Supporting Information

Title

Ultrahigh Photosensitive Organic Phototransistors by Photoelectric Dual Control

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Supplementary Figures

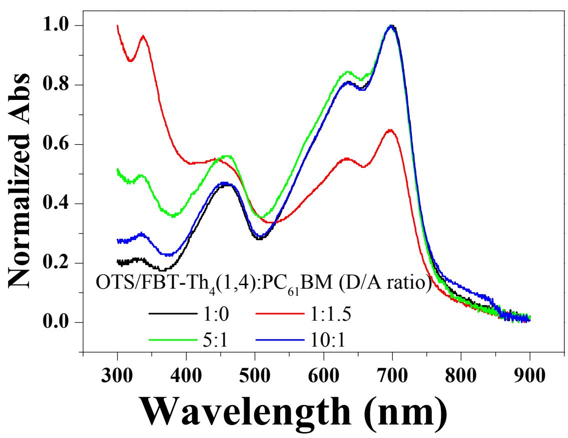

Figure S1. Optical extinction spectra of devices doped with different $PC_{61}BM$ ratios with Quartz/OTS/FBT-Th_4(1,4):$PC_{61}BM$ (D/A ratio) structure.

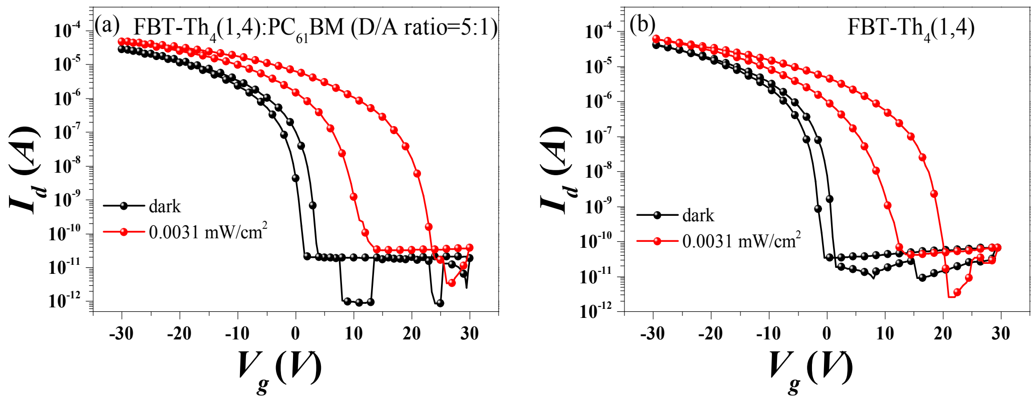

Figure S2. The transfer characteristic curves of organic phototransistor in dark and under light. (a) FBT-Th_4(1,4):PC_{61}BM device (Si /SiO_2 /OTS /FBT-Th_4(1,4):PC_{61}BM (D/A ratio = 5:1) (180 nm) /Au electrodes), (b) FBT-Th_4(1,4) device (Si /SiO_2 /OTS /FBT-Th_4(1,4) (190 nm) /Au electrodes). Here, the weak light were provided by diode pumped crystal laser with a wavelength of 405 nm.

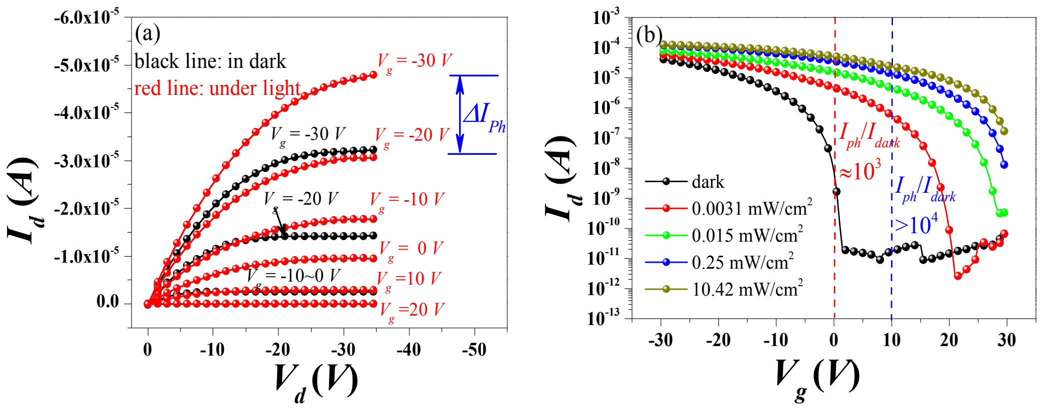

Figure S3. (a) the contrastive output characteristic curves of organic phototransistor with Si /SiO_2 /OTS /FBT-Th_4(1,4) (190 nm) /Au electrodes structure (logogram as the FBT-Th_4(1,4) device) in the dark and under weak photo-irradiation (0.0031 mW/cm^2), (b) the transfer *I*-*V* characteristic curves of the FBT-Th_4(1,4) device in dark and under different light intensity. The different light intensities were provided by diode pumped crystal laser with a wavelength of 405 nm.

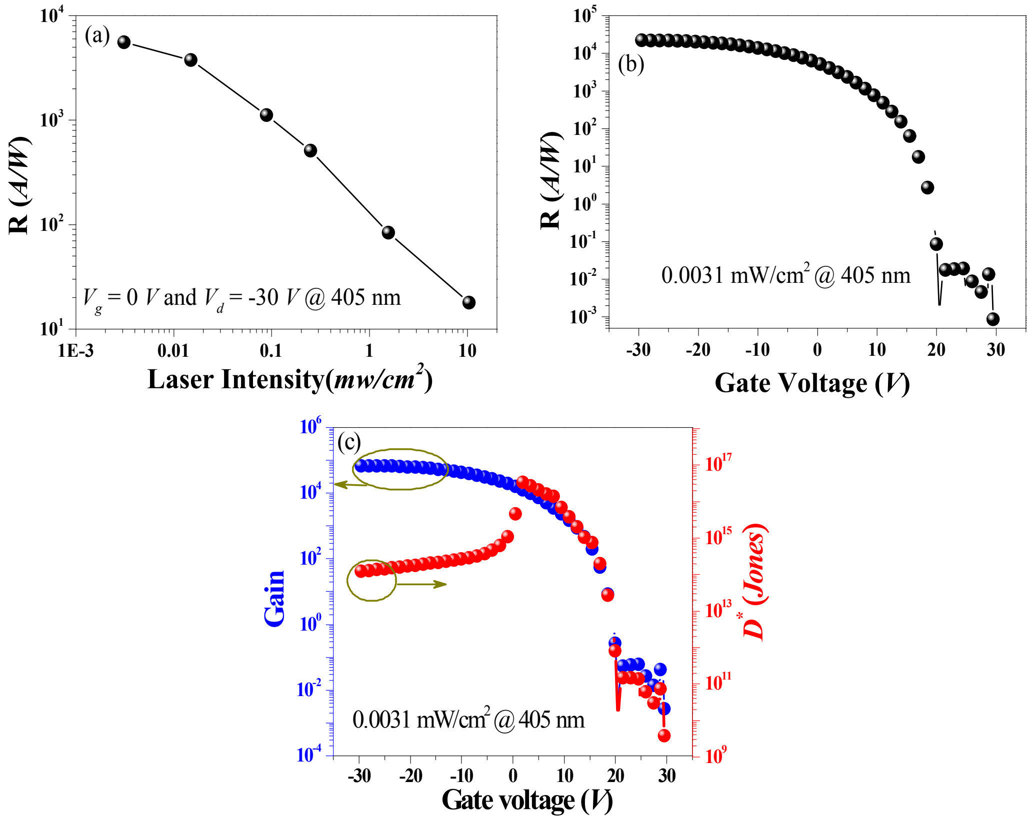

Figure S4. The photodetector parameters of OPT Si /SiO_2 /OTS /FBT-Th_4(1,4) /Au electrodes structure (FBT-Th_4(1,4) control device): (a) the responsivity dependent on light intensity under V_g = 0 V and V_d = -30 V; (b) the responsivity dependent on gate voltage under 0.0031 mW/cm^2; (c) the dependence of the gain and specific detectivity on gate voltage under 0.0031 mW/cm^2. Here, the different light intensities were provided by diode pumped crystal laser with a wavelength of 405 nm.

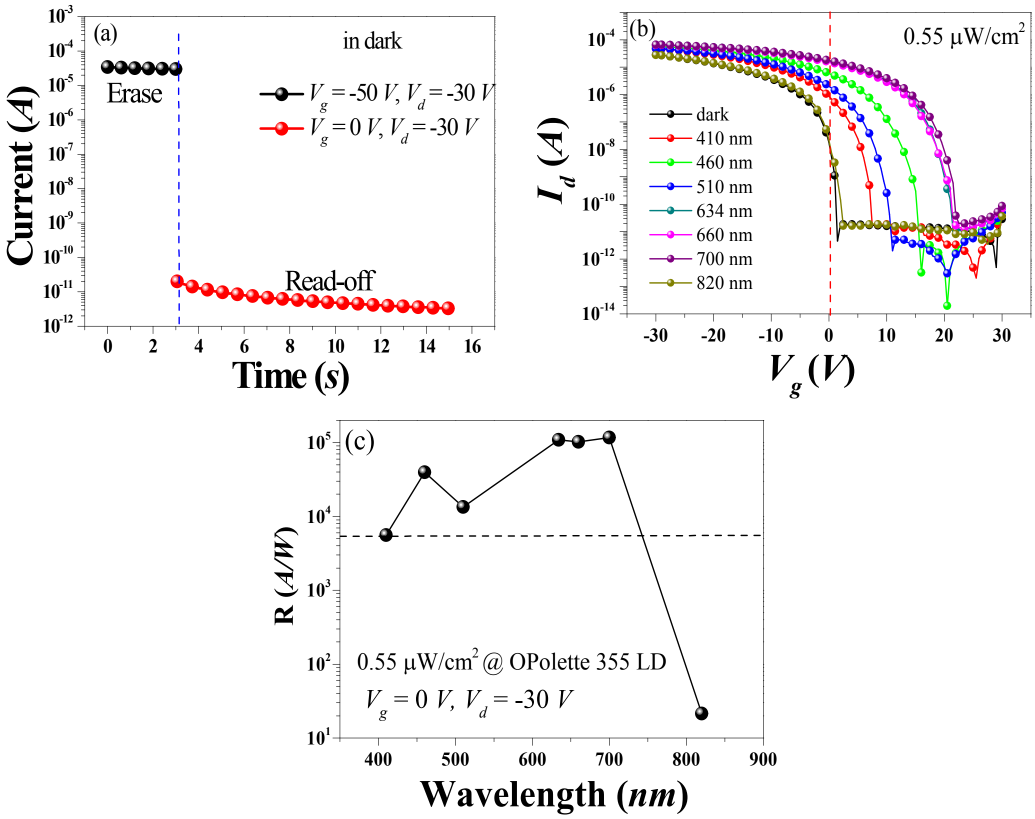

Figure S5. (a) Current-time characteristics for device initialization operation processes (erasing and reading (off-state)) based on V_d = -30 V, the gate voltages for different steps as marked in figures; (b) the transfer *I-V* characteristic curves of the FBT-Th_4(1,4):$PC_{61}BM$ device in dark and under different wavelength light source (0.55 μW/cm^2). (c) the dependence of the responsivity on the wavelength of OPT at V_g = 0 V and V_d = -30 V under 0.55 μW/cm^2. Here, the different light wavelength was provided by a continuous spectrum light source at 20 Hz (Opolette 355 LD). Before test the transfer *I-V* characteristic curves under different wavelength light, the current-time characteristics for device initialization operation processes (erasing and reading (off-state)) based on V_d = -30 V should be executed as shown in Figure S4a.

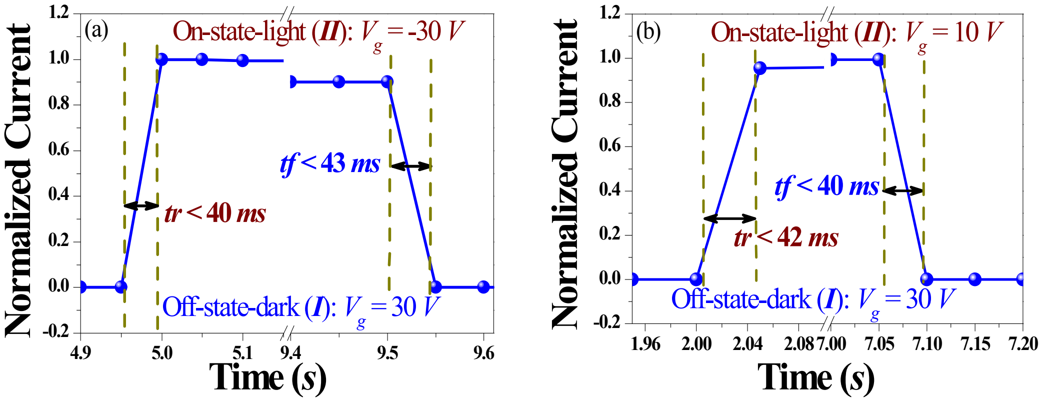

Figure S6. Normalized time-current curve of FBT-Th_4(1,4):$PC_{61}BM$ deivce at constant source drain voltage (V_d = -30 *V*) under light excitation (0.0031 mW/cm^2). (a) on-state gate voltage (OSGV) V_g = -30 *V* and off-state gate voltage V_g = 30 *V*; (b) on-state gate voltage (OSGV) V_g = 10 *V* and off-state gate voltage V_g = 30 *V*. Here, the weak light were provided by diode pumped crystal laser with a wavelength of 405 nm. The on-state-light (*II*) means the device work in light with V_g = 0 *V* and V_d = -30 *V*; The off-state-dark (*I*) means the device work in the dark with V_g = 30 *V* (or *10 V*) and V_d = -30 *V*.

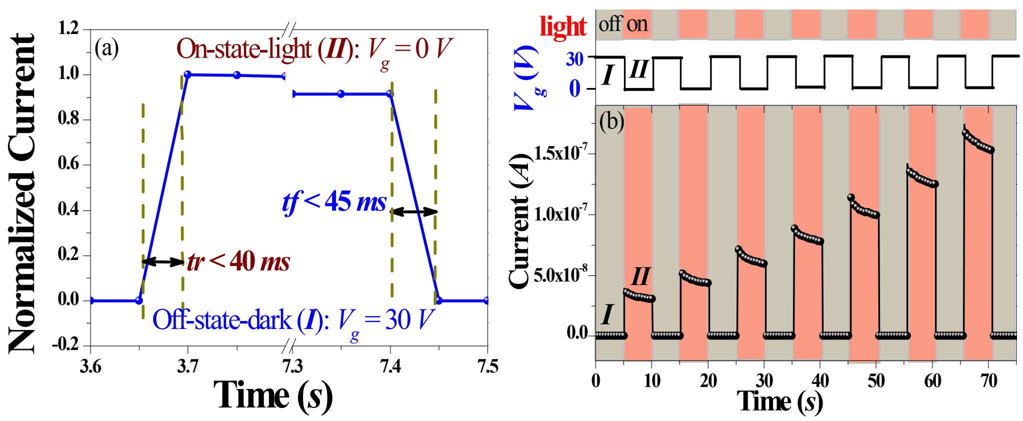

Figure S7. (a) normalized time-current curve and (b) current-time curve of FBT-Th_4(1,4) control deivce at on-state gate voltage (OSGV) V_g = -30 *V* and off-state gate voltage V_g = 30 *V* under light excitation (0.0031 mW/cm^2). Here, the weak light were provided by diode pumped crystal laser with a wavelength of 405 nm. *I* represents the off-state, *II* represents the on-state. Synchronous optical programming and gate voltage programming were shown in upper part in Figure S7a,b. The source-drain voltage is maintained at V_d = -30 *V* in both *I* and *II* process throughout the test.