# Electronic Supplementary Information (ESI) for:

## Hierarchical Thornbush-like Organic Nanostructures via Surface Grafting for High-Performance Multi-level Photomemory Devices

Hojeong Yu, [‡a] Inho Song, [‡b] Sangwook Lee,[a] Ji Hyung Jung,[a] Joon Hak Oh[a]

[a]School of Chemical and Biological Engineering, Institute of Chemical Processes, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea. E-mail: joonhoh@snu.ac.kr

[b]Department of Chemical Engineering, Chung-Ang University (CAU), Seoul 06974, Republic of Korea.

[‡]Hojeong Yu and Inho Song equally contributed to this work.

## Supplementary Figures

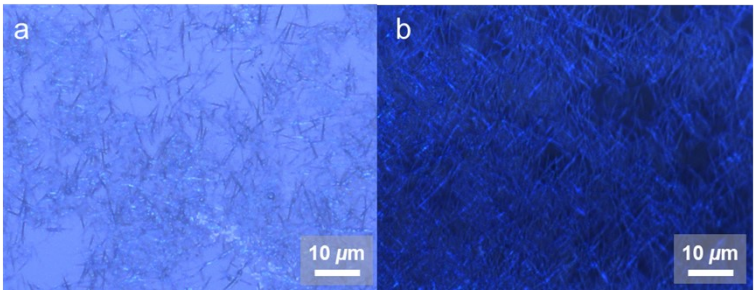


**Figure S1.** (a) A bright-field and (b) a dark-field optical microscope image of pure TCPP MWs fabricated by direct acidification of TCPP in aqueous solution.

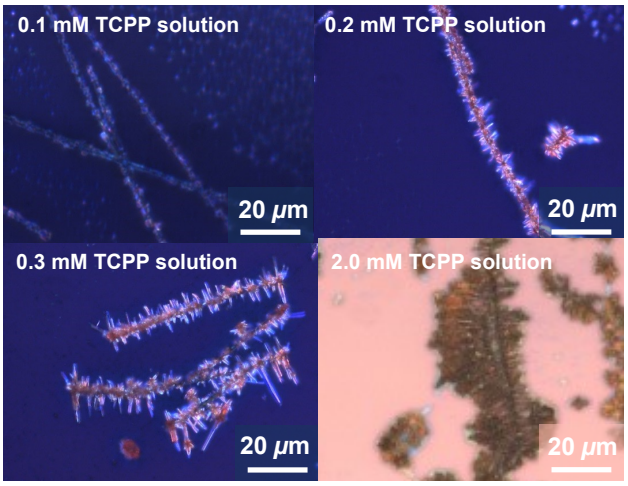


**Figure S2**. Dark-field optical microscope image of TCPP/BPE-PTCDI MWs fabricated with different concentration of TCPP solutions; 0.1 mM, 0.2 mM, 0.3 mM, and 2.0 mM.

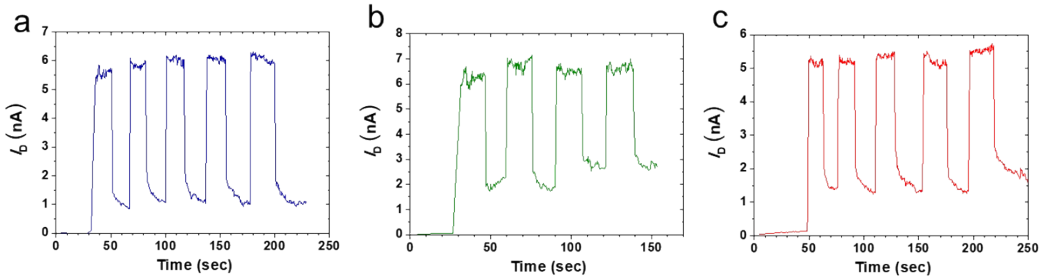


**Figure S3**. The on/off switching of TCPP/BPE-PTCDI MW-FETs ($W/L$= 0.049) upon (a) blue light illumination, (b) green light illumination, and (c) red light illumination with optical power density of 500 $\mu$Wcm$^{-2}$. The on/off switching was measured at $V_{GS}$ = 0 V and $V_{DS}$ = 80 V.

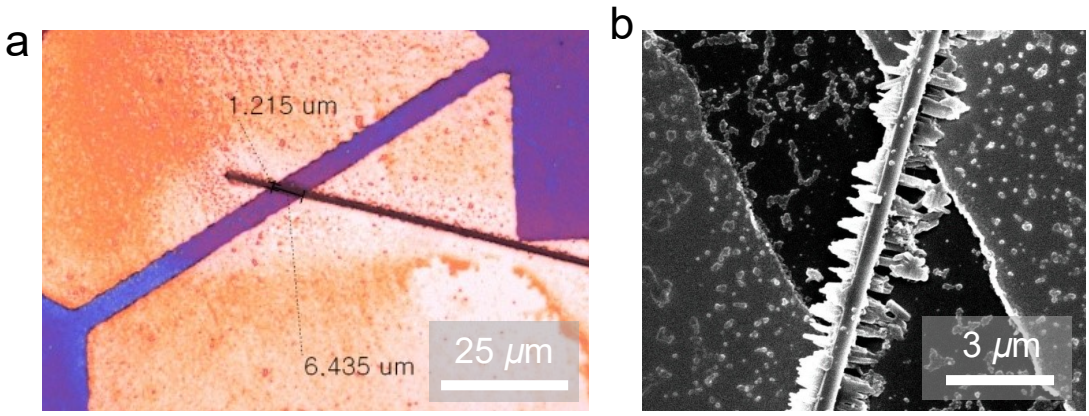


**Figure S4**. (a) An optical microscope image and (b) a SEM image of an actual measured TCPP/ BPE-PTCDI MW device which have the single MW positioned across the source and drain electrodes.

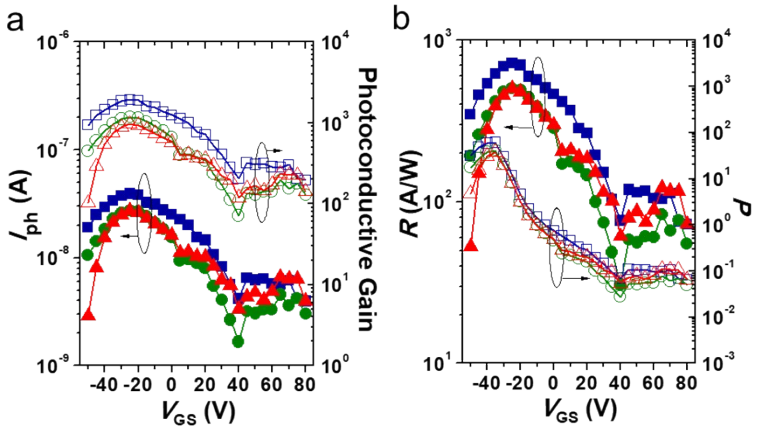


**Figure S5**. (a) Photocurrent and photoconductive gain of a TCPP/BPE-PTCDI MW-OPTs as a function of $V_{GS}$ (-50 V to 80 V) measured with $V_{DS}$ = 80 V under light illumination; 460 nm (blue), 530 nm (green), 670 nm (red) with optical power density of 500 $\mu$Wcm$^{-2}$. (b) The corresponding light responsivity ($R$) and photocurrent/dark-current ratio ($P$) variations of the device.

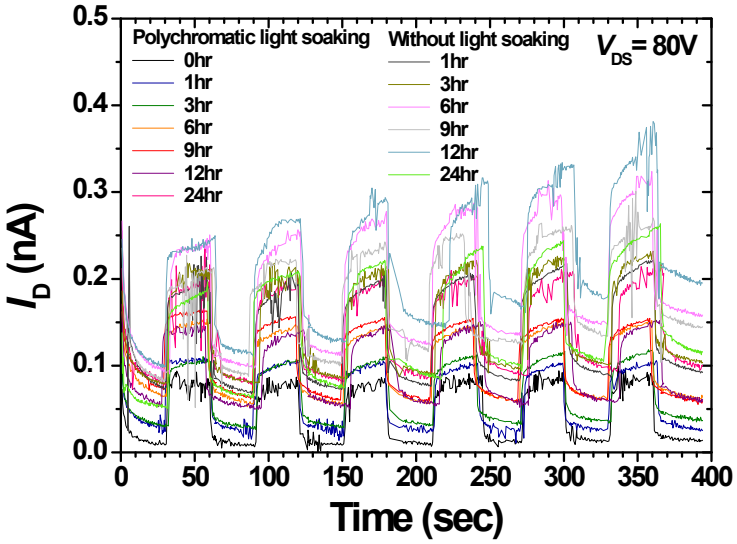


**Figure S6**. The on/off switching of TCPP MW-devices upon polychromatic light soaking and decay treatment. The on/off switching was measured at $V_{GS}$ = 0 V and $V_{DS}$ = 80 V.

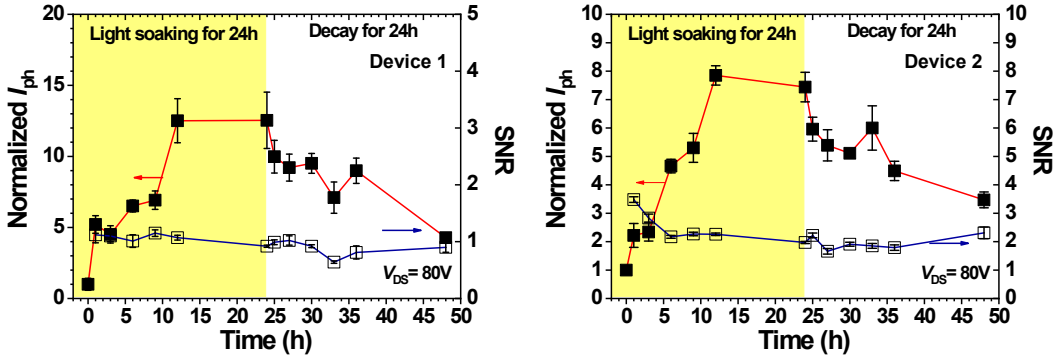


**Figure S7**. Normalized $I_{ph}$ variations under the polychromatic light soaking and decay treatment and signal to noise ratio (SNR) values obtained from the on/off switching of polychromatic light in two individual devices. The on/off switching was measured at $V_{GS}$ = 0 V and $V_{DS}$ = 80 V. The devices were stored in the dark for light decay treatment. Each data point represents the average value of 5 times of on/off switching.

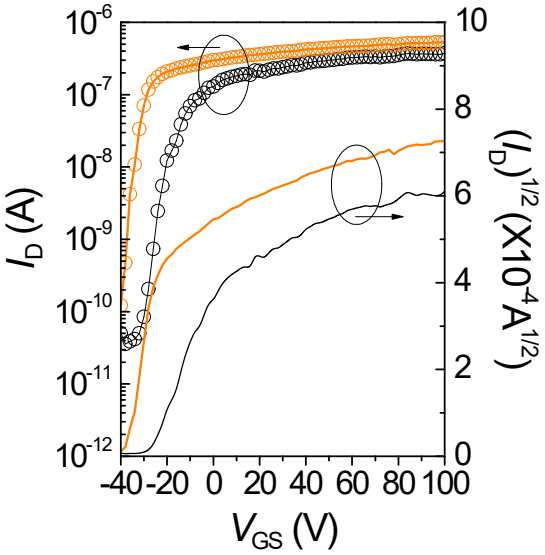


**Figure S8**. The transfer curves of the TCPP/BPE-PTCDI MW-FET for pristine (black) and illuminated (yellow) conditions with reaching extremely high $\mu_e$ from 1.4 $cm^2V^{-1}s^{-1}$ up to 6.1 $cm^2V^{-1}s^{-1}$ at $V_{DS}$ = 100 V ($W/L$= 0.039).

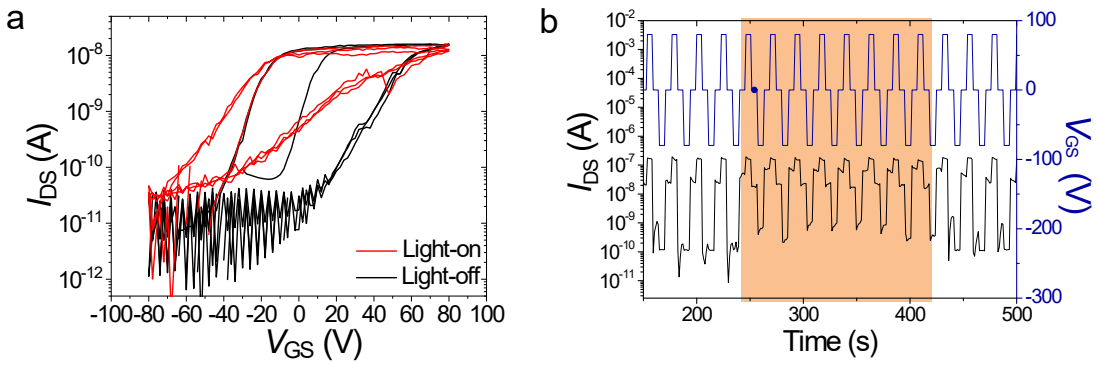


**Figure S9**. Transfer characteristics of (a) pure BPE-PTCDI MW-OPMs, where $V_{GS}$ = -80 and 80 V were applied for the programming and erasing procedures, at $V_{DS}$ = 40 V. The red and black lines indicate properties under polychromatic light on (15 mWcm$^{-2}$) and off conditions, respectively. (b) Current response to the WRER cycles of the BPE-PTCDI MW-OPMs. The drain current was measured at $V_{DS}$ = 40 V. The writing, reading and erasing were at the gate voltages of -80, 0, and 80 V, respectively. The red shades indicate polychromatic light on conditions (15 mWcm$^{-2}$).