Supporting Materials

Deciphering Photocurrent Polarity of Bi_2O_2Se Heterojunction Phototransistors to Enhance Detection Performance

Jiayue Han,[a] Xingwei Han,[a] Chaoyi Zhang,[a] Silu Peng,[a] Chao Han,[a] Xingchao Zhang,[a] Xianchao Liu,[a] Xiaoyang Du,[a] Jun Gou[a,b,] and Jun Wang[a,b,]**

a. School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China, Chengdu 610054, China

b. State Key Laboratory of Electronic Thin Films and Integrated Devices, University of Electronic Science and Technology of China, Chengdu 610054, China

E-mail: goujun@uestc.edu.cn, wjun@uestc.edu.cn

Key words:

Phototransistors, photocurrent polarity analysis, graphene/Bi_2O_2Se heterojunction, tunneling injection, band structure calculation

1. The EDS, UPS and absorption spectrum.

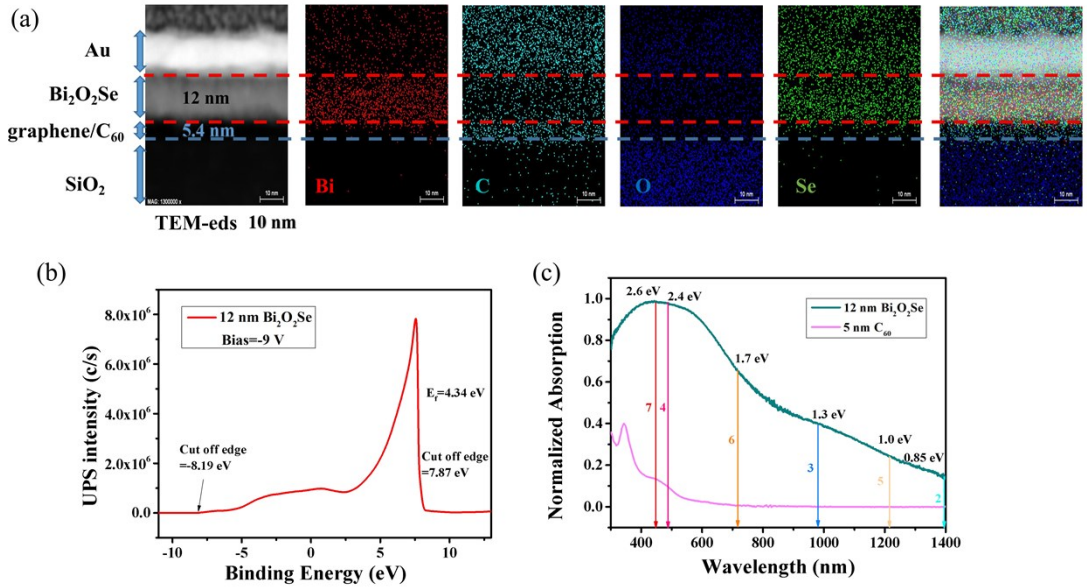


Fig. S1. (a) The EDS of our device can distinguish 12 nm Bi_2O_2Se and 5.4 nm graphene/C_{60}. (b) The UPS spectra of bare Bi_2O_2Se (c) The absorption spectrum of 5 nm C_{60} and 12 nm Bi_2O_2Se, respectively.

2. The IV curve of graphene/C_{60}/Bi_2O_2Se

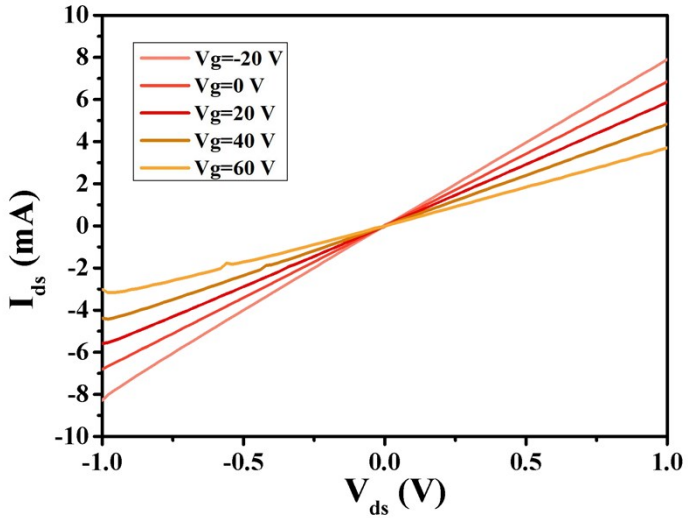
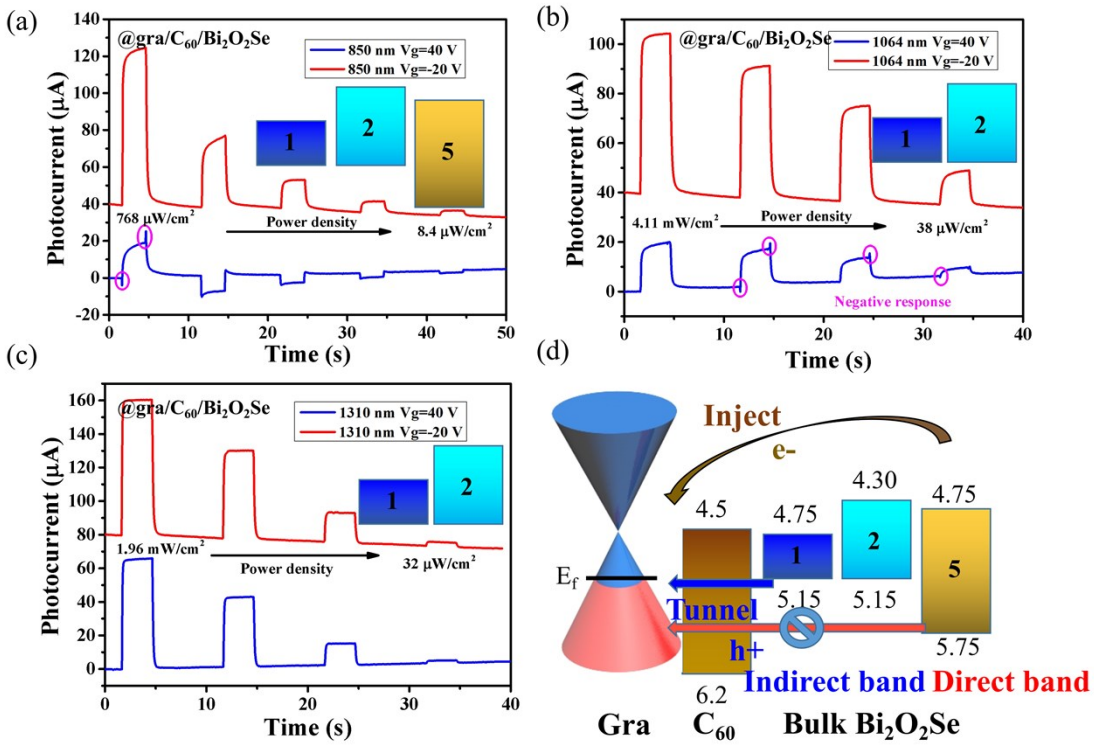


Fig. S2. The IV curve as the function of Vg.

3. The polar photocurrent discrimination of graphene/C_{60}/Bi_2O_2Se



(a,b,c) Transient power dependent photocurrent measurements at wavelengths of 850, 1064 and 1310 nm with 40 V and -20 V Vg in graphene/C_{60}/Bi_2O_2Se. (d) Band diagram of graphene/C_{60}/Bi_2O_2Se.

4. Transient photocurrent measurements at increasing gate voltages (Gra/Bi_2O_2Se)

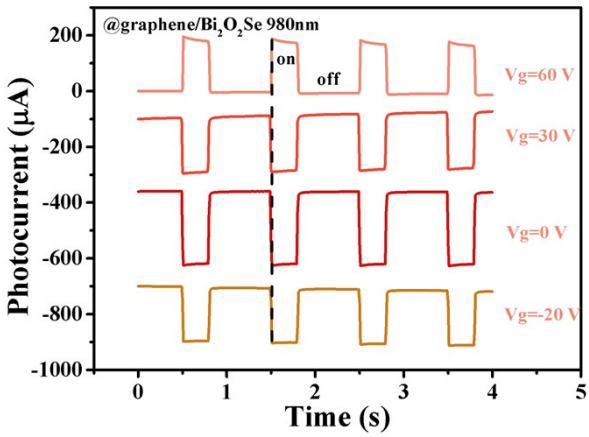


Fig. S4. Transient photocurrent measurements at increasing gate voltages in graphene/Bi_2O_2Se, the power density=15 mW/cm^2.

5. The noise spectrum and dynamic response time of graphene/Bi_2O_2Se

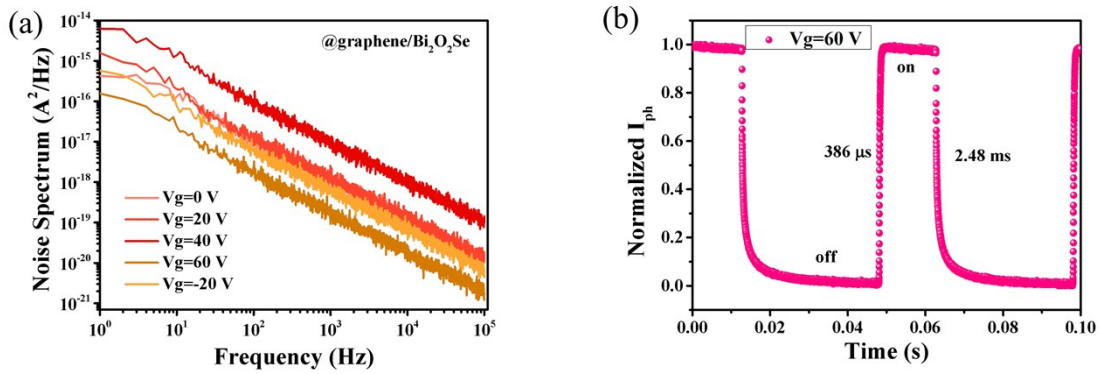


Fig. S5. (a) The 1/f noise analysis of the device for different Vg values. (b) The dynamic response time of graphene/Bi_2O_2Se with variation of Vg= 60 V, interval: 10 µs.

6. The photoresponse and noise of graphene/C_{60}/Bi_2O_2Se and graphene/Bi_2O_2Se

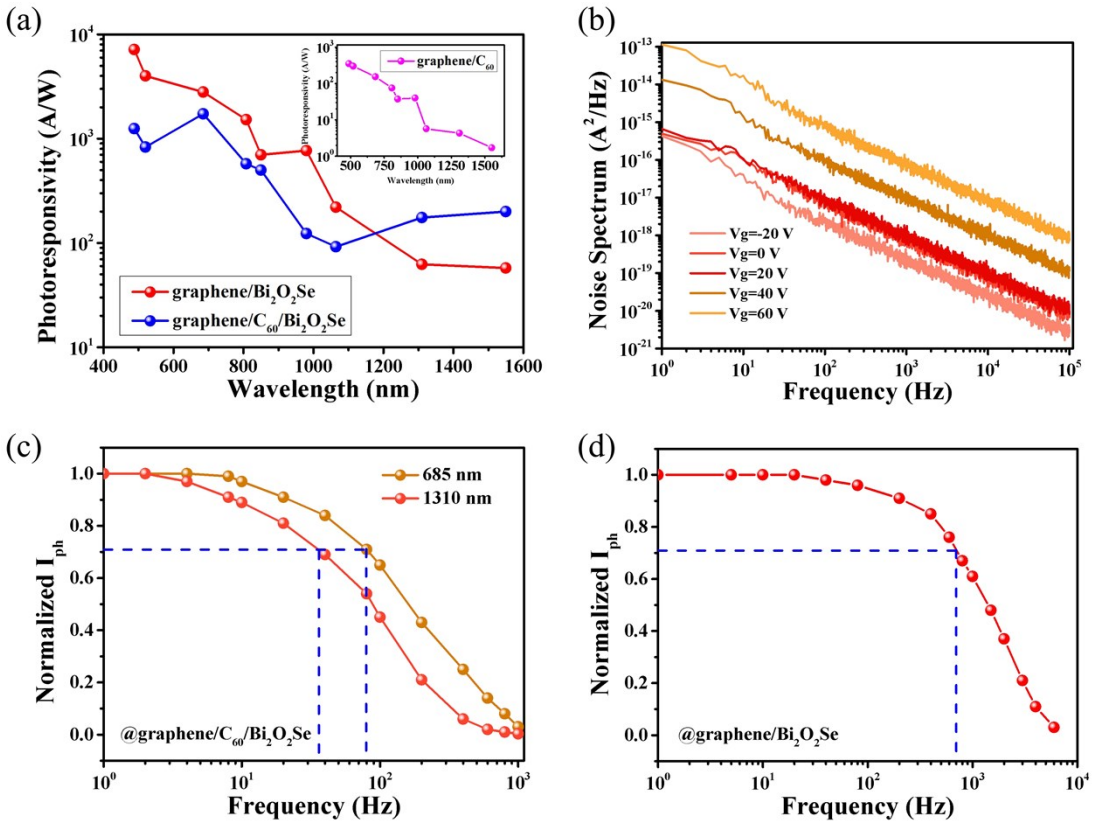


Fig. S6. (a) The comparison of spectral photoresponse in graphene/C_{60}/Bi_2O_2Se and graphene/Bi_2O_2Se, the inset is the photoresponse of graphene/C_{60}. (b) The 1/f noise analysis of the device for different Vg values. (c,d) Normalized photo-currents with the variation of operated frequency.

7. Thickness dependent performance and response time of graphene/C_{60}/Bi_2O_2Se

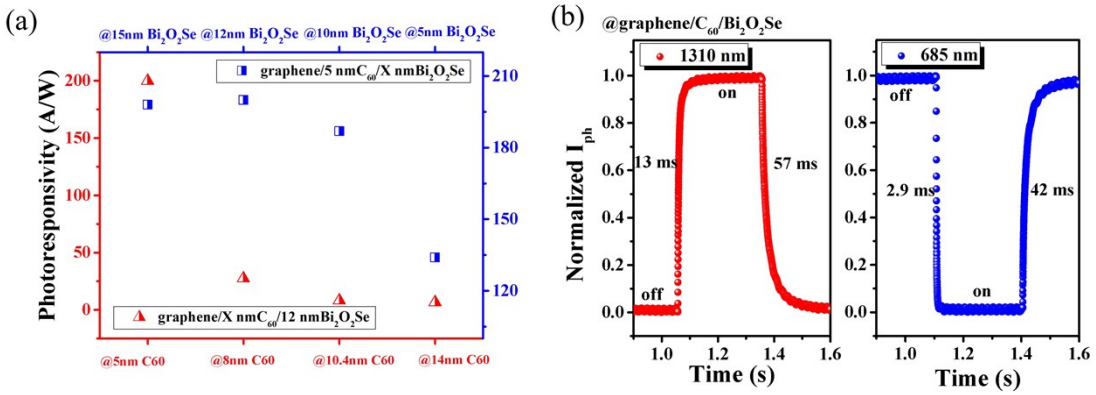


Fig. S7. (a) The thickness dependent performance. (b) The response time of graphene/C_{60}/Bi_2O_2Se with variation of Vg= 0V

8. The stability of graphene/C_{60}/Bi_2O_2Se

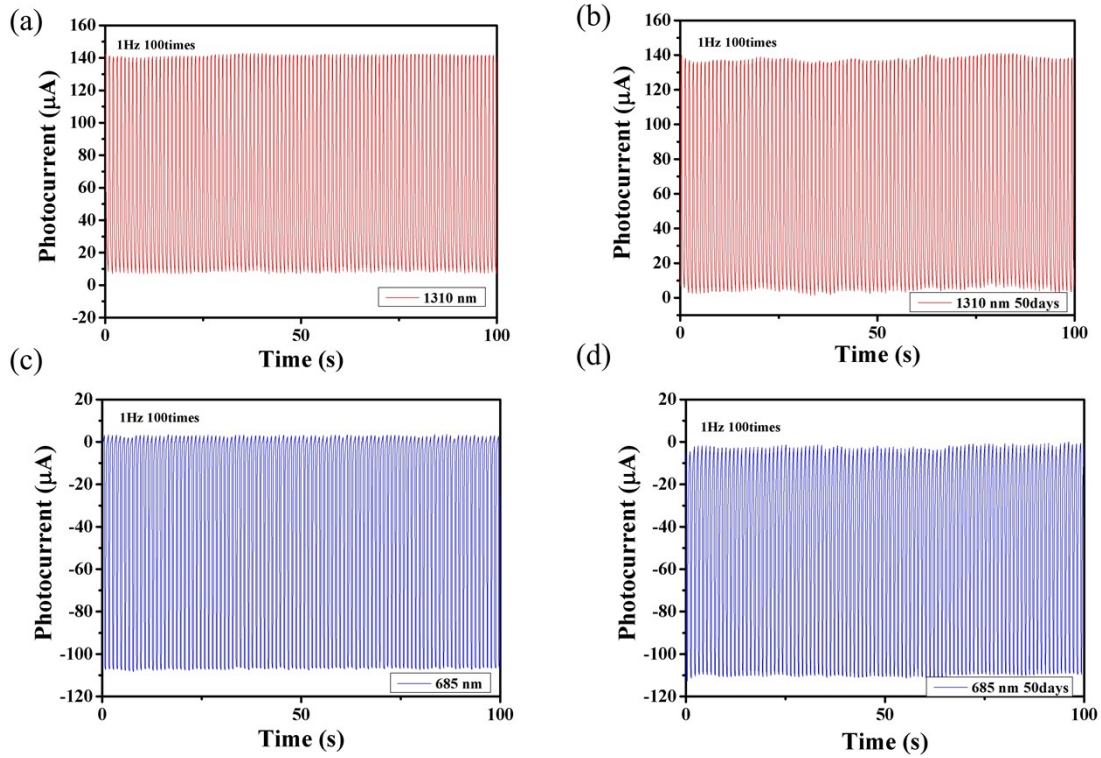


Fig. S8. (a,b) The detection stability of graphene/C_{60}/Bi_2O_2Se at 1310 and 685 nm. (c,d) And after 50 days, the stability of graphene/C_{60}/Bi_2O_2Se.