

Supporting Information

Thiazole-Flanked Diketopyrrolopyrrole Polymeric Semiconductors for Ambipolar Field-Effect Transistors with Balanced Carrier Mobilities

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1. Theoretical calculations

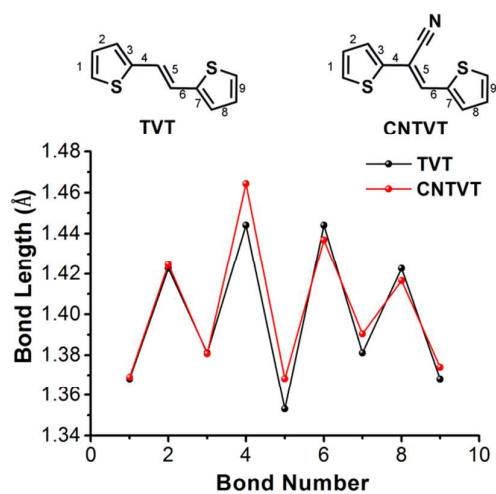


Figure S1. Calculated bond lengths of CNTVT and TVT at the B3LYP/6-31G(d) level.

2. Cyclic voltammetry

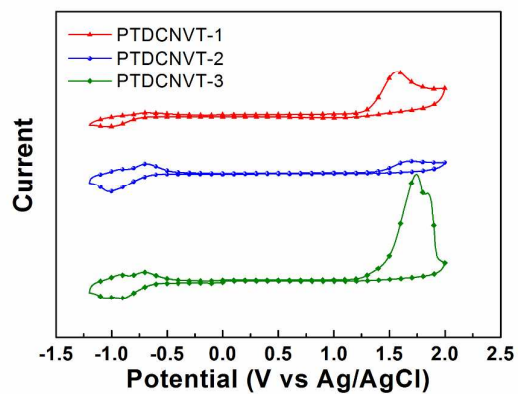


Figure S2. Cyclic voltammograms of PTDCNVT-n polymers

3. Device optimization and Gate leakage characterization

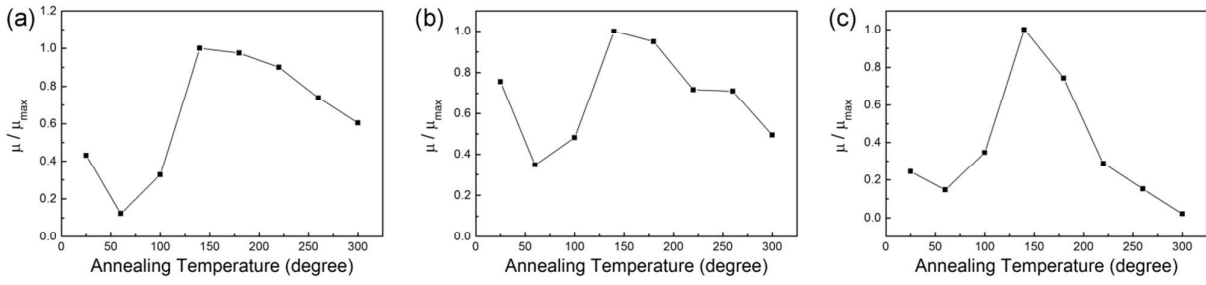


Figure S3. Annealing temperature dependence of the mobilities for BGBC transistor devices: (a) PTDCNTVT-1, (b) PTDCNTVT-2, and (c) PTDCNTVT-3.

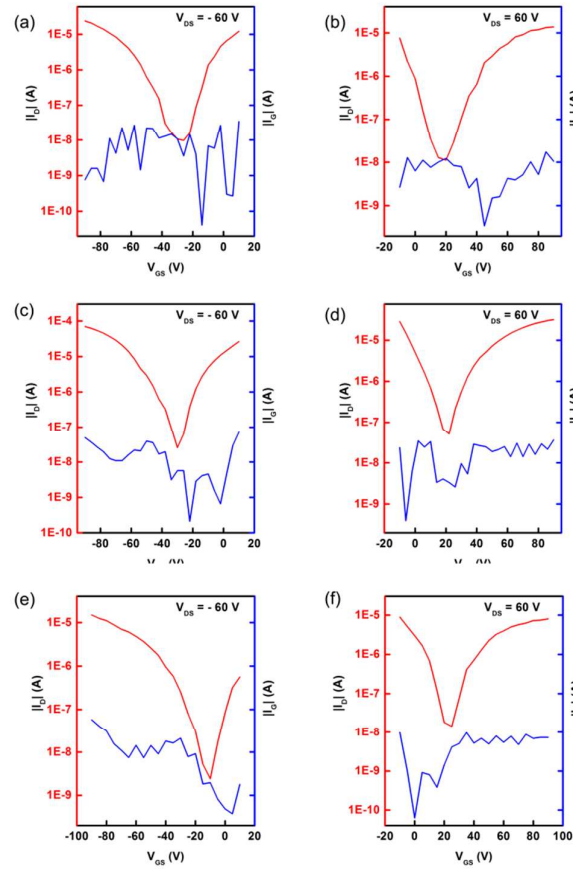


Figure S4. Gate leakage current of polymer based TGBC devices: (a,b) PTDCNTVT-1, (c,d) PTDCNTVT-2, and (e,f) PTDCNTVT-3.

4. Complementary inverters

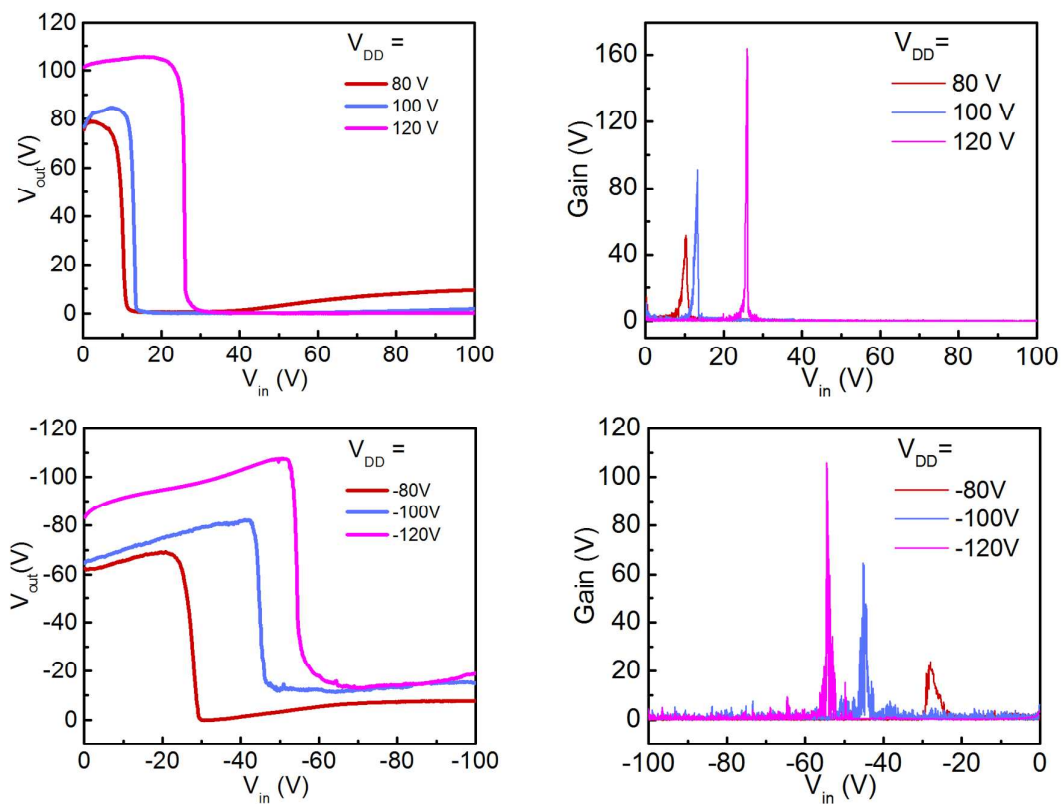


Figure S5. PTDCNTVT-2 complementary inverters

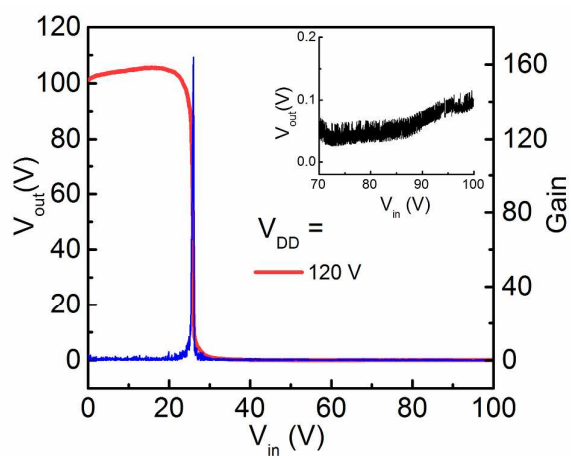


Figure S6. Complementary inverter based on PTDCNTVT-2 (Inset: zoomed-in view of the voltage transfer curve in the high-voltage region).

5. GIXRD data

Table S1. GIXRD Data of the PTDCNTVT-n Polymers

Polymer	Temperature (°C)	d-spacing distance (Å)	π -stacking (Å) ^a
PTDCNTVT-1	RT	21.68	3.58
	60	21.86	3.57
	100	21.86	3.58
	140	21.86	3.58
	180	21.62	3.57
	220	21.50	3.58
	260	21.20	3.58
	300	21.09	3.59
PTDCNTVT-2	RT	23.03	3.54
	60	22.62	3.52
	100	22.89	3.52
	140	23.03	3.53
	180	23.03	3.54
	220	22.96	3.52
	260	22.82	3.53
	300	22.62	3.54
PTDCNTVT-3	RT	24.04	3.53
	60	23.94	3.52
	100	24.26	3.52
	140	24.48	3.53
	180	24.48	3.53
	220	24.37	3.53
	260	24.37	3.53
	300	24.26	3.54

^aThe π -stacking distances for PTDCNTVT-1 and PTDCNTVT-2 were calculated from diffraction peaks along the in-plane direction, whereas the ones for PTDCNTVT-3 were calculated from diffraction peaks along the out-of-plane direction.

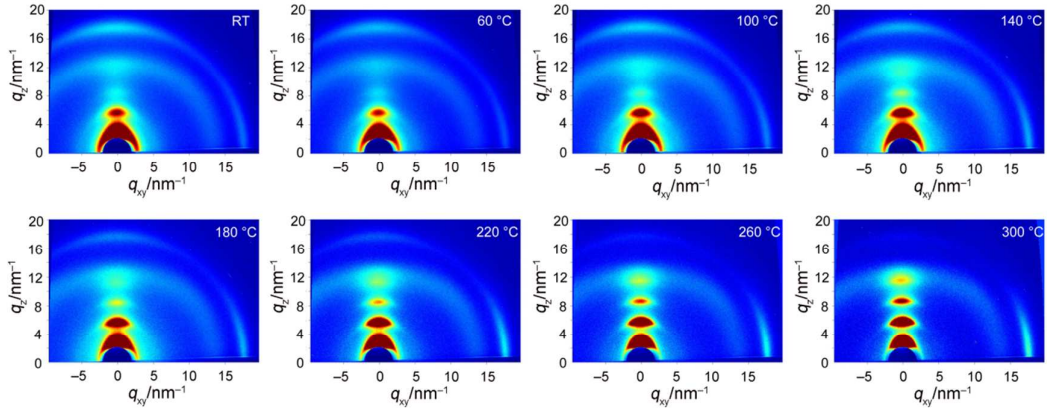


Figure S7. Annealing temperature dependent GIXRD of PTDCNTVT-1 thin film.

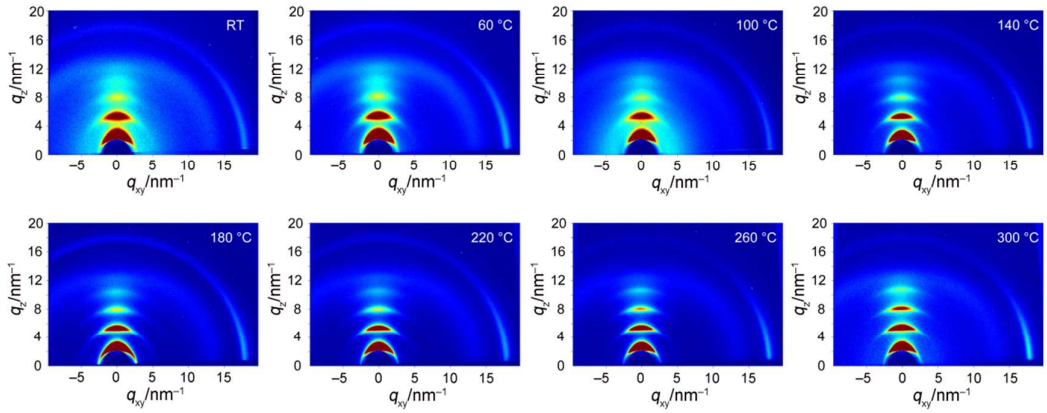


Figure S8. Annealing temperature dependent GIXRD of PTDCNTVT-2 thin film.

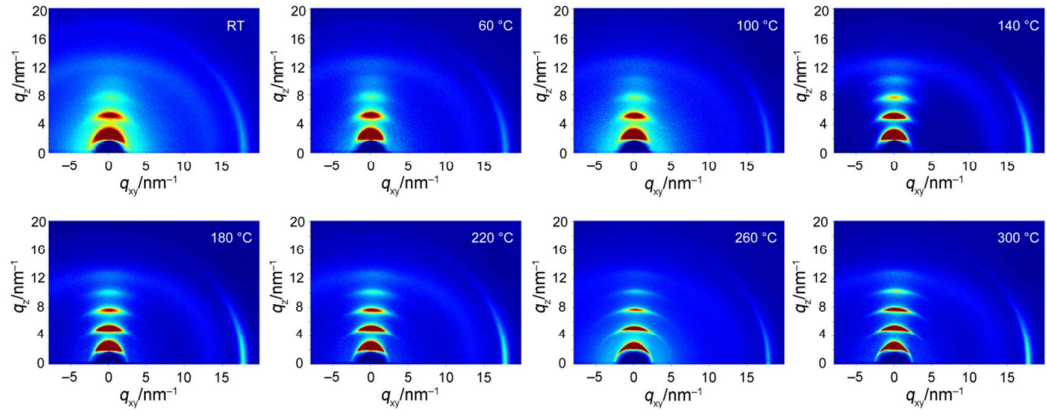


Figure S9. Annealing temperature dependent GIXRD of PTDCNTVT-3 thin film.

6. AFM images at different annealing temperatures

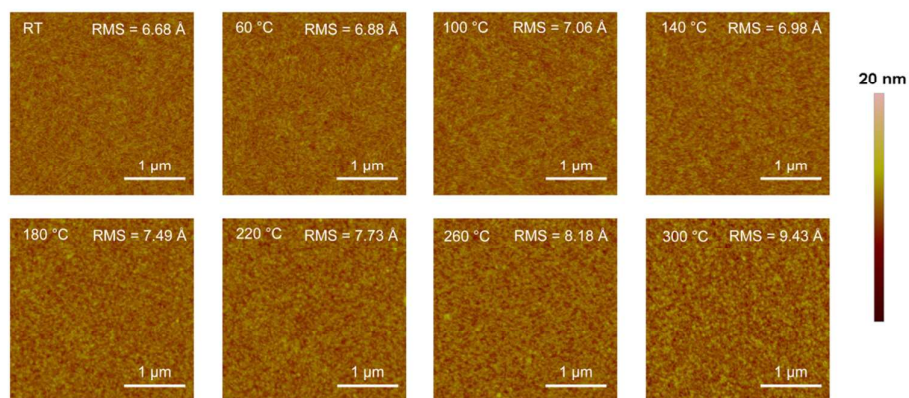


Figure S10. Annealing temperature dependent AFM images of PTDCNTVT-1 thin film.

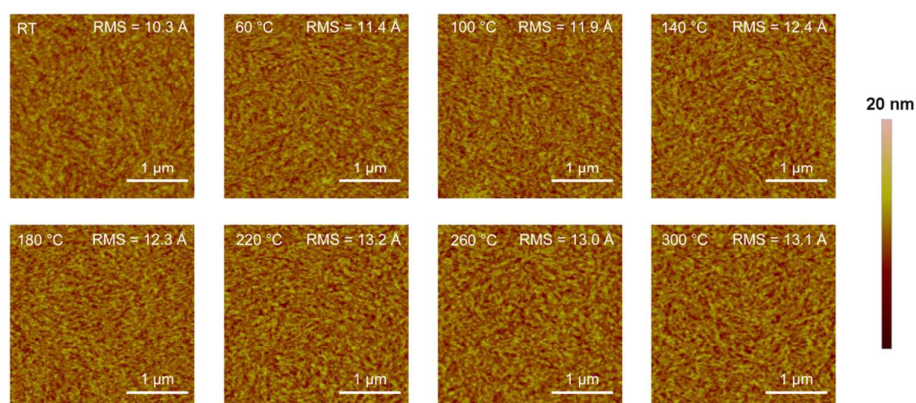


Figure S11. Annealing temperature dependent AFM images of PTDCNTVT-2 thin film.

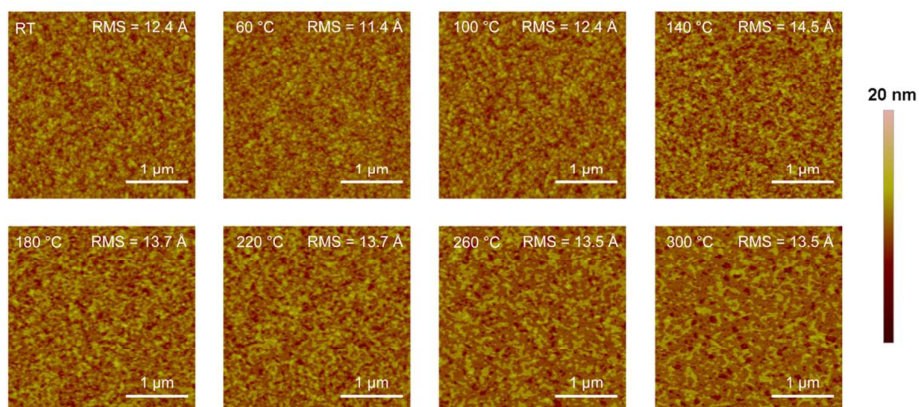


Figure S12. Annealing temperature dependent AFM images of PTDCNTVT-3 thin film.

7. NMR spectra of new compounds

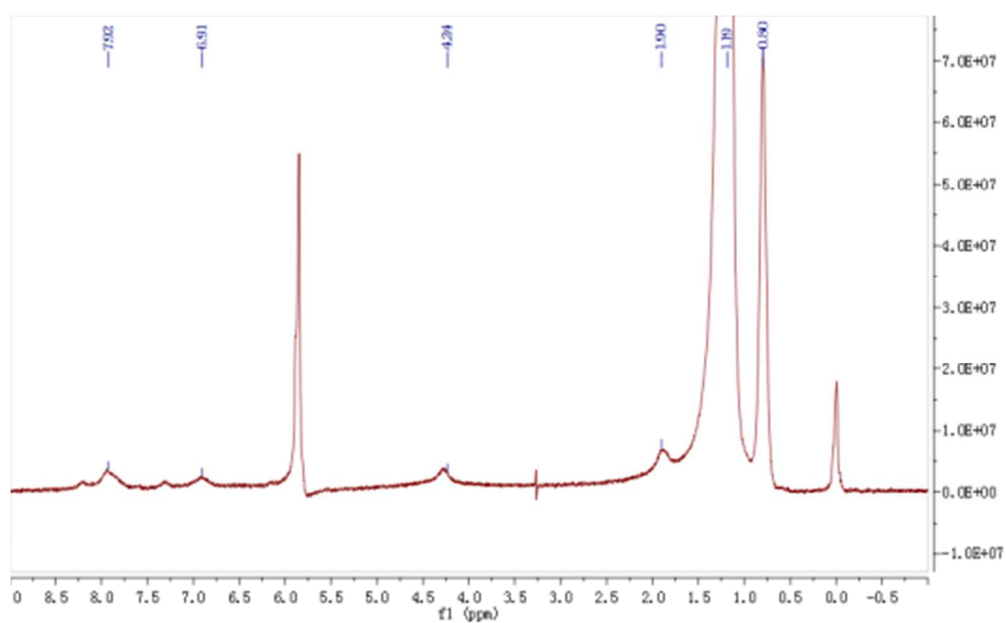


Figure S13. ^1H NMR of PTDCNTVT-1

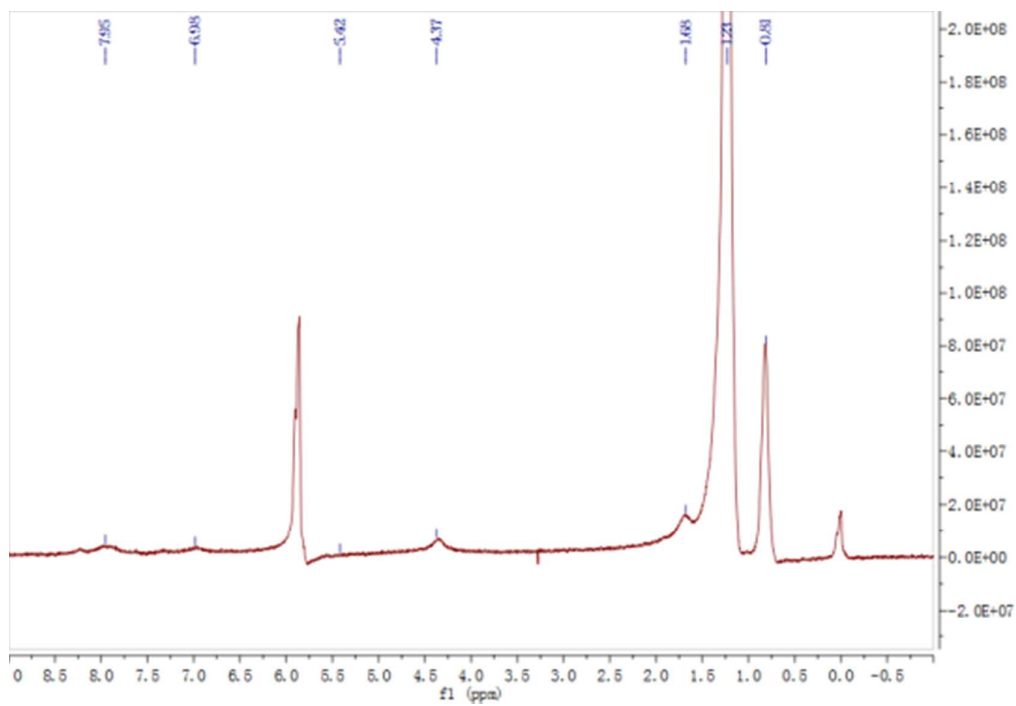


Figure S14. ^1H NMR of PTDCNTVT-2

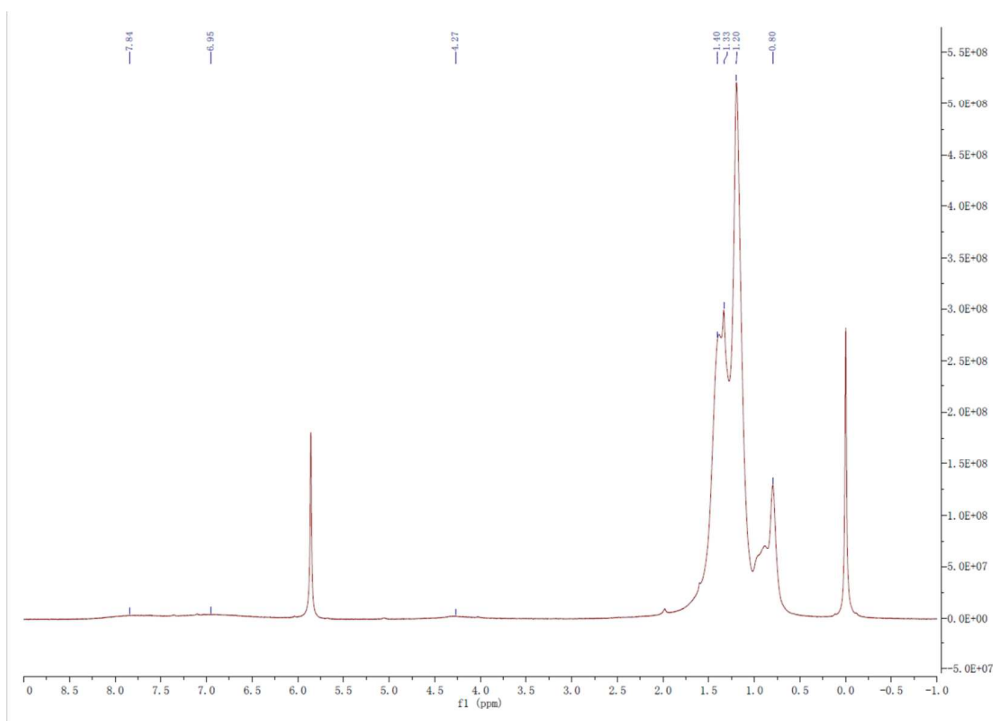


Figure S15. ^1H NMR of PTDCNTVT-3

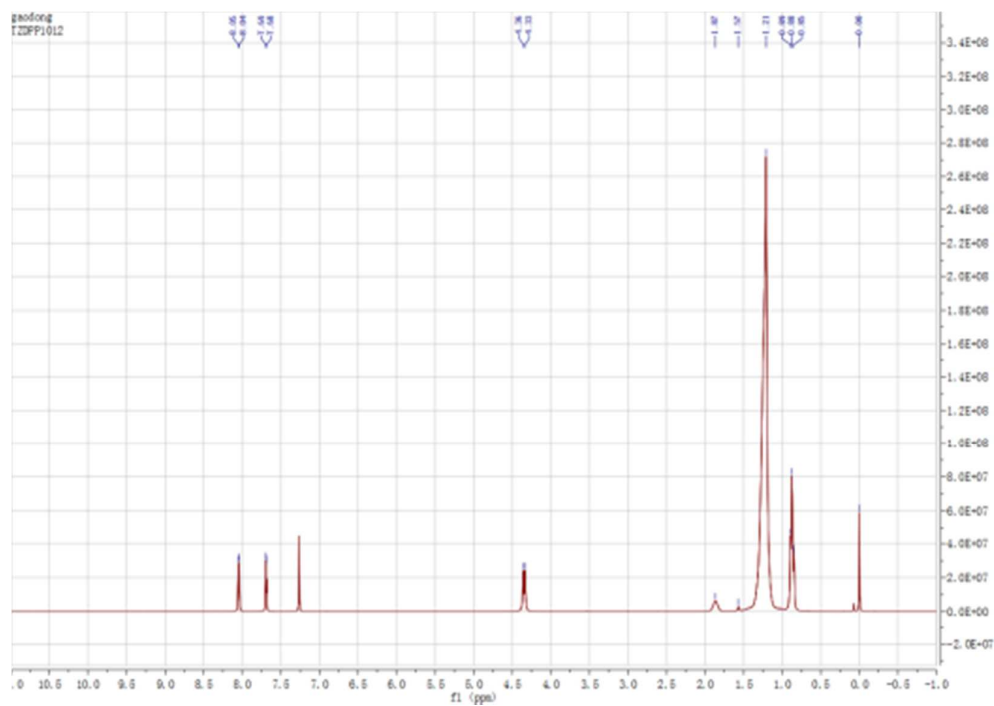


Figure S16. ^1H NMR of

3,6-bis(thiazol-2-yl)-2,5-bis(2-decyltetradecyl)pyrrolo[3,4-c]pyrrole-1,4(2*H*,5*H*)-dione.

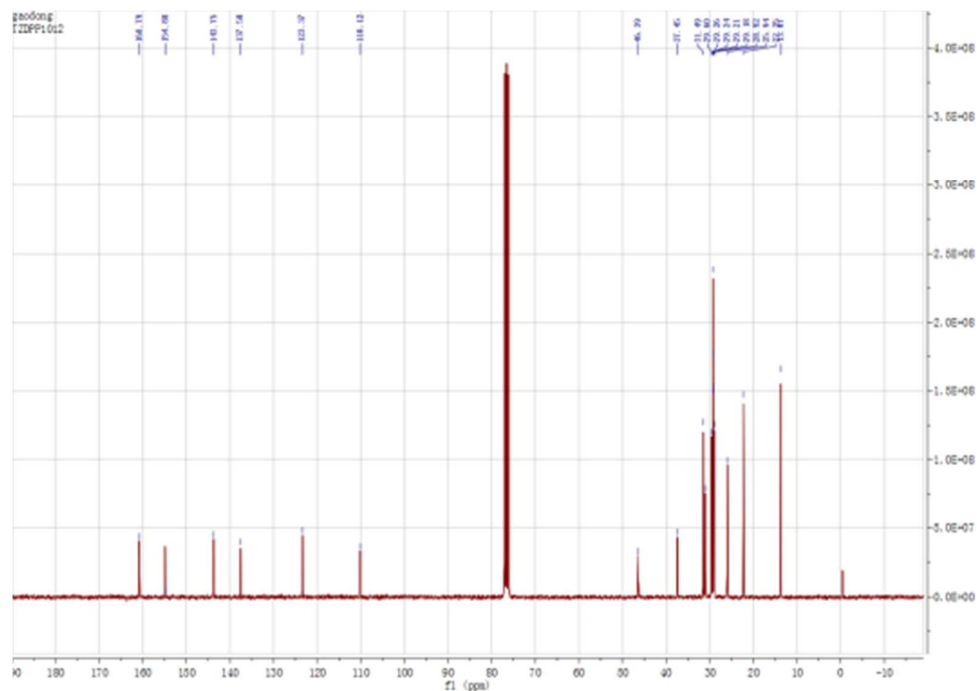


Figure S17. ^{13}C NMR of 3,6-bis(thiazol-2-yl)-2,5-bis(2-decyltetradecyl)pyrrolo[3,4-*c*]pyrrole-1,4(2*H*,5*H*)-dione.

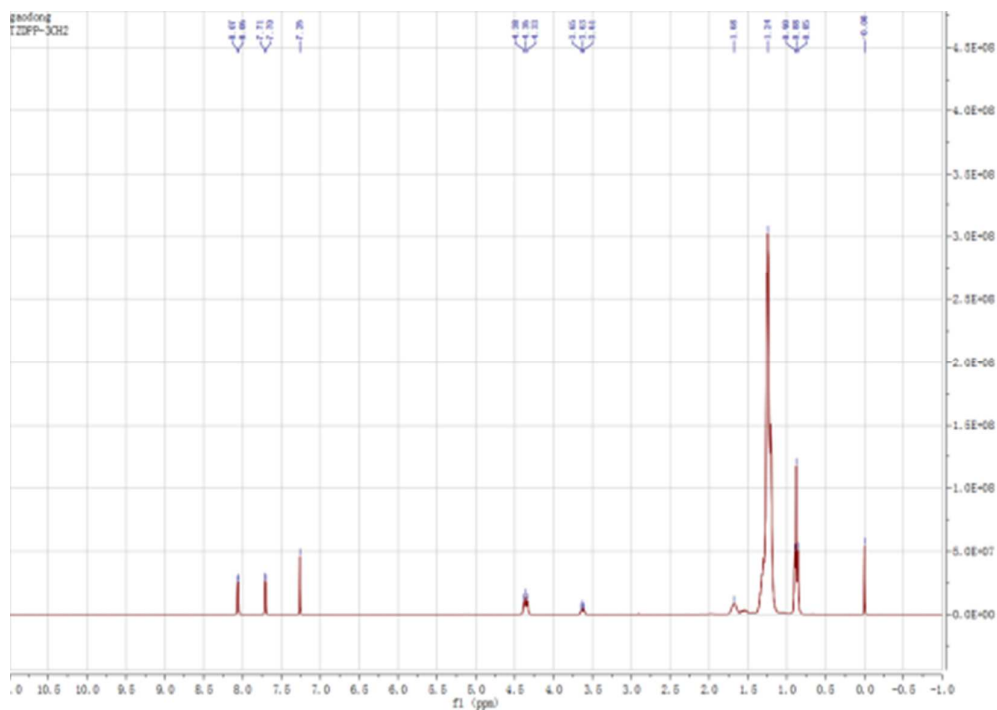


Figure S18. ^1H NMR of 3,6-bis(thiazol-2-yl)-2,5-bis(4-decyltetradecyl)pyrrolo[3,4-*c*]pyrrole-1,4(2*H*,5*H*)-dione.

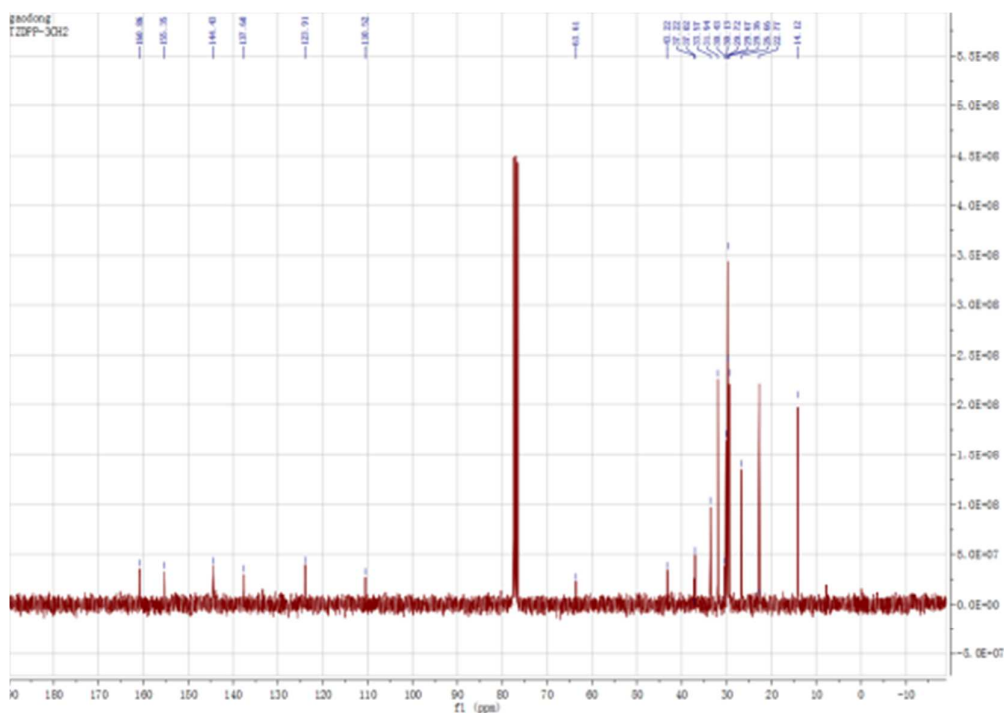


Figure S19. ^{13}C NMR of
3,6-bis(thiazol-2-yl)-2,5-bis(4-decyltetradecyl)pyrrolo[3,4-c]pyrrole-1,4(2*H*,5*H*)-dione.

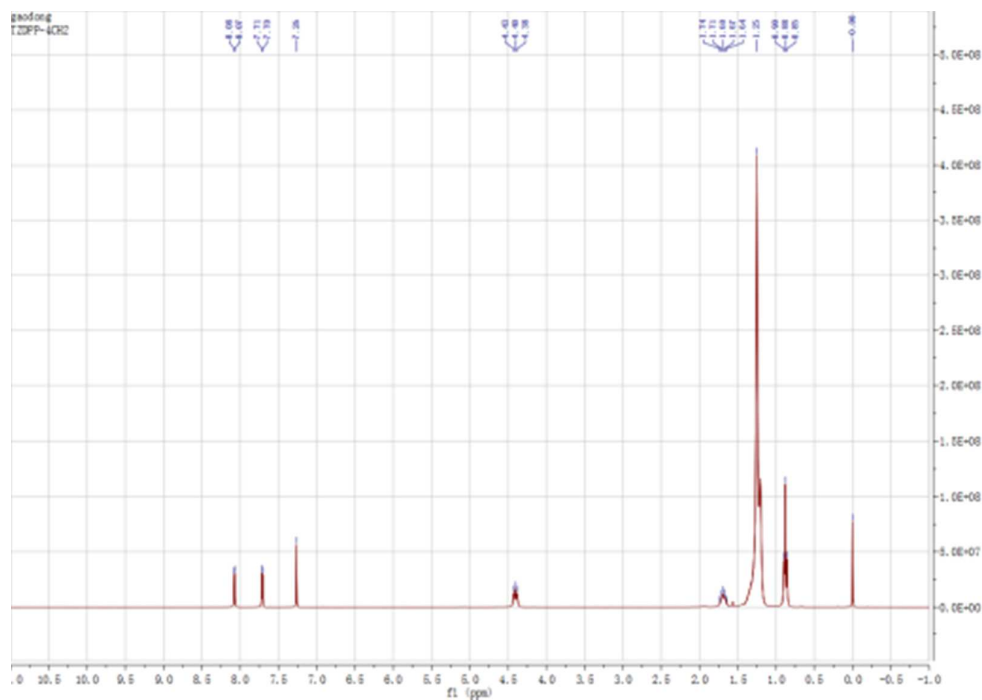


Figure S20. ^1H NMR of the compound
3,6-bis(thiazol-2-yl)-2,5-bis(5-decylpentadecyl)pyrrolo[3,4-c]pyrrole-1,4(2*H*,5*H*)-dione.

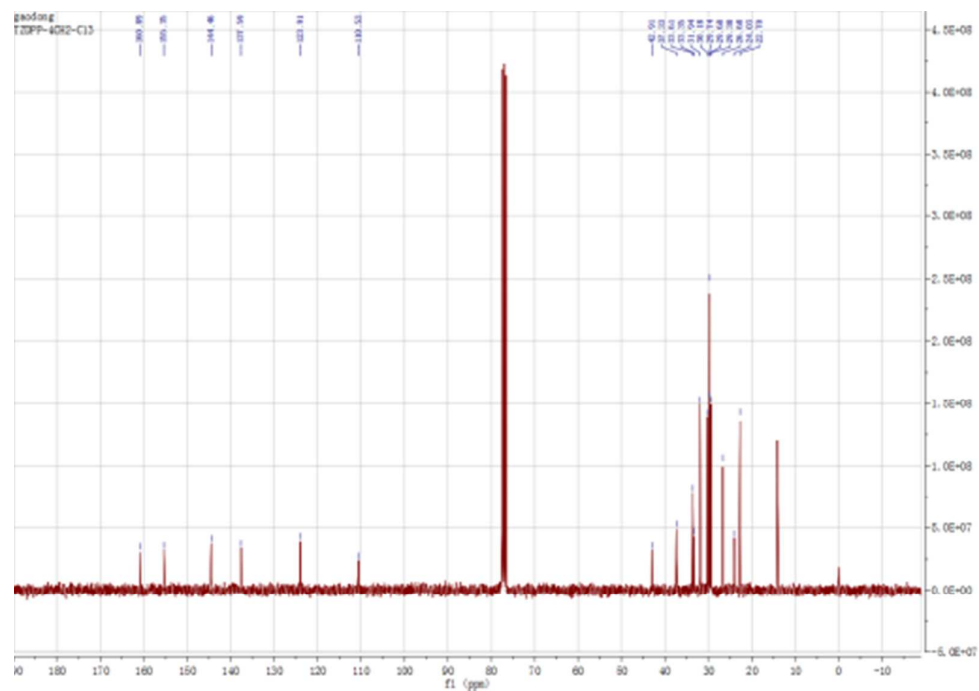


Figure S21. ^{13}C NMR of
3,6-bis(thiazol-2-yl)-2,5-bis(5-decylpentadecyl)pyrrolo[3,4-*c*]pyrrole-1,4(2*H*,5*H*)-dione.

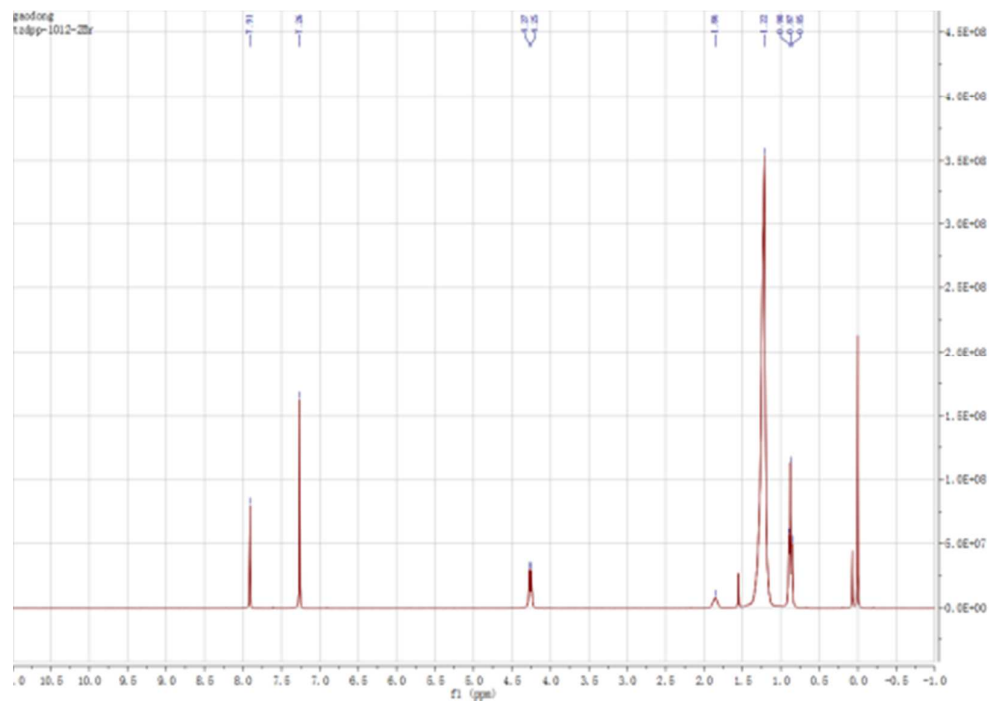


Figure S22. ^1H NMR of
3,6-bis(5-bromo-thiazol-2-yl)-2,5-bis(2-decyltetradecyl)pyrrolo[3,4-*c*]pyrrole-1,4(2*H*,5*H*)-dione.

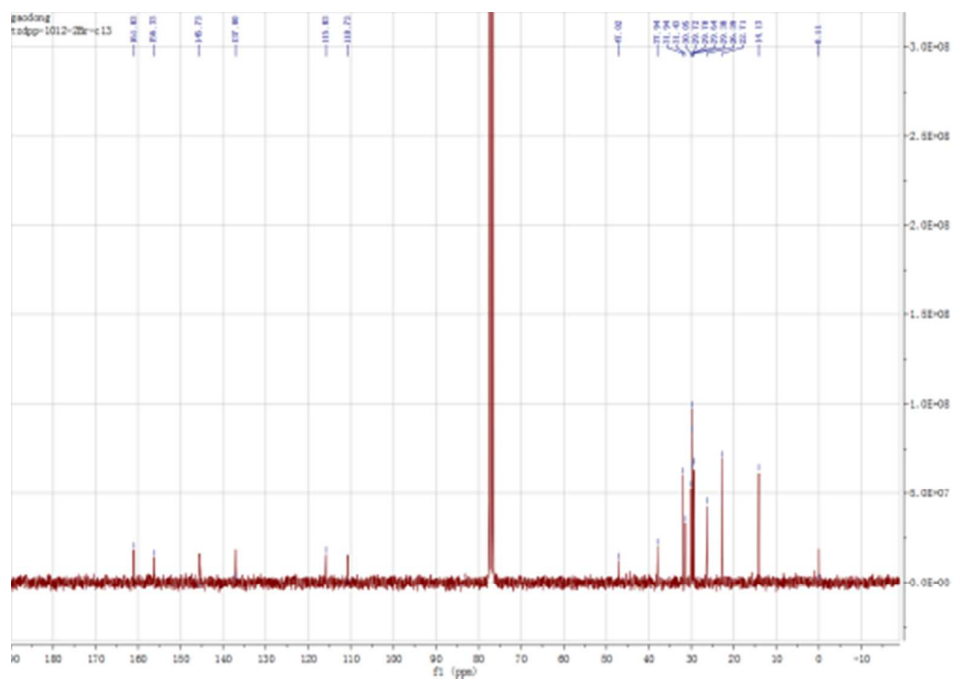


Figure S23. ^{13}C NMR of 3,6-bis(5-bromo-thiazol-2-yl)-2,5-bis(2-decyltetradecyl)pyrrolo[3,4-c]pyrrole-1,4(2*H*,5*H*)-dione.

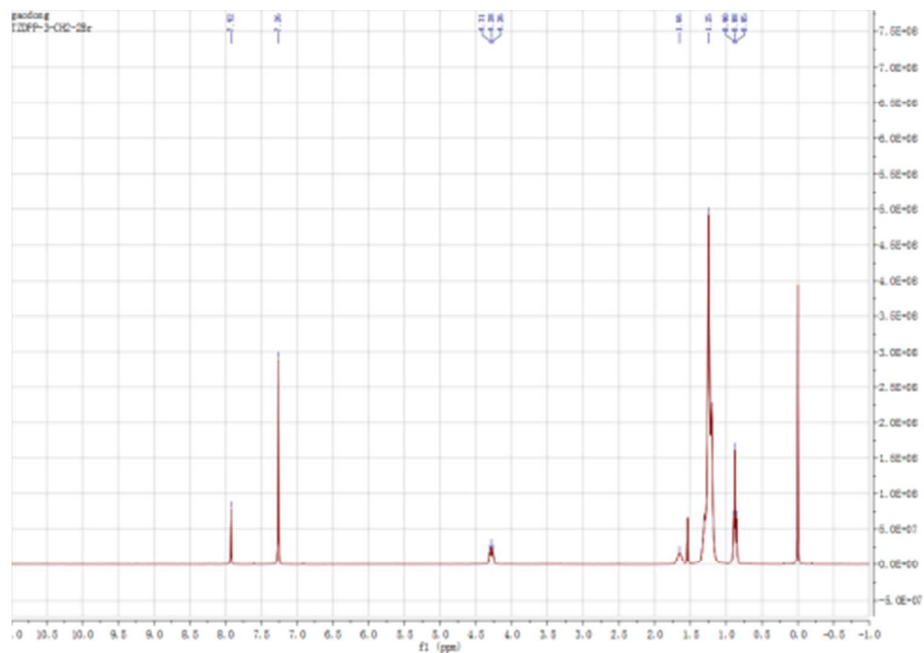


Figure S24. ^1H NMR of 3,6-bis(5-bromo-thiazol-2-yl)-2,5-bis(4-decyltetradecyl)pyrrolo[3,4-c]pyrrole-1,4(2*H*,5*H*)-dione.

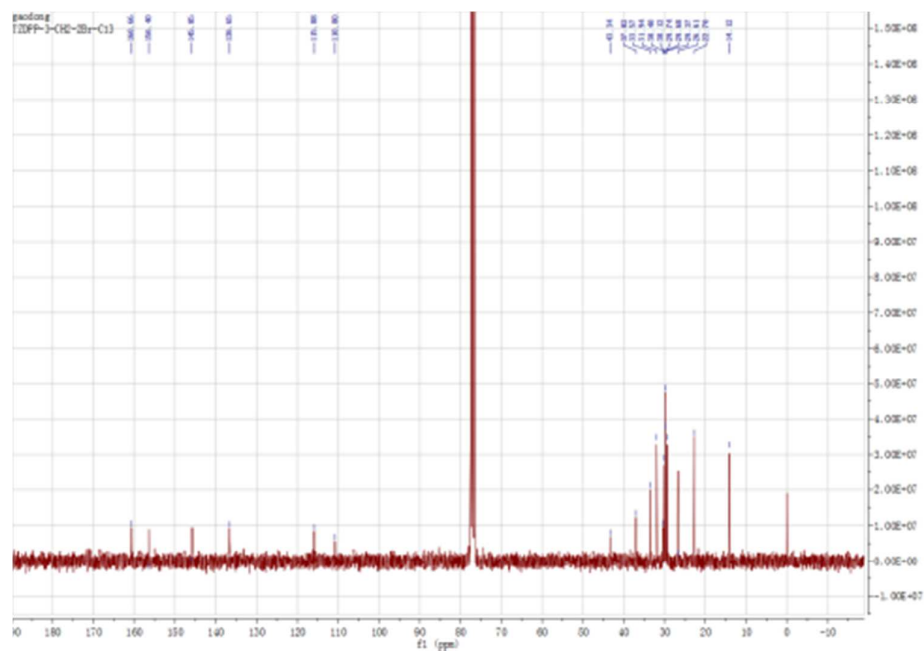


Figure S25. ^{13}C NMR of 3,6-bis(5-bromo-thiazol-2-yl)-2,5-bis(4-decyltetradecyl)pyrrolo[3,4-c]pyrrole-1,4(2*H*,5*H*)-dione.

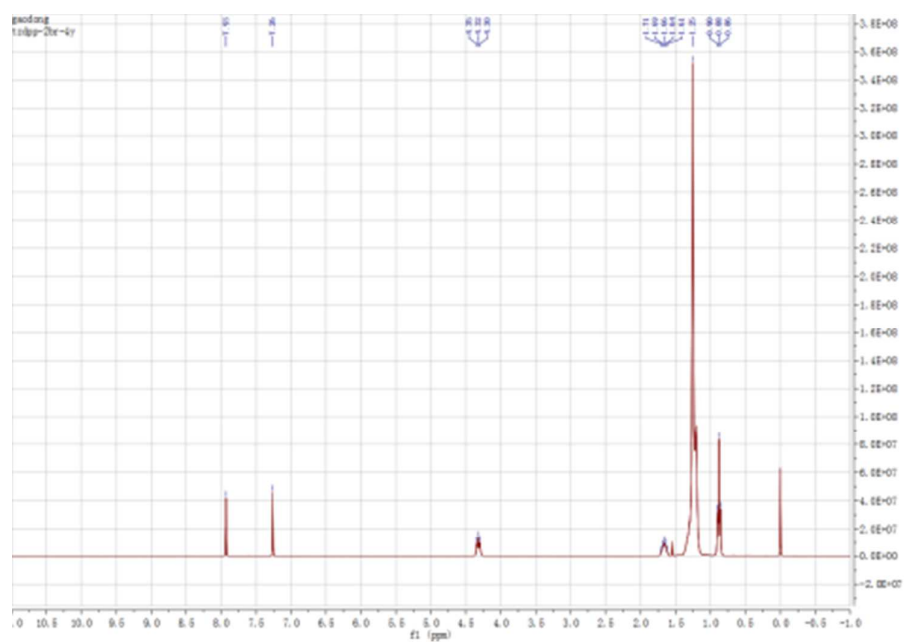


Figure S26. ^1H NMR of 3,6-bis(5-bromo-thiazol-2-yl)-2,5-bis(5-decylpentadecyl)pyrrolo[3,4-c]pyrrole-1,4(2*H*,5*H*)-dione.

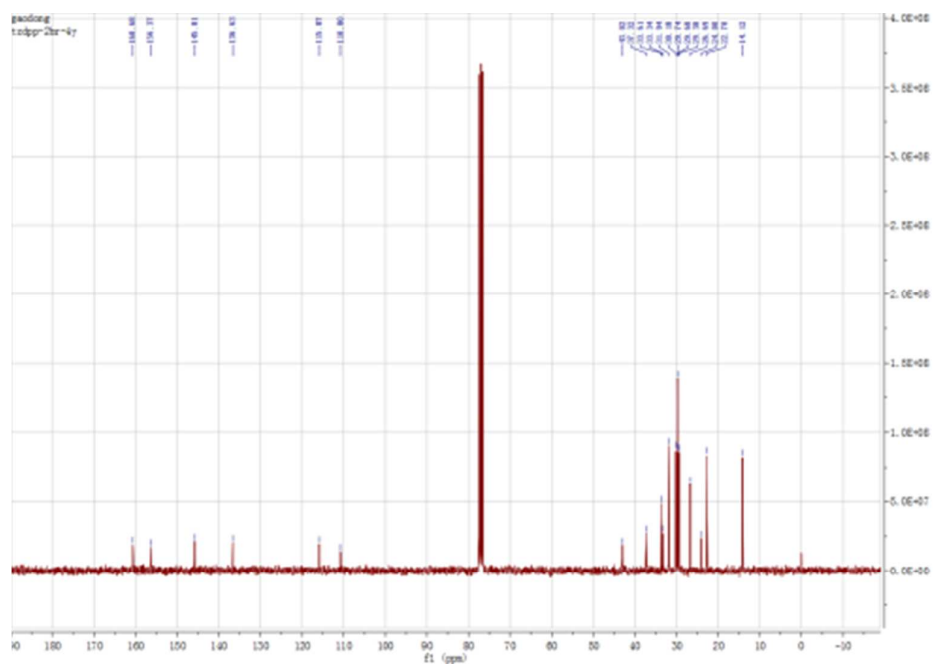


Figure S27. ^{13}C NMR of 3,6-bis(5-bromo-thiazol-2-yl)-2,5-bis(5-decylpentadecyl)pyrrolo[3,4-*c*]pyrrole-1,4(2*H*,5*H*)-dione.