Covalent Organic Polymer Based Transistor with Multifunctional Memory and Synaptic Functions

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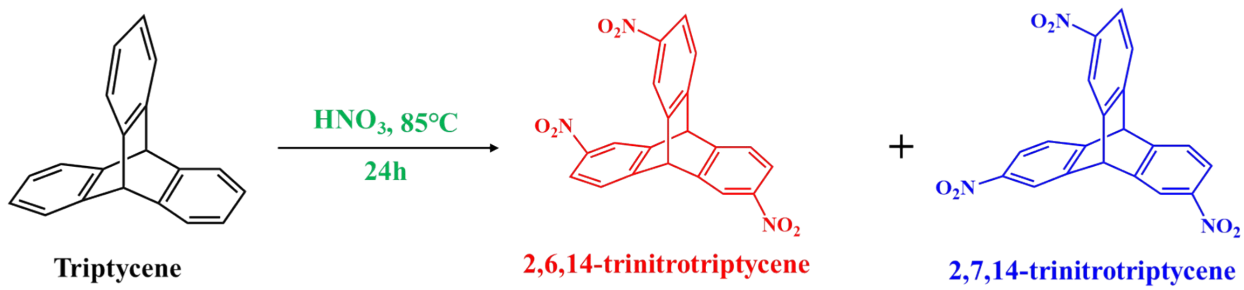
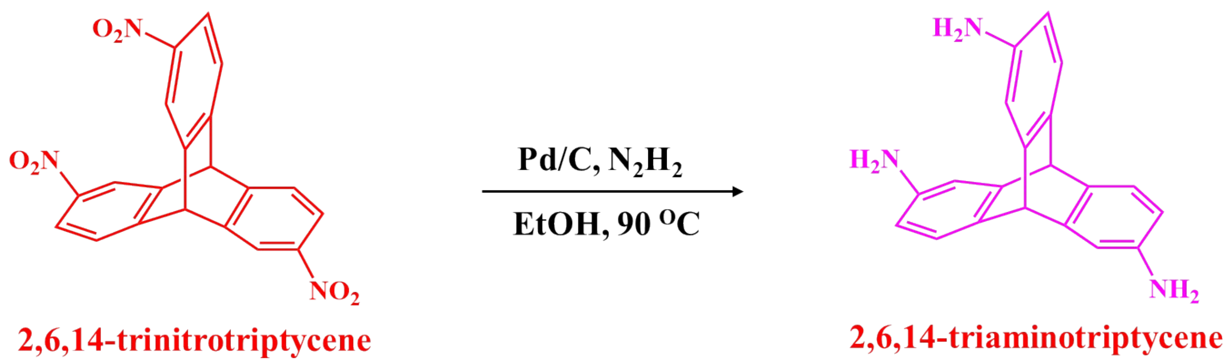


Scheme S1. Synthesis of Trinitrotriptycene.



Scheme S2. Synthesis of 2,6,14-Triaminotriptycene.

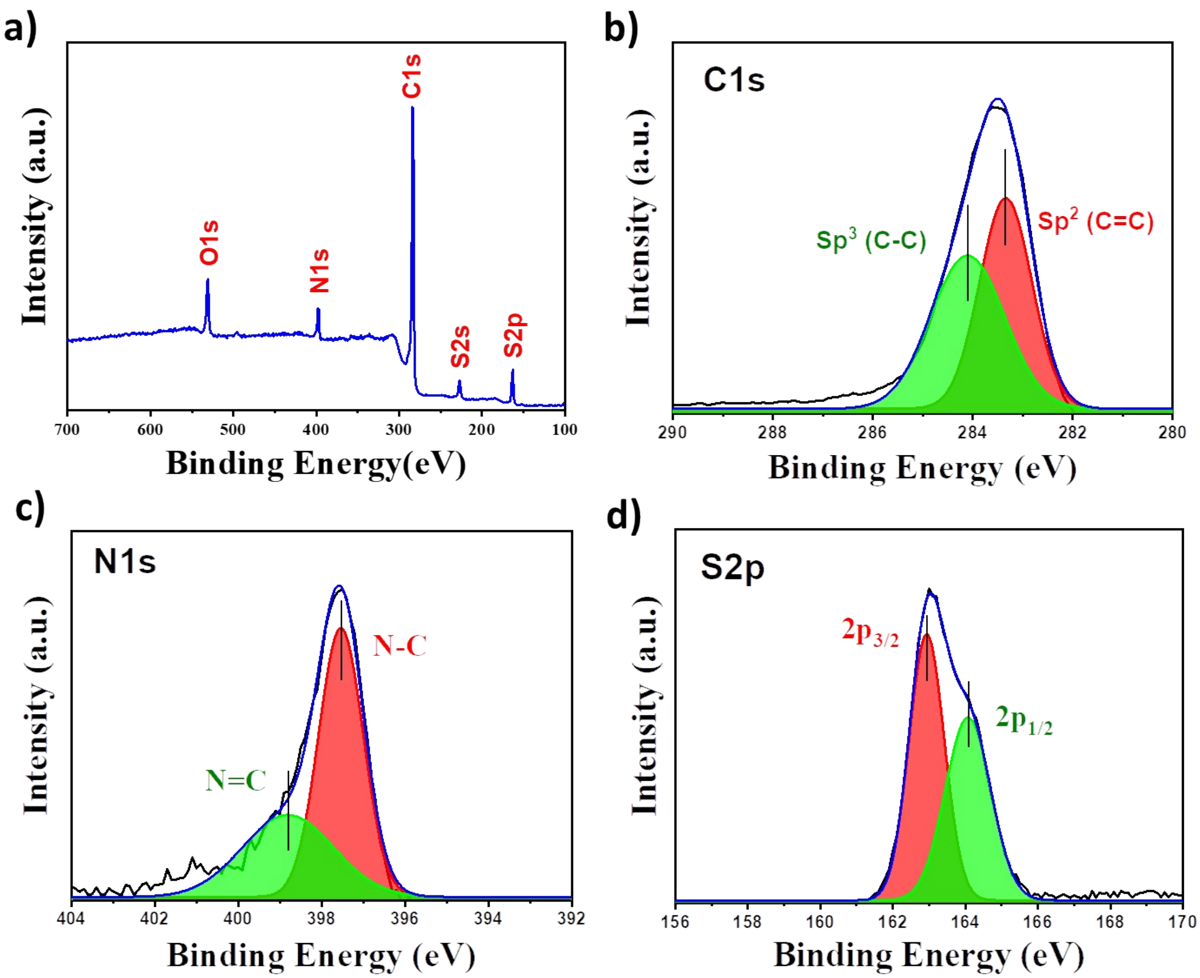


Figure S1. (a) XPS spectra and high-resolution spectra of (b) C 1s, (c) N 1s, and (d) S 2p peaks for MT-TP.

Table S1. X-ray photoelectron spectroscopy data of MT-TP.

Polymer	C1s	N1s	O1s	S2p
MT-TP	84.36	5.39	7.08	3.17

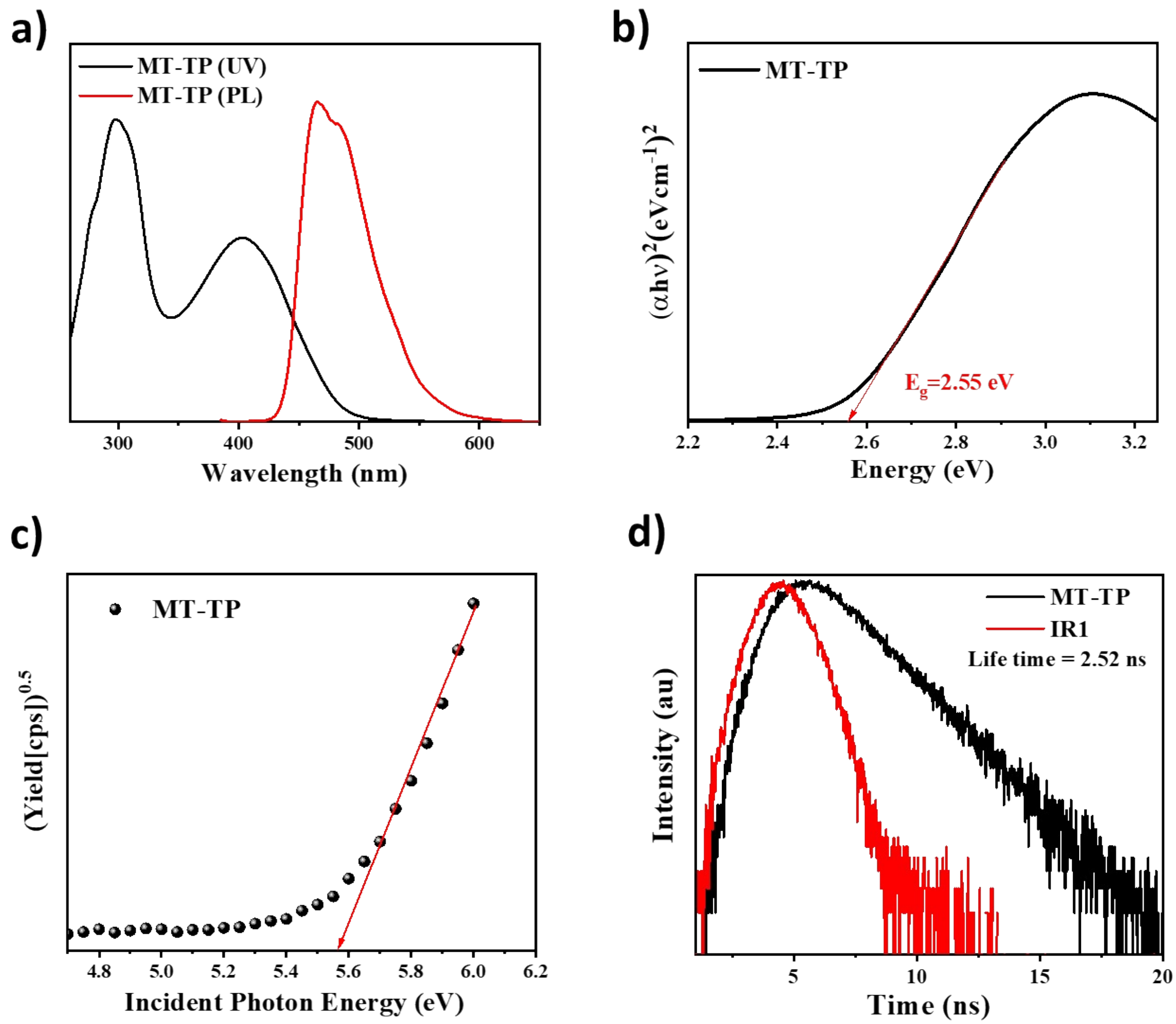


Figure S2. a) UV–visible absorption and b) photoluminescence spectra of MT-TP. c) Calculated HOMO of MT-TP COP by photoelectron spectroscopy (model: AC-2). d) Time-resolved PL spectra of MT-TP COP.

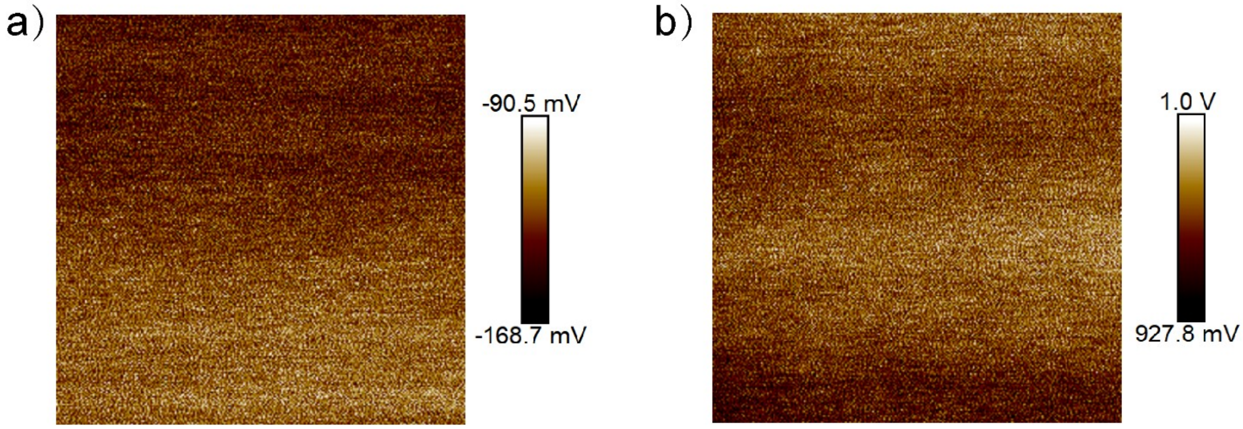


Figure S3. KPFM of MT-TP film before (a) and after (b) applying 1V bias though the probe.

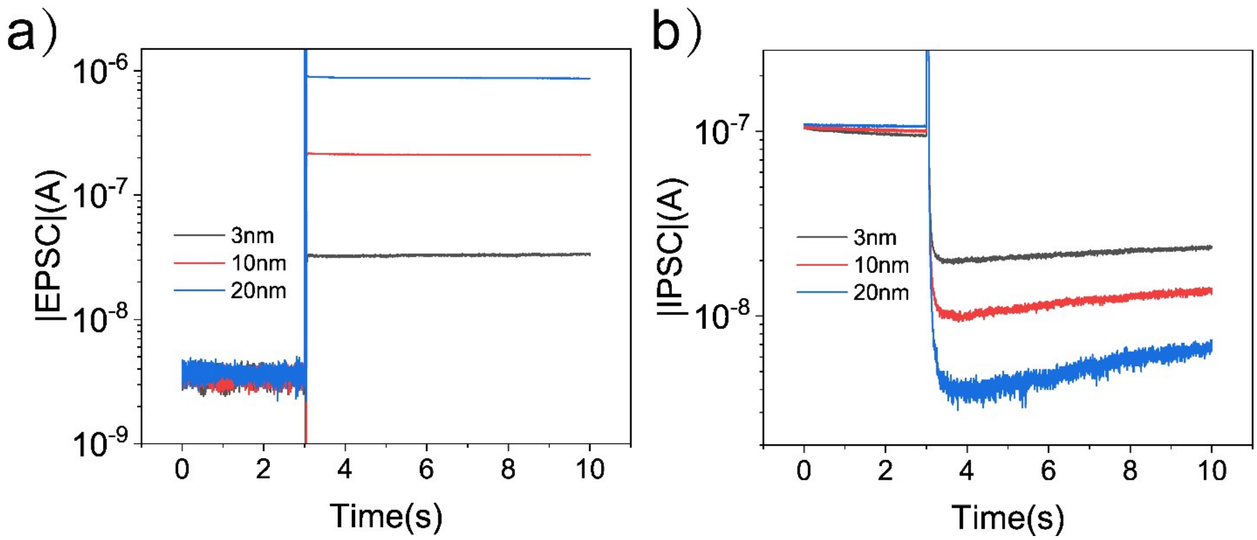


Figure S4. a) |EPSC| induced by positive gate pulse operation of different thickness of MT-TP (pulse amplitude: 50V, pulse width: 50 ms) with base V_{GS} = -5 V and V_{DS} = -10V. b) |IPSC| induced by negative gate pulse operation of different thickness of MT-TP (pulse amplitude: -50V, pulse width: 50ms) with base V_{GS} = -5V and V_{DS} = -10V.

Table S2. Photophysical properties of MT-TP.

Polymer	HOMO/LUMO [eV]	Bandgap [eV]	Lifetime [ns]
MT-TP	-5.55/-3.00	2.55	2.52

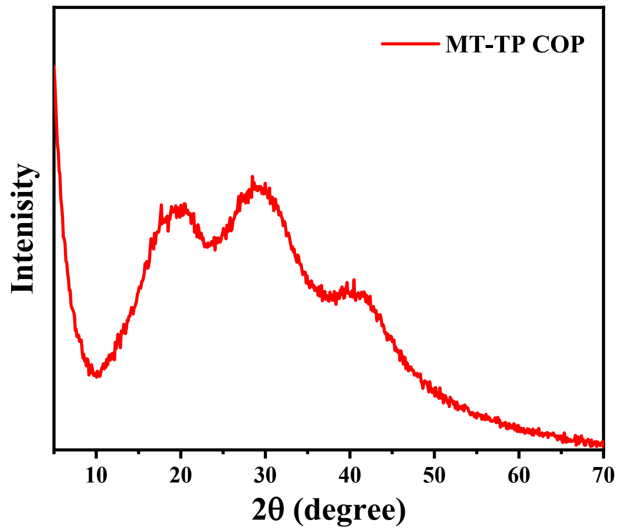


Figure S5. The XRD pattern of MT-TP.

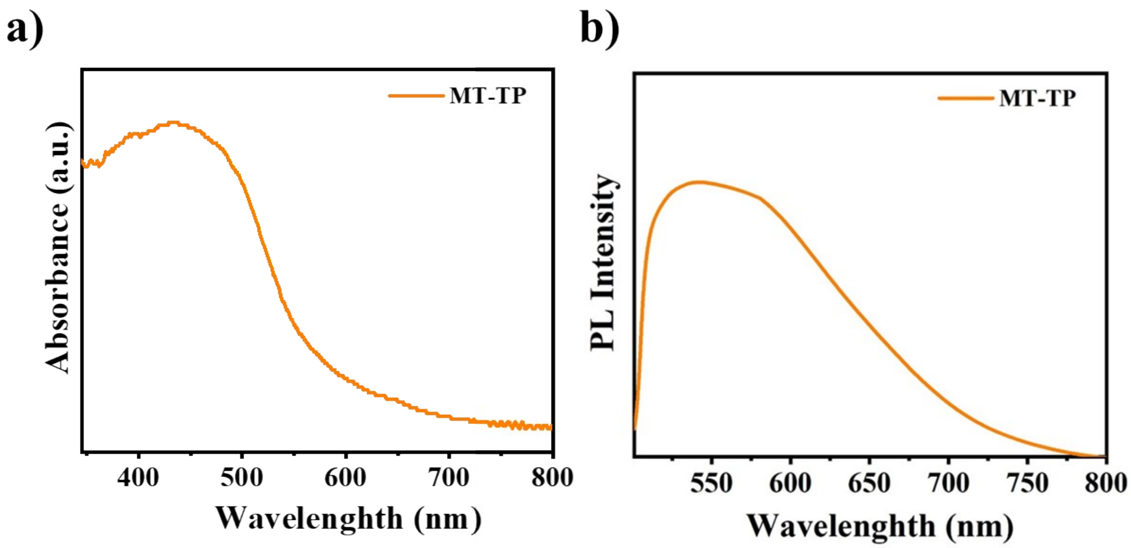


Figure S6. (a) UV-Vis and (b) PL emission spectra (at excitation wavelength of 400 nm) for MT-TP thin film.

Device Fabrication

The MT-TP synaptic transistor was fabricated with a bottom-gate top-contact structure. Si/SiO_2 substrate was bought from commercial sources and the thickness of the gate dielectric was 100 nm. The MT-TP layer was prepared by spin-coating 2 mg/ml copolymers MT-TP solutions in formic acid on the gate dielectric layer. The rotation speed was kept at 500 rpm for 5s and 1500 rpm for 30 s, and the film was annealed at 80 ˚C for 30 min. 2 mg/ml poly (methyl methacrylate) dissolved in toluene was further spin-coated onto the MT-TP layer by 800 rpm for 5s and 3000 rpm for 50 s, and the film was annealed at 120 ˚C for 2 hours. Subsequently, 50 nm pentacene were evaporated onto the substrate as semiconductor layer. 50 nm Au metal electrodes were finally evaporated on the semiconductor layer under vacuum using shadow masks. The channel width/length of the MT-TP devices are 50 μm /500 μm. Electrical characterization were carried out with a Keysight B2902A Precision Source/Measure Unit. All of the mentioned processes were executed inside the glove box under nitrogen condition.

References

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