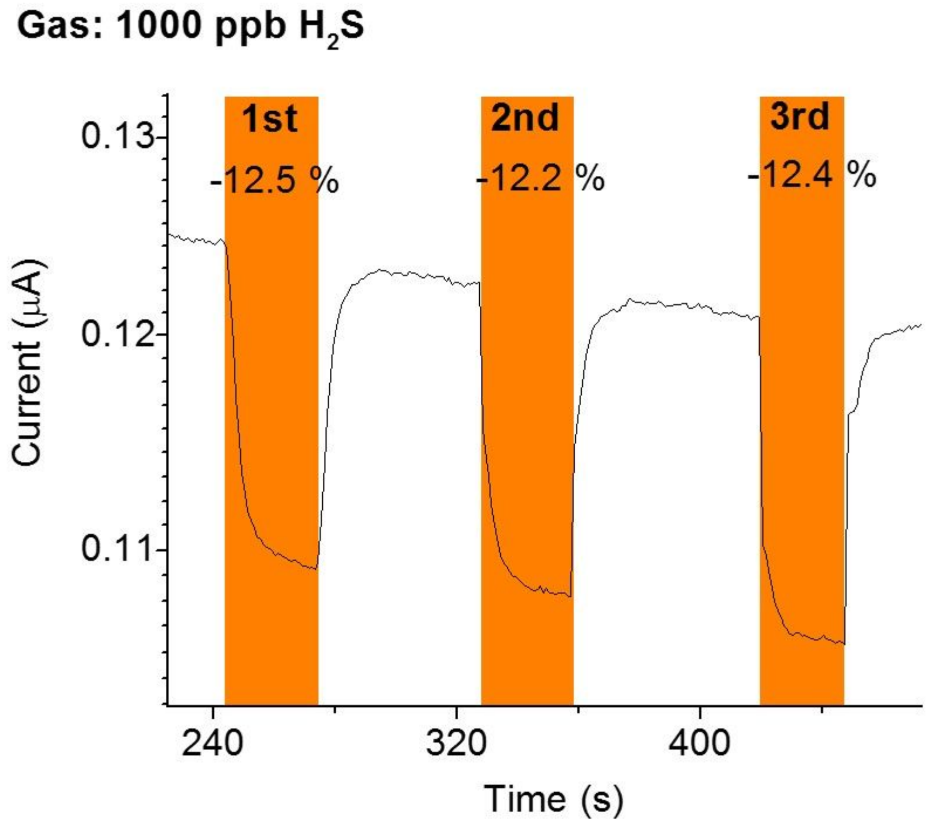


Figure S7. Current response under 1000 ppb H_2S (3 times gas measurements).

Table S2. Comparison of recent reports for H_2S sensors.

	Materials	Fabrication temperature	Operating temperature	Sensitivity	Flexible substrate
Joshi, Nirav, et al.(2014)	Gold modified polycarbazole film	R.T.	R.T.	1 ppm	Yes
Asad, Mohsen, et al. (2015)	Cu nanoparticle decorated SWCNTs	80°C	R.T.	5 ppm	Yes
Mousavi, Saeb, et al. (2016)	Electrospun polyaniline-polyethylene oxide nanofibers	250°C	R.T.	1 ppm	Yes
Li, Zhijie, et al.(2016)	Porous CuO nanosheets	600°C	R.T.	10 ppb	No
Wang, Yanrong, et al.(2016)	Cr-doped WO_3 microshperes	500°C	80°C	50 ppm	No
Tian, Kuan, et al.(2017)	Hierarchical and hollow Fe_2O_3 nanoboxed	400°C	50°C - 250°C	250 ppb at 200°C	No
Kim, Min-Hyeok, et al.(2018)	Porous WO_3 with Pt Catalysts	600°C	300°C-450°C	1 ppm	No
Our work	Thin film IZO	NIR Laser < 200°C	R.T.	300 ppb	Yes

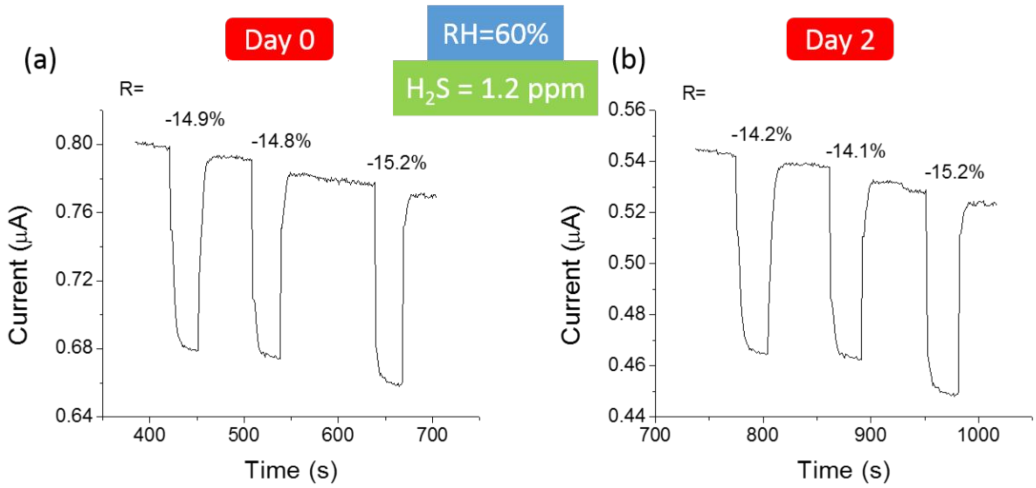


Figure S8. The 3-times repeated real-time sensing responses to 1.2 ppm H_2S when device was (a) just fabricated (noted as Day 0) and (b) stored in a food-storage-quality nitrogen bag for 2 days (noted as Day 2).