Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Electronic Supplementary Information

Deep ultraviolet to near-infrared photoresponse from glucose-derived graphene oxide

Sin Ki Lai,[a] Libin Tang, [ab] Yeung Yu Hui,[ab]Chi Man Luk[ab] and Shu Ping Lau*[ab]

[a]Department of Applied Physics, The Hong Kong Polytechnic University, Hung Hom, Kowloon, HKSAR.

[b]The Hong Kong Polytechnic University Shenzhen Research Institute, Shenzhen 518057, China.

E-mail: apsplau@polyu.edu.hk

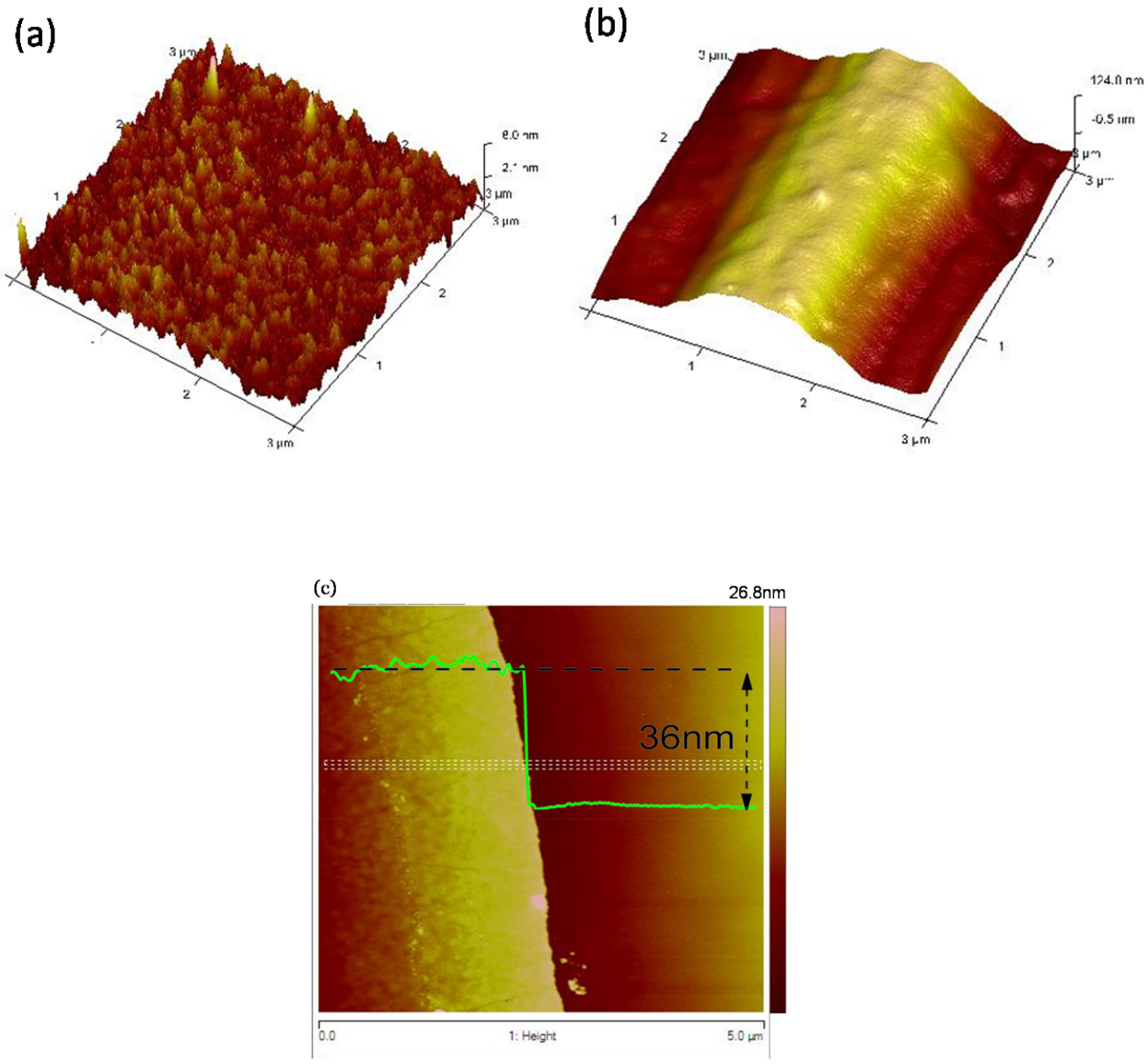

Fig. S1 AFM 3D topographic image for (a) a 450GO with RMS roughness 1.13 nm and (b) a 650GO, transferred to Si substrate from Cu foil with a RMS roughness of 51 nm. (c) Height profile of a 450GO with a synthesis time of 3 hrs and film thickness of 36 nm.

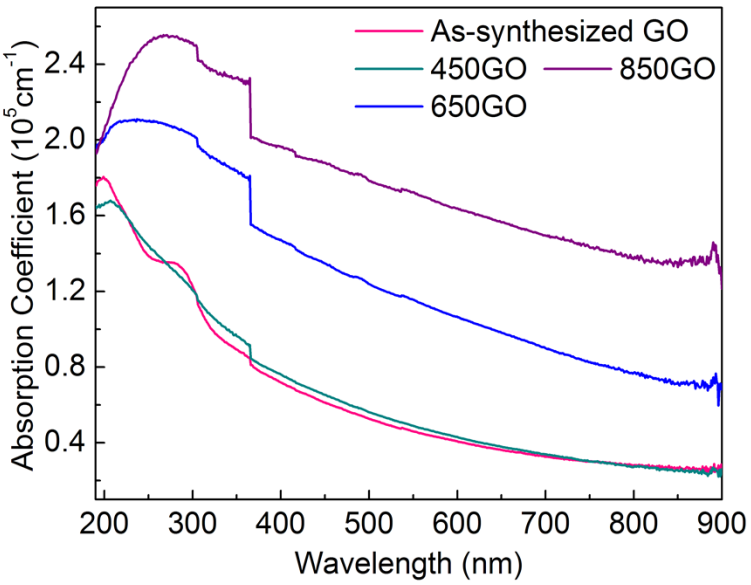

Fig. S2 Absorption coefficients against wavelength for GO of different annealing temperatures. GO of higher degree of reduction shows a stronger absorption in visible and NIR. Abrupt jump at about 365 nm is due to the change of light source in spectrometer but not the samples.

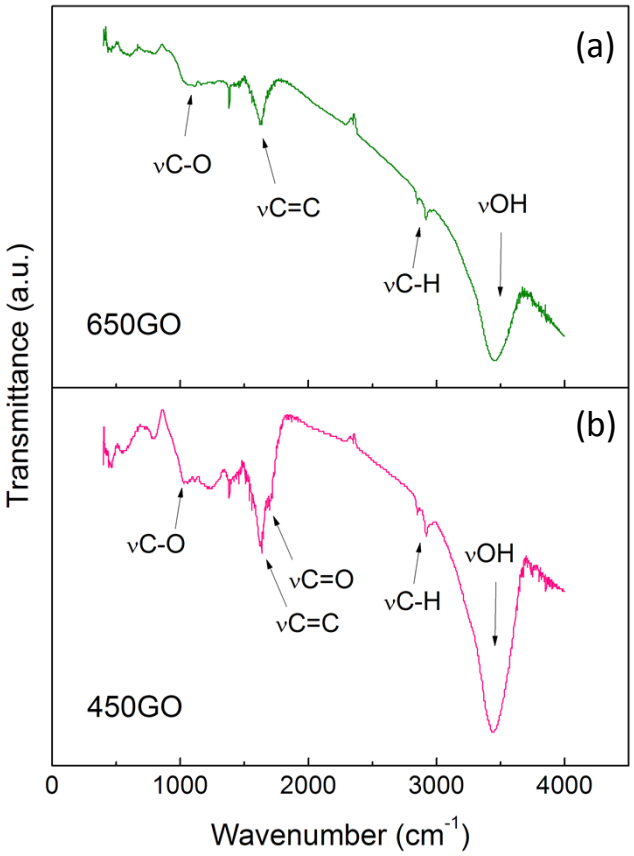

Fig. S3 FTIR spectra of (a) 650GO and (b) 450GO.

Fig.S3 (a)-(b) shows the FTIR spectra of 650GO and 450GO respectively. The peak at ~2920 cm^{-1} corresponds to the stretching of C-H.[1] Peaks at ~1710 and 1640 cm^{-1} are attributed to C=O in carboxylic group and C=C respectively. Absorption band at ~3400 cm^{-1} is due to –OH. Absorption peak at ~1040 cm^{-1} is attributed to C-O in hydroxyl group.[2] At higher annealing temperature, absorption peaks of C=O and C-O decrease in intensity, possibly due to a reduction in carboxylic group and hydroxyl group in RGO.

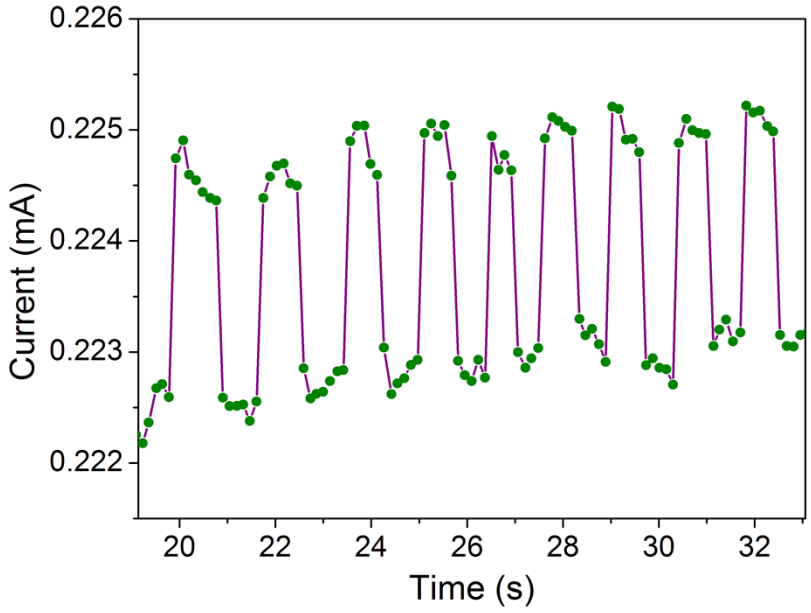

Fig. S4 Photoresponse of 700GO/450GO device under 410 nm excitation at 3.1 mW and 1 V bias. An increase in dark current at 1V bias is observed as compare to 650GO/450GO device.

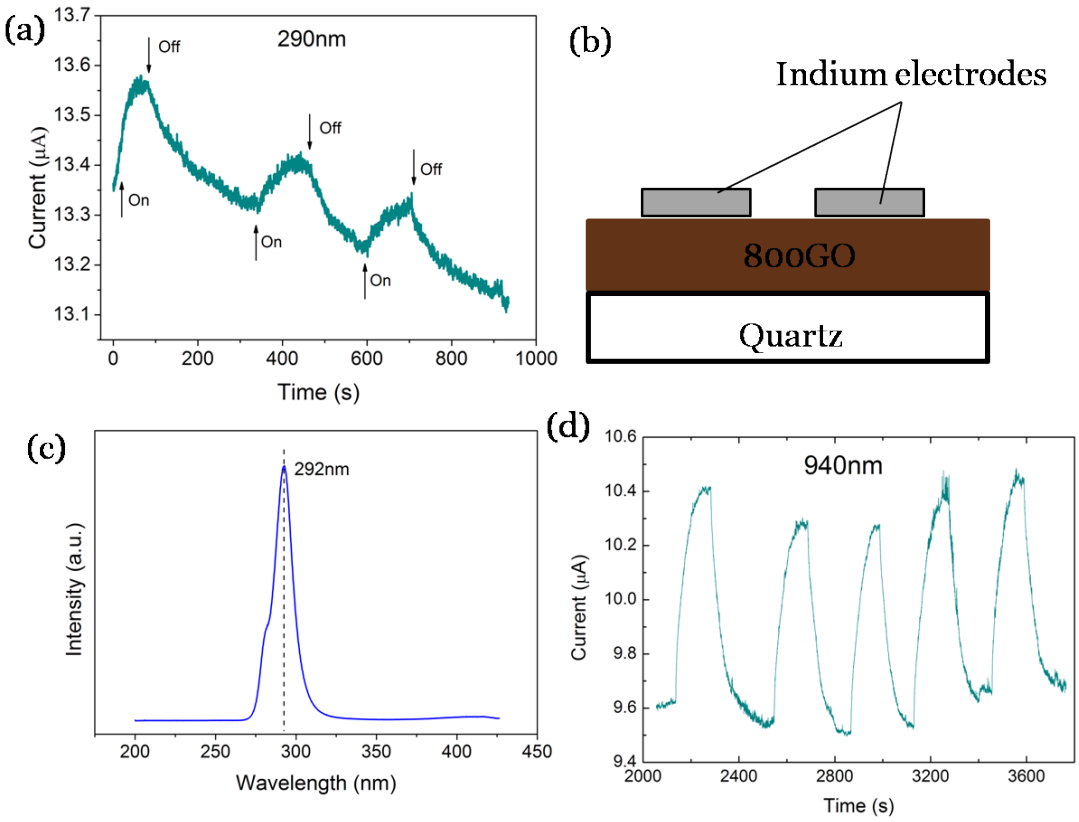

Fig. S5 (a) Deep UV photoresponse of the GO at 290 nm excitation measured with the planar structure device as shown in (b). (b) Device structure used to measure the photoresponse of GO at 290 nm illumination. ITO coated glass is opaque to 290 nm. (c) Electroluminescence (EL) spectrum of the 290 nm LED used in the measurements. Spectrum measured by Maya 2000 pro spectrometer with a range 200-400 nm. (d) Photoresponse of the device at 940 nm excitation.

Manufacturers and spectral characteristics of the light sources

Manufacturer of

275 nm LED: Shenzhen Sealand Opto-electronics Co., Ltd

375 nm LED: Shenzhen Chundaxin Photodelectric Co. Ltd.

410 nm LED: HaSun (HK) Optoelectronics Co., LTD.

660 nm, 940 nm LED: Shenzhen Xin Hua Kai photoelectric Co., Ltd.

1610 nm laser diode: Mitsubishi Electric Corp. ML925B22F-42-03A

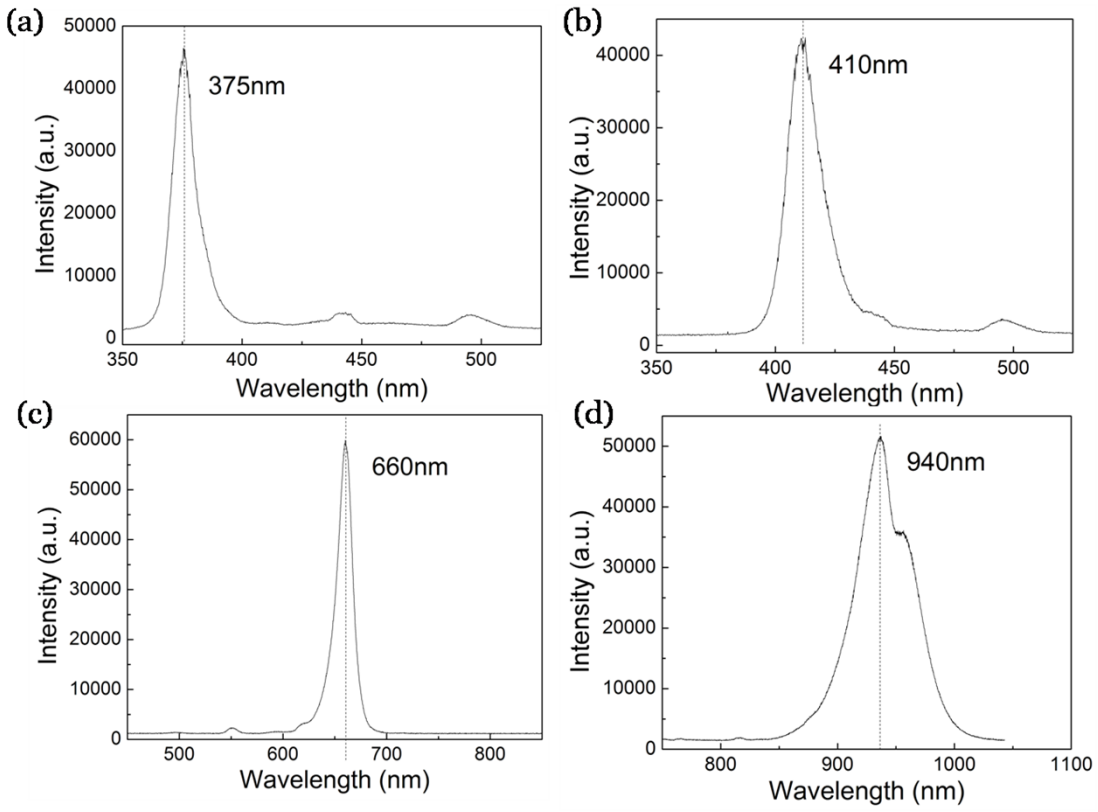

Fig. S6 EL spectra of various light sources with luminescence peak at (a) 375 nm, (b) 410 nm, (c) 660 nm and (d) 940 nm. Spectra are measured with Ocean Optics USB4000 VIS-NIR spectrometer with a range 350 – 1050 nm.

Table S1
Electrical properties of GO at different annealing temperatures

Annealing temperature (^oC)	Resistivity (Ωcm)	Electron mobility ($cm^2V^{-1}s^{-1}$)
600-700	10^2-10^3	10^{-1}
800-900	10^{-1}	10^0
900-1000	10^{-3}	10^0

Electrical measurements were carried out in Hall measurement system (Ecopia HMS 5000).

Table S2

Magnitude of photocurrent over on/off cycles up to about 48 s in Fig. S7 under 410 nm excitation

On/Off Cycle Number	Magnitude of photocurrent (nA)
1	19.59
2	18.44
3	18.12
4	17.61
5	18.63
6	17.37
7	18.01
8	17.12
9	17.52
10	17.61
11	17.81
12	17.25
13	17.71
14	17.51
15	17.90
16	17.15
17	17.20
18	17.21

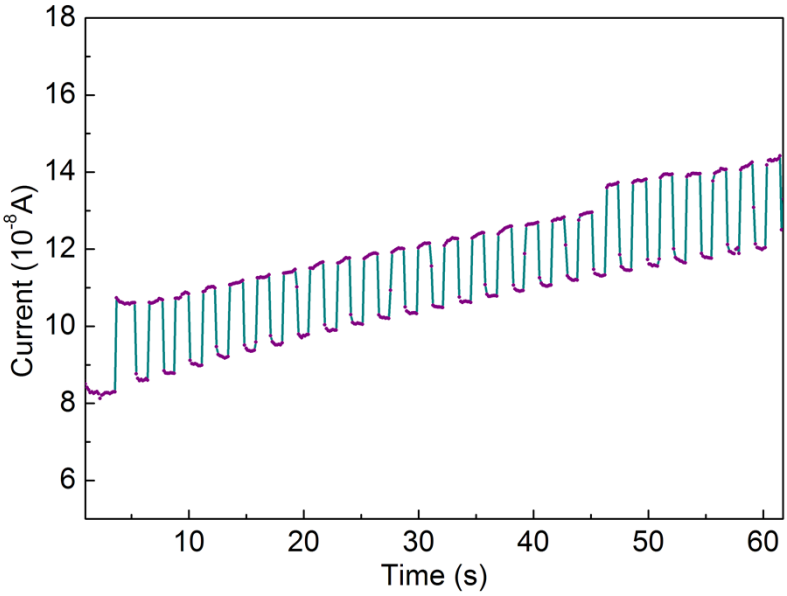

Fig. S7 Photoresponse under 0.432 Hz on/off light cycles at 410 nm. The increase in photocurrent beyond about 48 s is due to an increase in bias voltage.

Although the dark current increases in a slow manner under an applied bias, the magnitude of the photocurrent is almost constant as tabulated in Table S2 with a standard deviation of 0.63.

References

1. L. Tang, X. Li, R. Ji, K. S. Teng, G. Tai, J. Ye, C. Wei and S. P. Lau, *J. Mater. Chem.*, 2012, **22**, 5676-5683.
2. C. Liu, F. Hao, X. Zhao, Q. Zhao, S. Luo and H. Lin, *Sci. Rep*., 2014, **4**, 3965