Electronic Supplementary Material (ESI) for Polymer Chemistry.

Supporting Information

Carbazole-Based Copolymers via Direct Arylation Polymerization (DArP) for Suzuki-Convergent Polymer Solar Cell Performance

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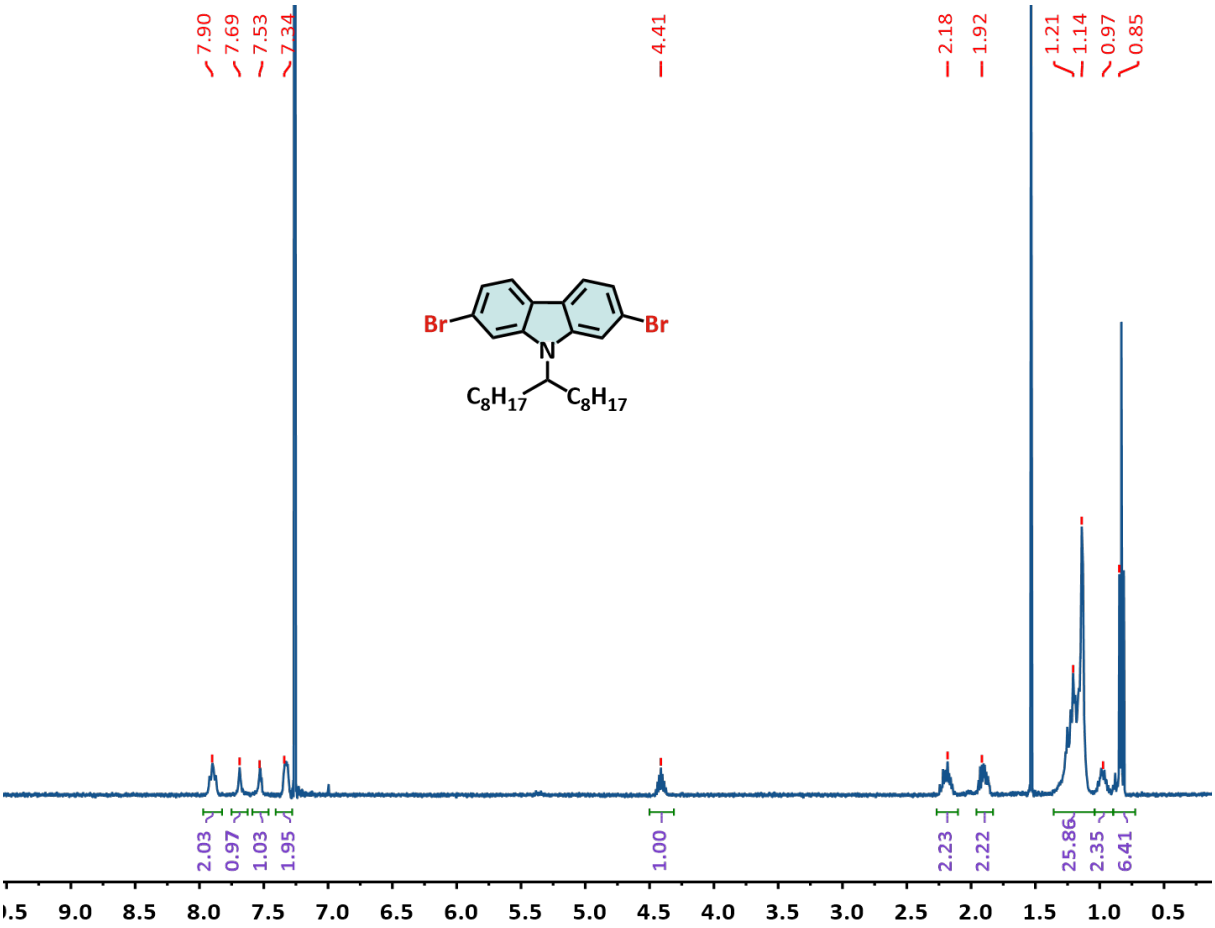

Figure S1. ^{1}H NMR of 2,7-dibromo-9-(heptadecan-9-yl)-9H-carbazole in $CDCl_3$

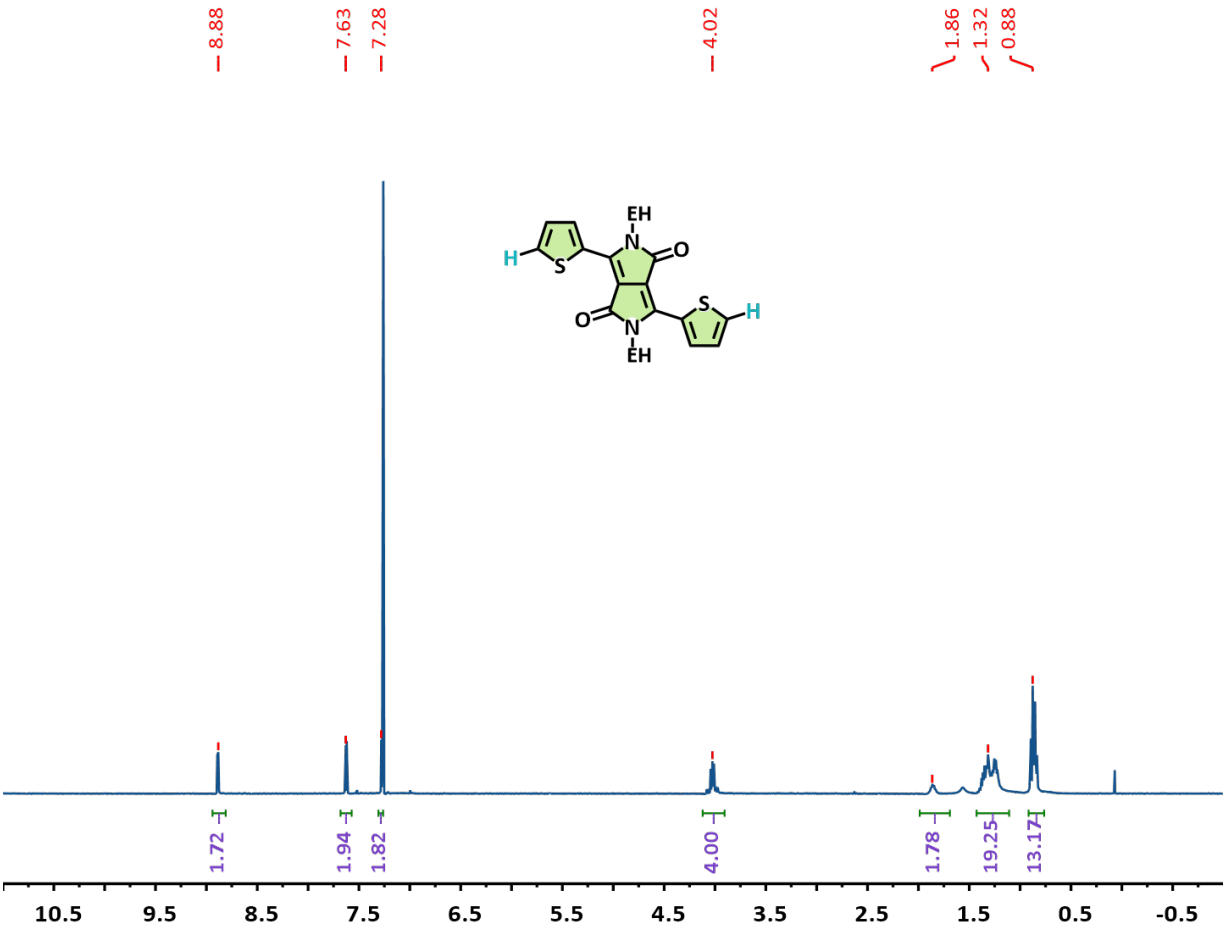

Figure S2. ^{1}H NMR of 2,5-diethylhexyl-3,6-di(thiophen-2-yl)-2,5-dihydropyrrolo[3,4-c]pyrrole-1,4-dione in $CDCl_3$

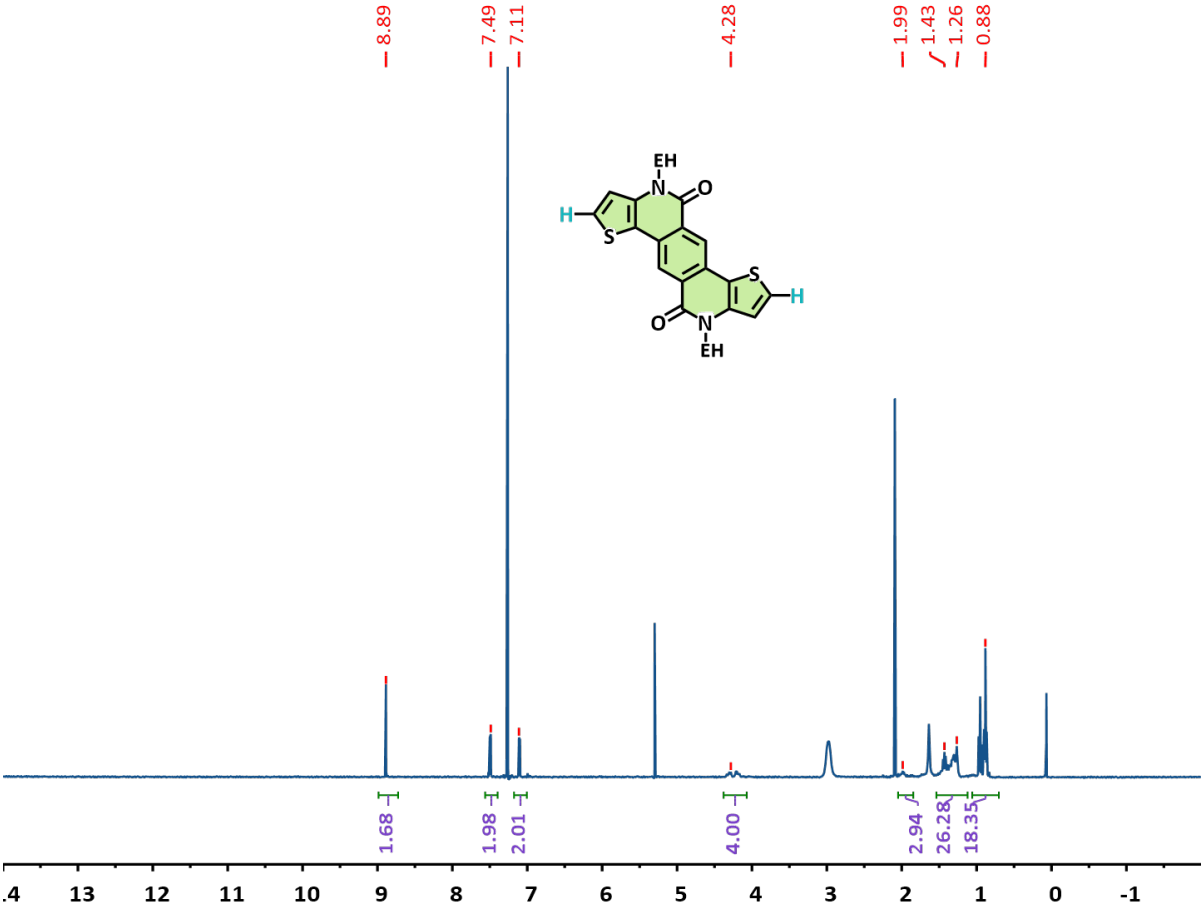

Figure S3. ^{1}H NMR of 4,10-bis(diethylhexyl)-thieno[2',3':5,6]pyrido[3,4-g]thieno[3,2-c]isoquinoline-5,11-dione in $CDCl_3$

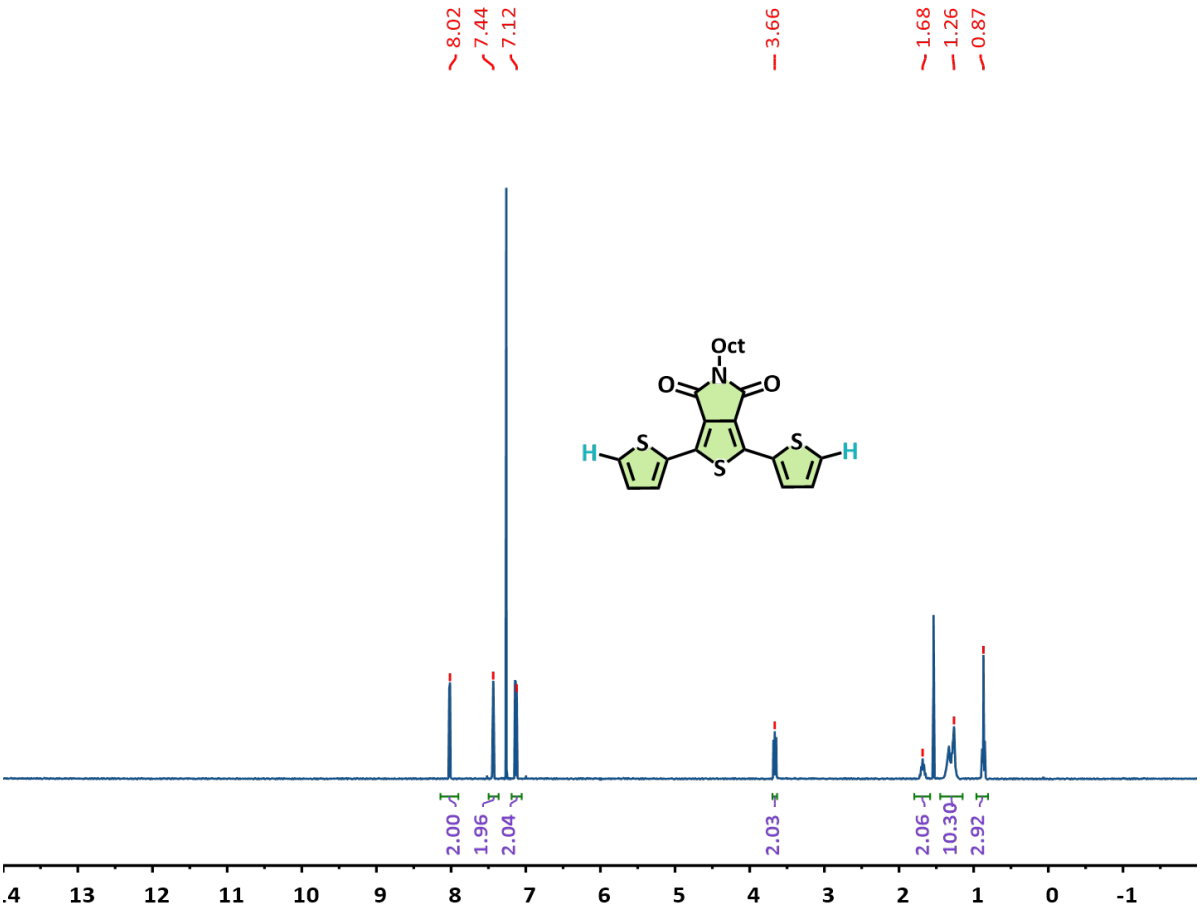

Figure S4. ^{1}H NMR of 5-octyl-1,3-di(thiophen-2-yl)-4H-thieno[3,4-c]pyrrole-4,6(5H)-dione in $CDCl_3$

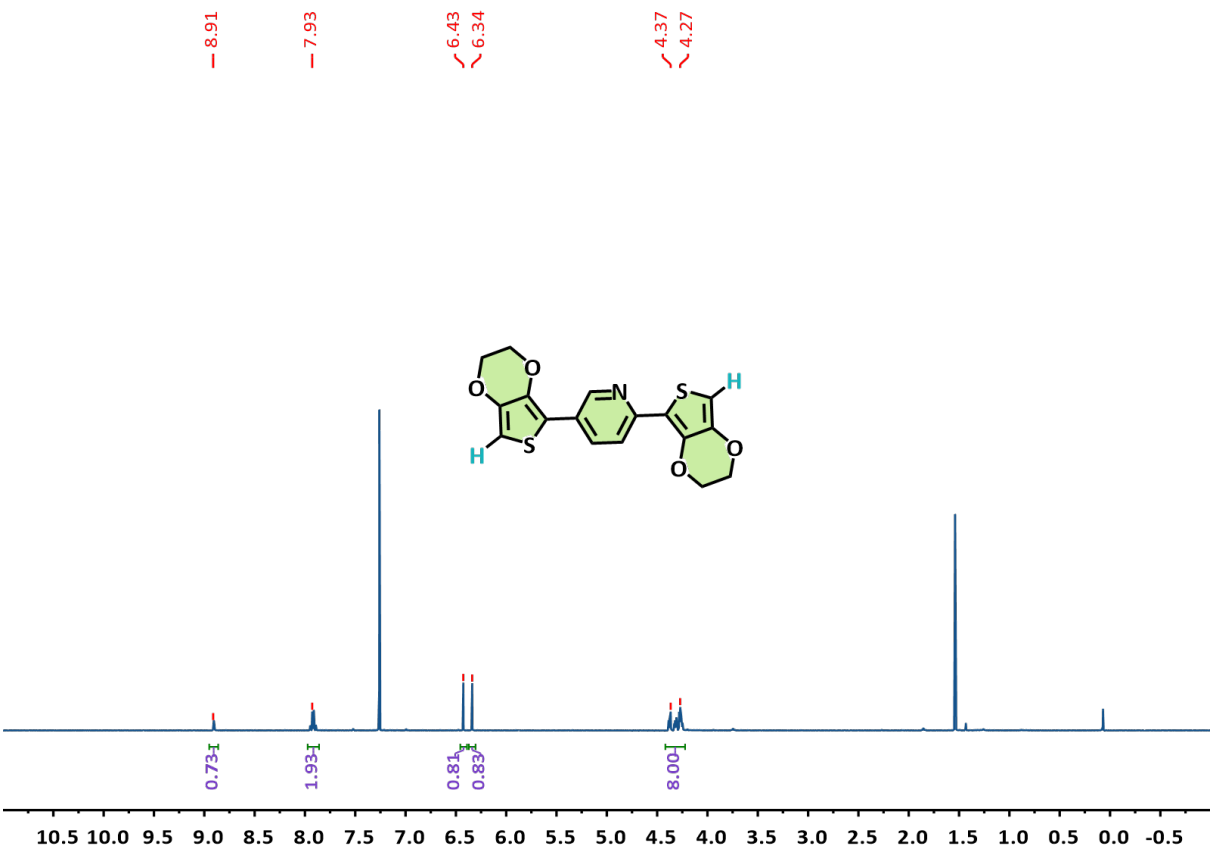

Figure S5. ^{1}H NMR of 2,5-bis(2,3-dihydrothieno[3,4-b][1,4]dioxin-5-yl)pyridine in $CDCl_3$

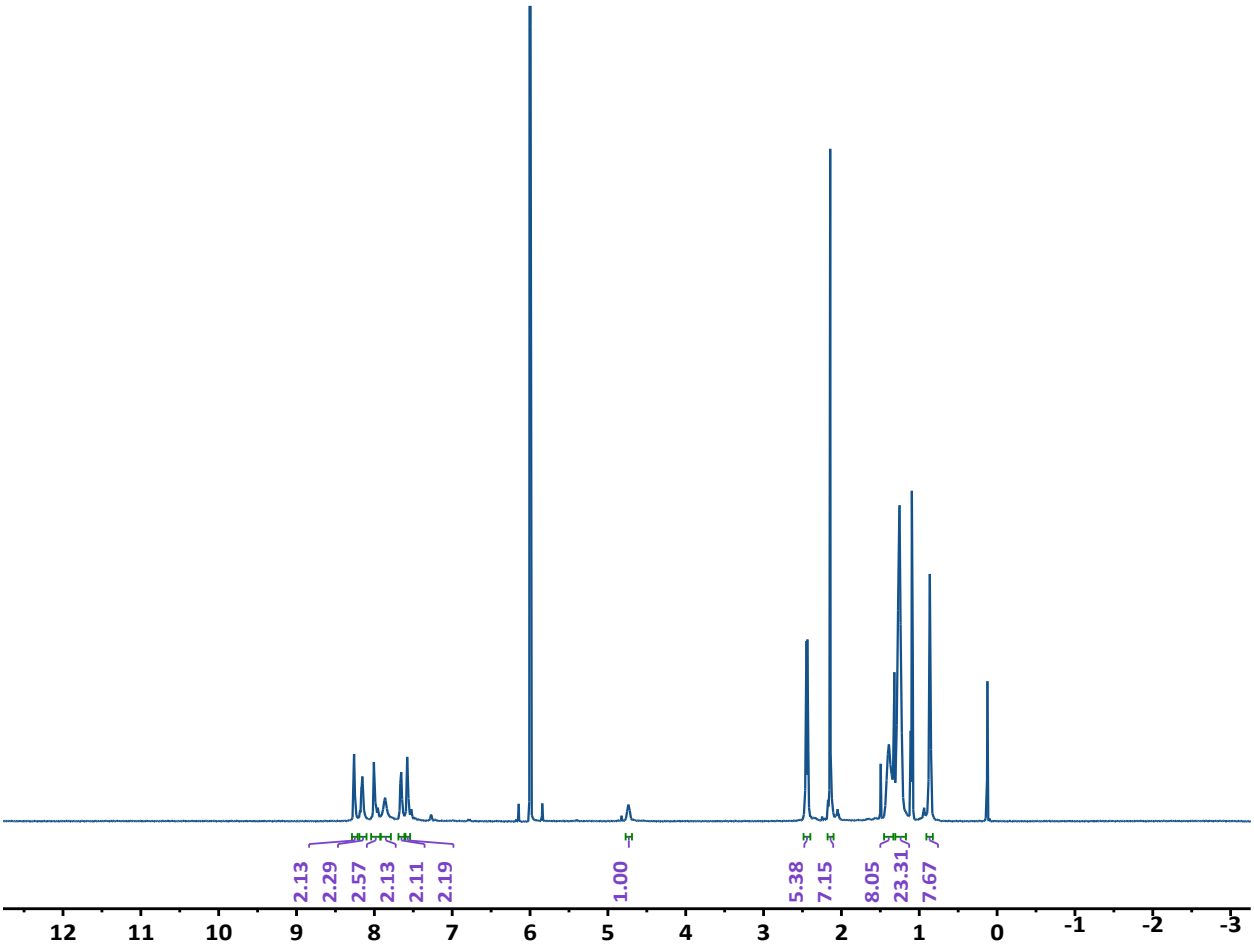

Figure S6. High Temperature ^{1}H NMR of **P1** in $C_2D_2Cl_4$

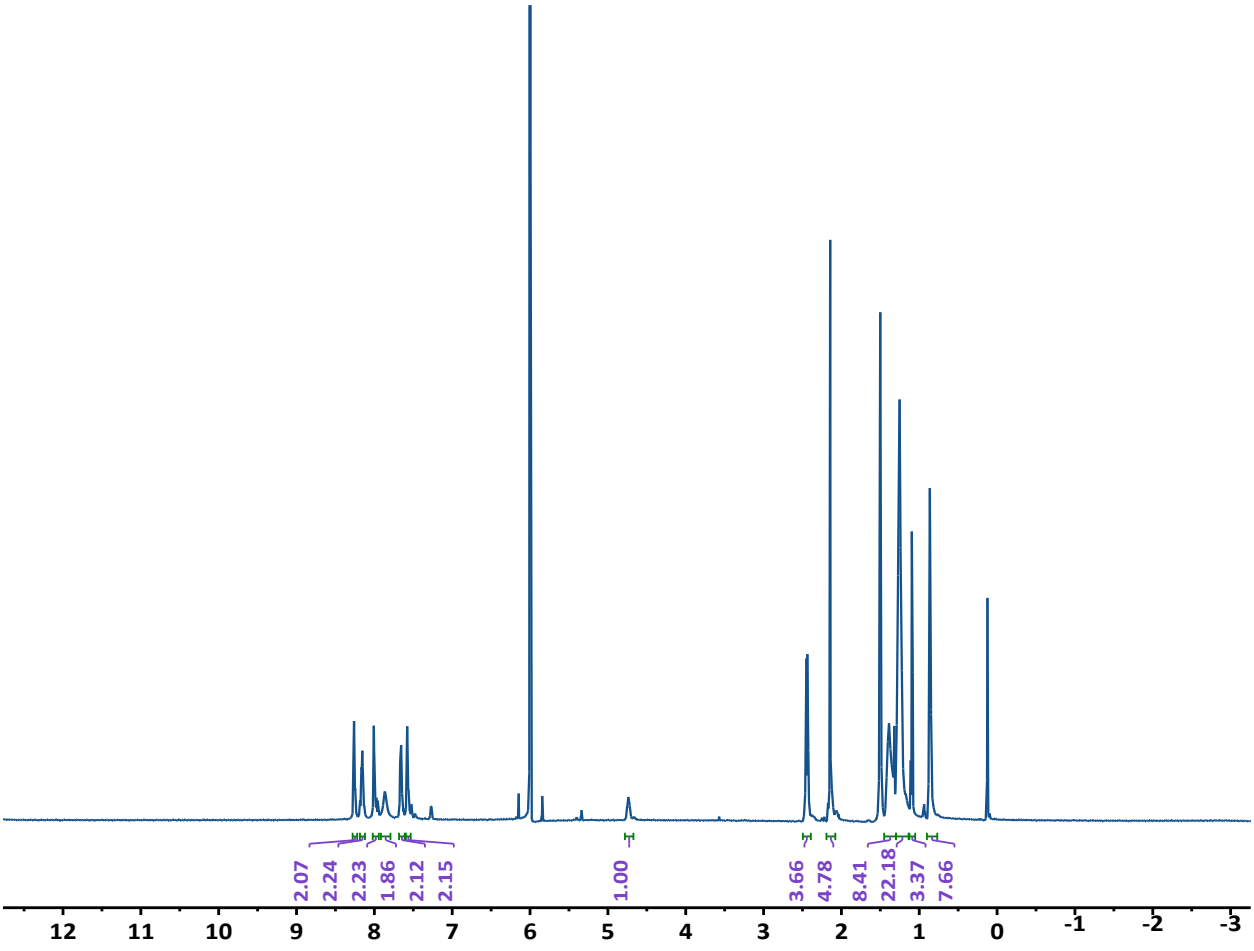

Figure S7. High Temperature ^{1}H NMR of **P3** in $C_2D_2Cl_4$

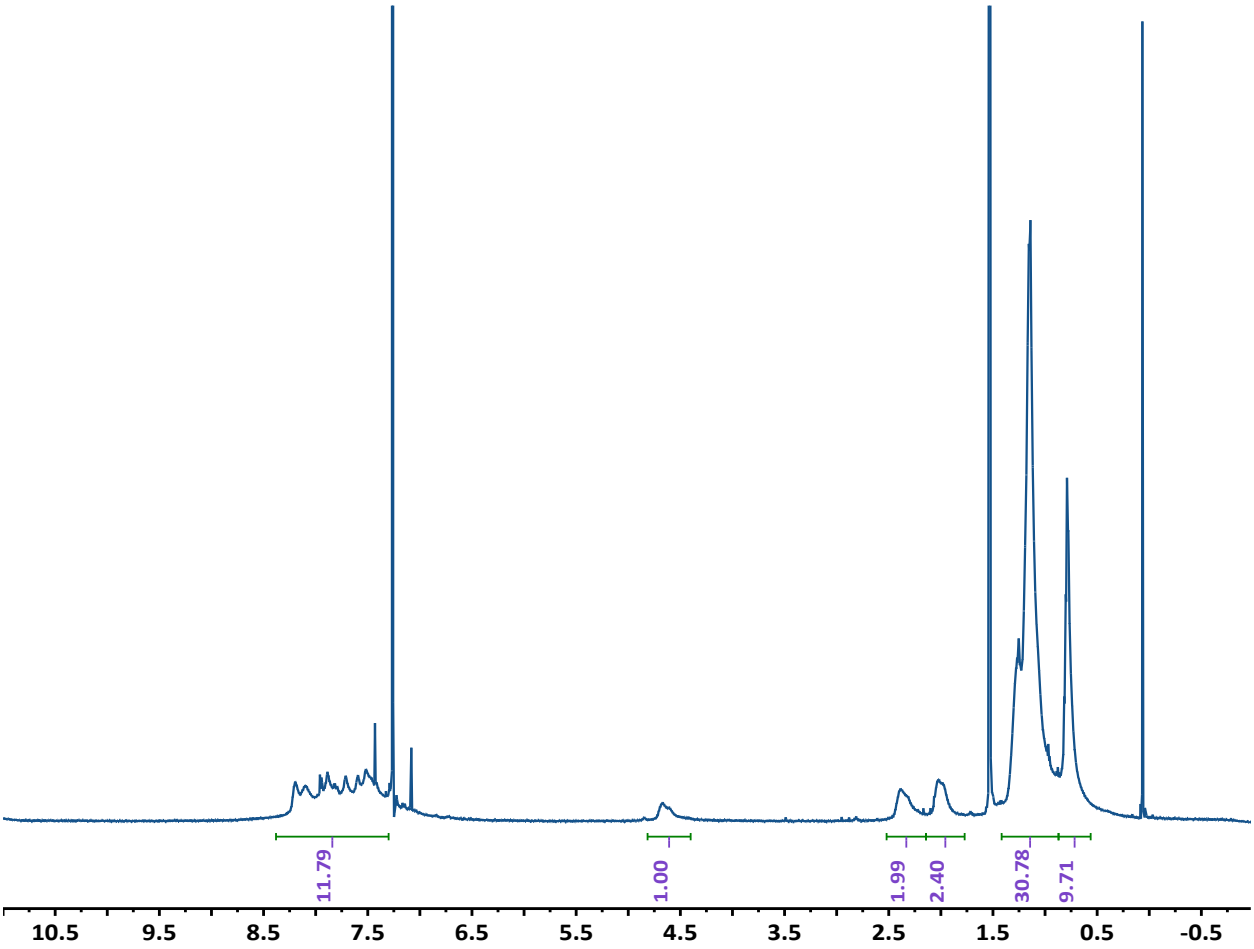

Figure S8. ^{1}H NMR of **P1** in $CDCl_3$

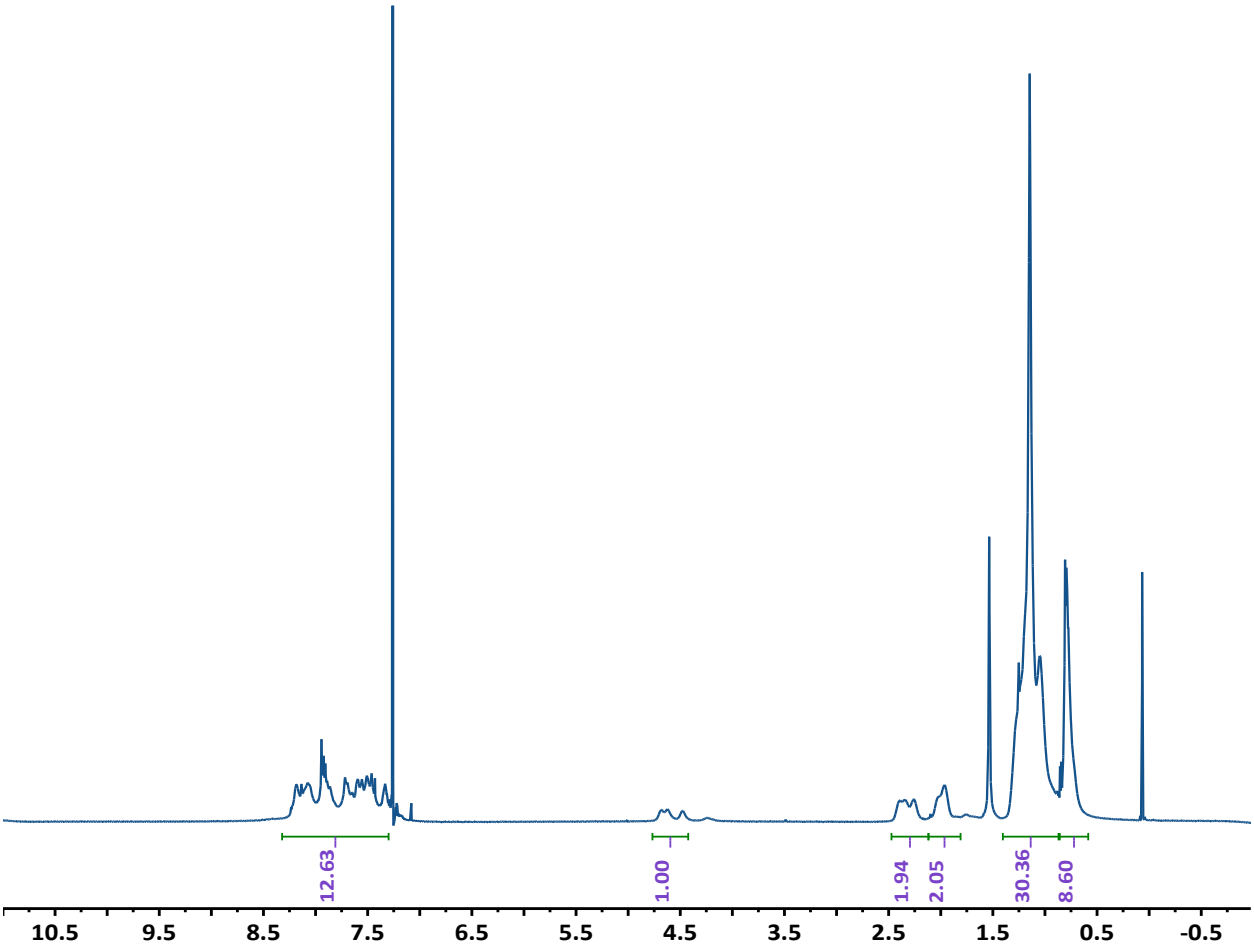

Figure S9. ^{1}H NMR of **P2** in $CDCl_3$

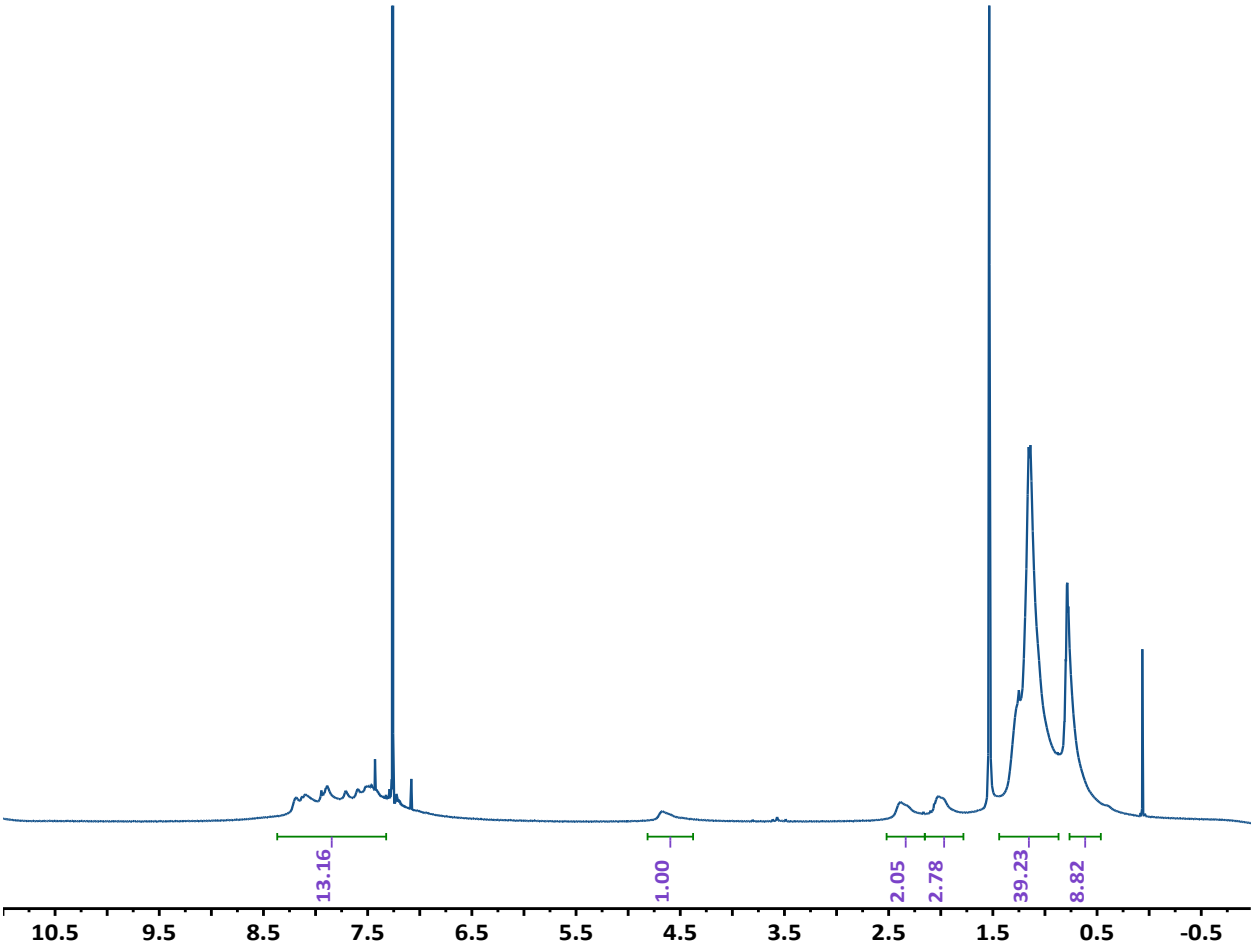

Figure S10. ^{1}H NMR of **P3** in $CDCl_3$

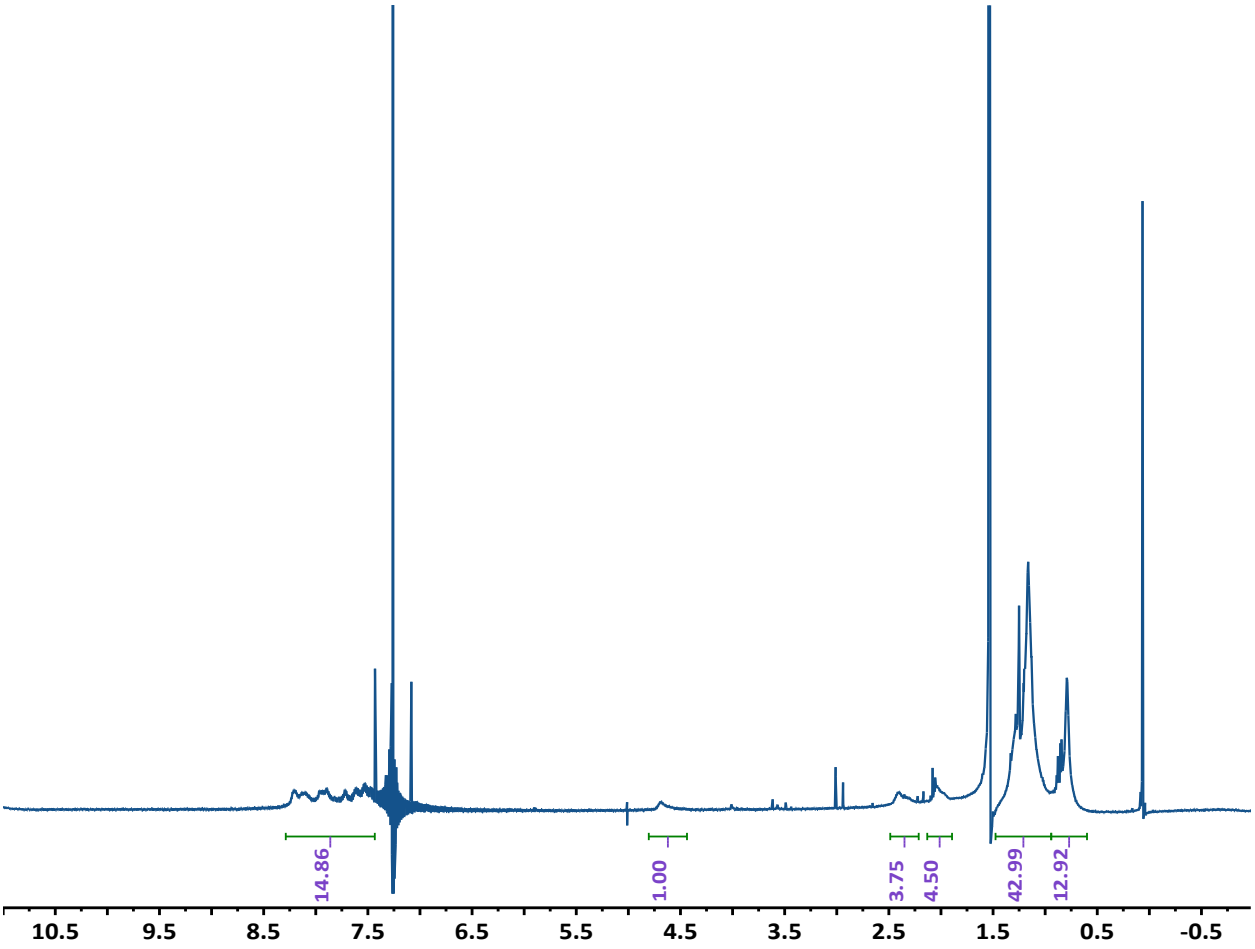

Figure S11. ^{1}H NMR of **P4** in $CDCl_3$

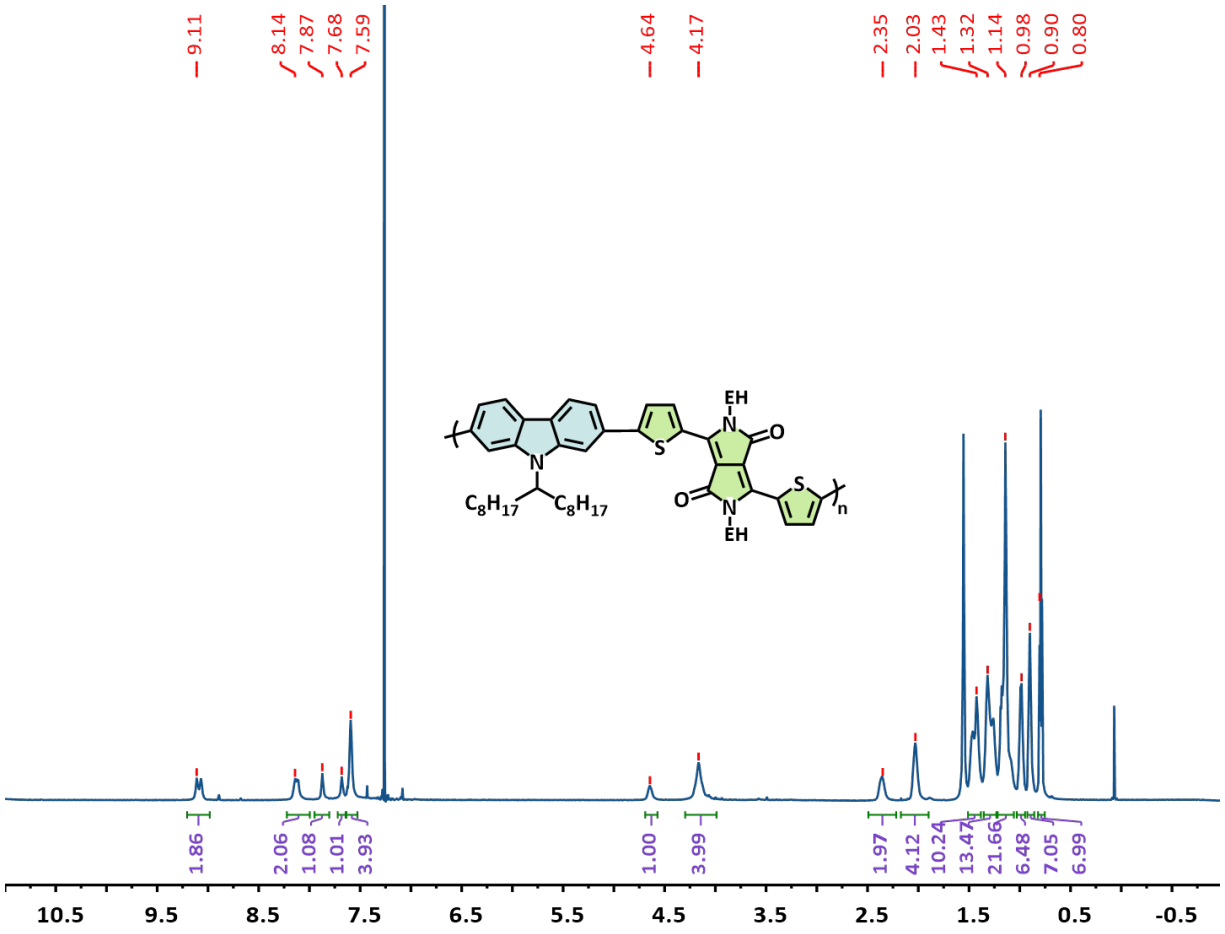

Figure S12. ^{1}H NMR of **A1** in $CDCl_3$

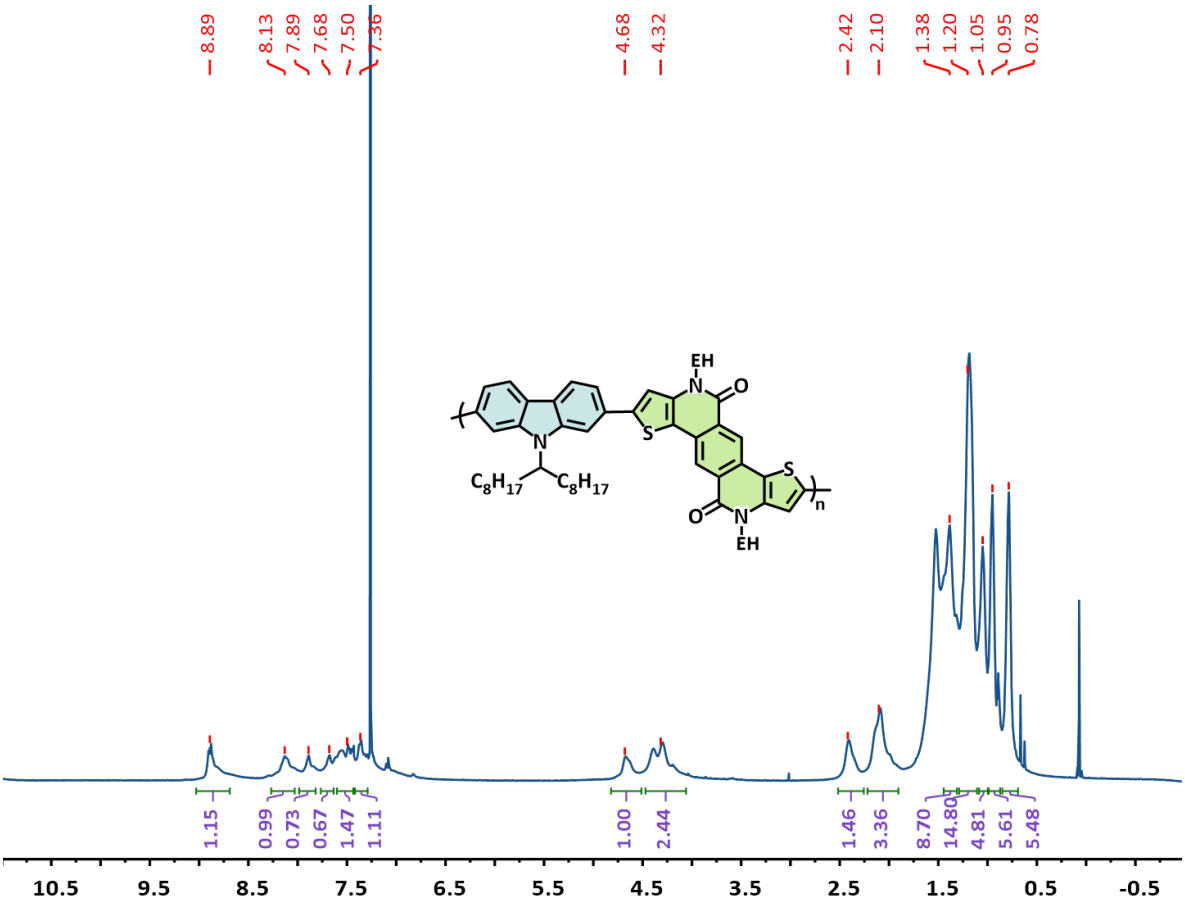

Figure S13. ^{1}H NMR of **A2** in $CDCl_3$

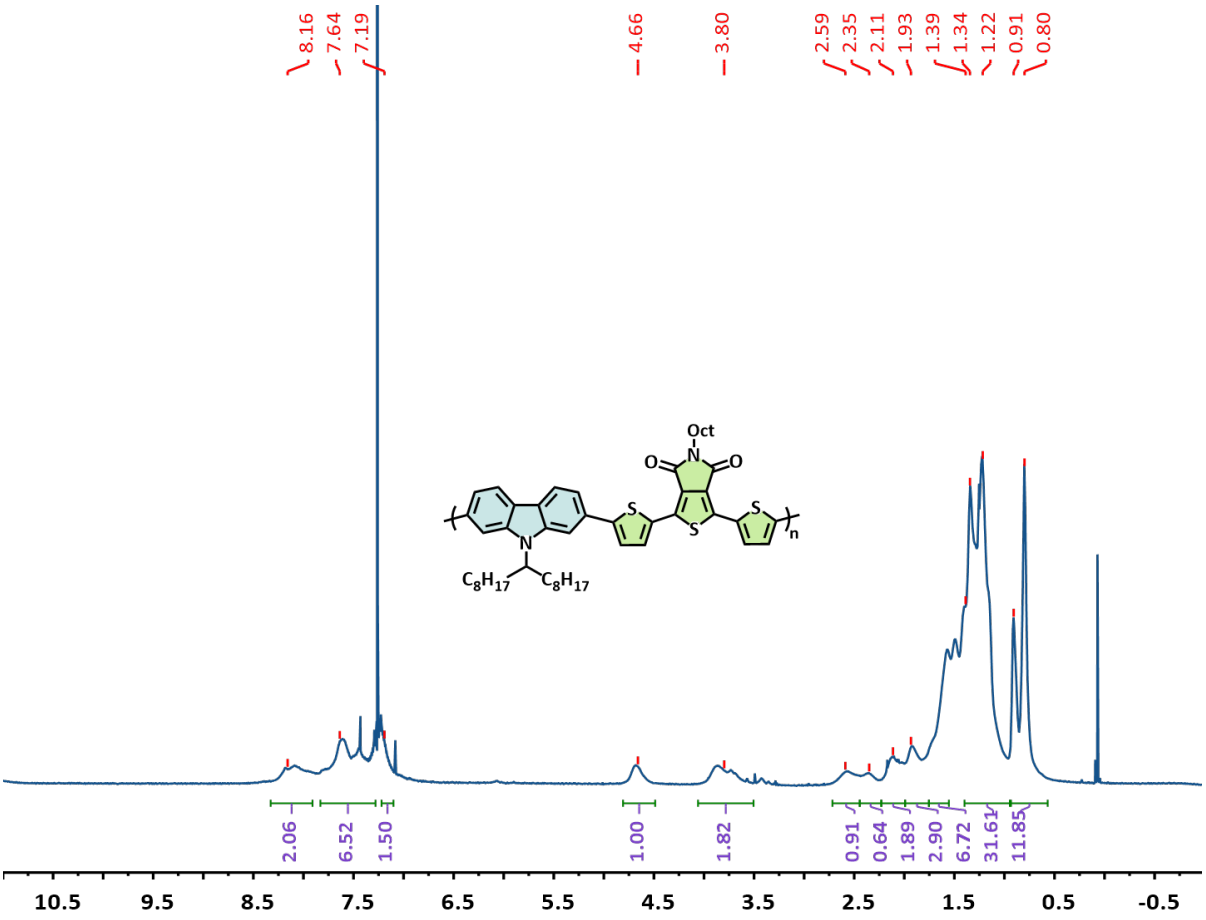

Figure S14. ^{1}H NMR of **A3** in $CDCl_3$

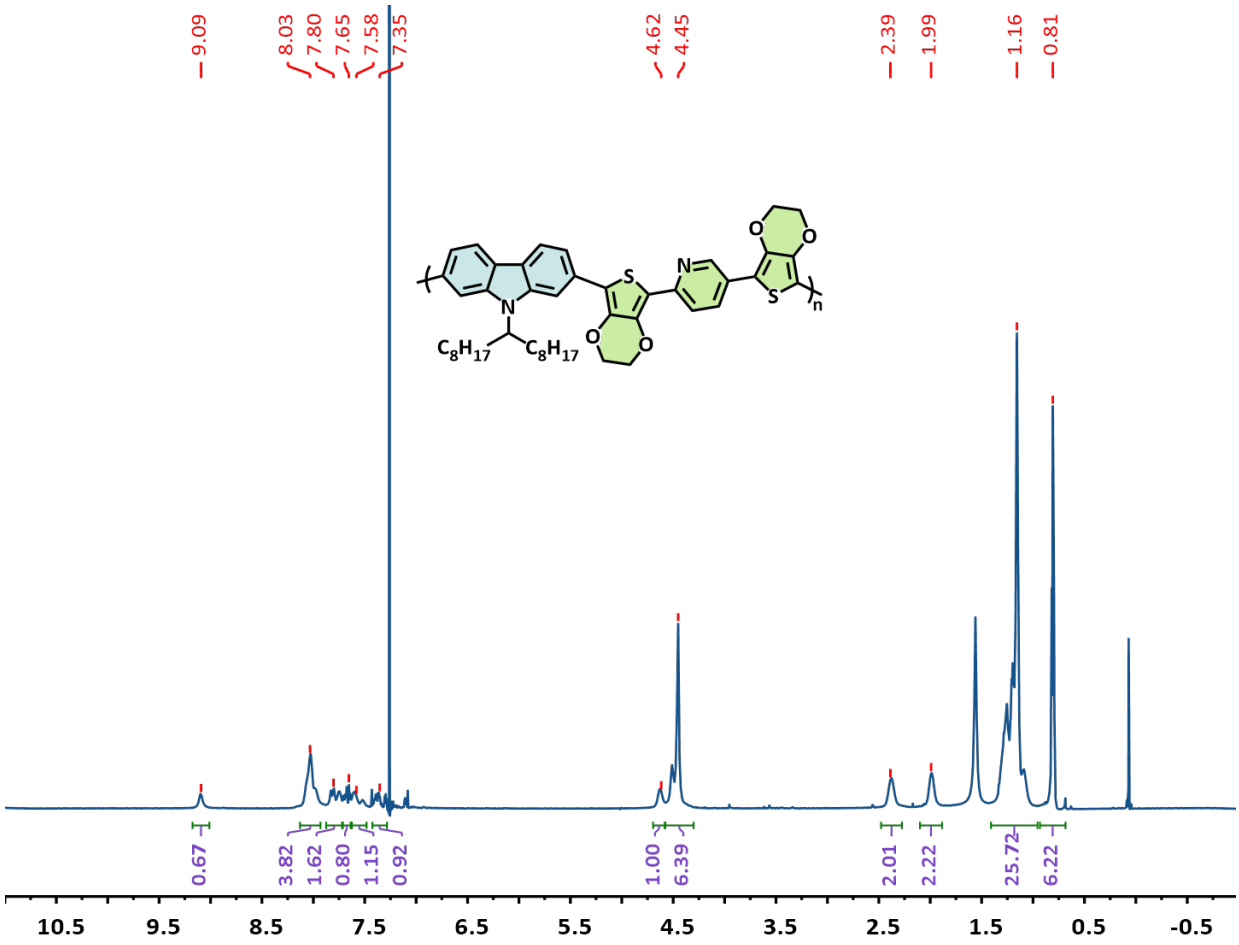

Figure S15. ^{1}H NMR of **A4** in $CDCl_3$

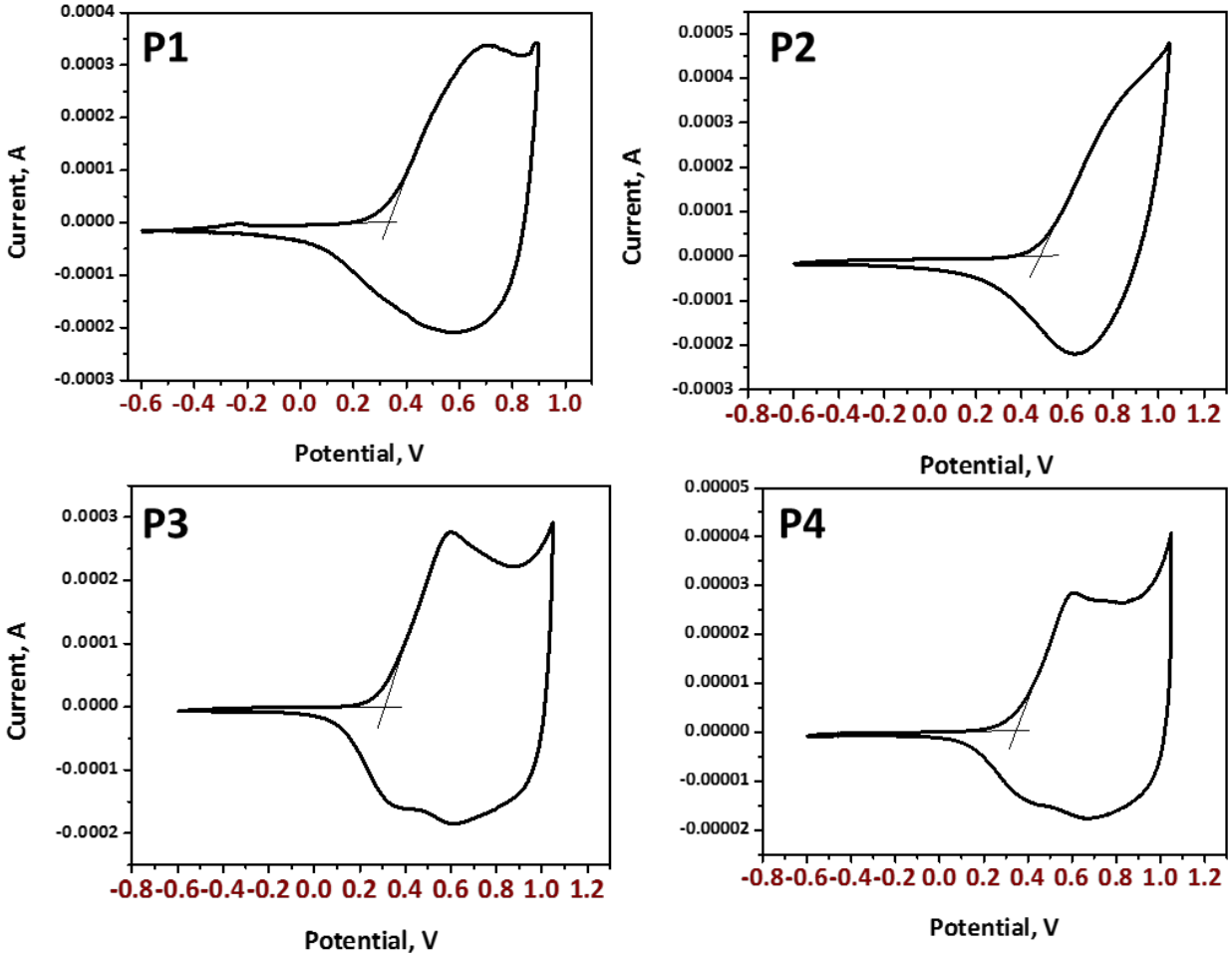

Figure S16. CV Traces for PCDTBT Series of Copolymers

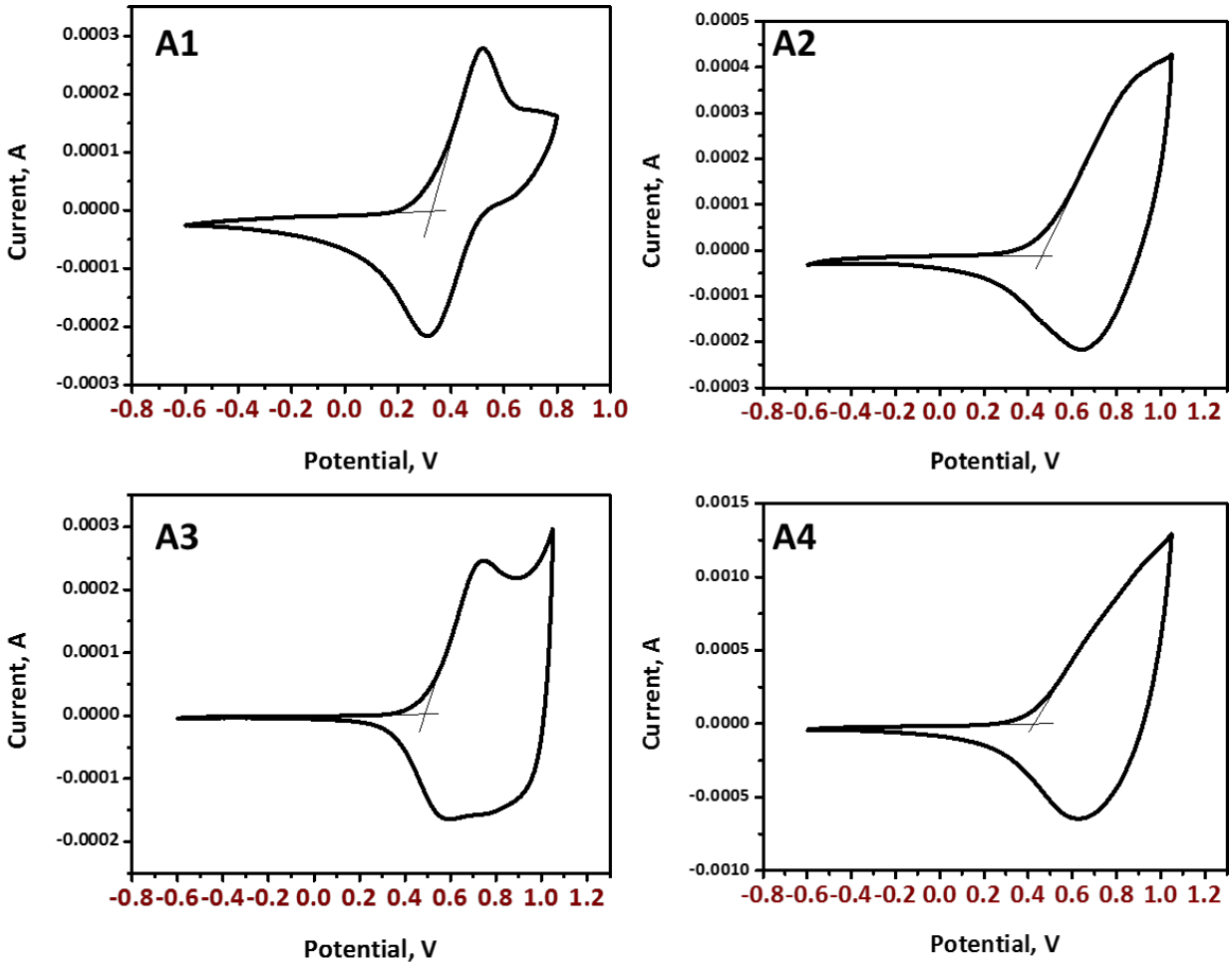

Figure S17. CV Traces for DArP Carbazole Series of Copolymers, where **A1** is PCDTDPP, **A2** is PCTPTI, **A3** is PCDTTPD, and **A4** is PCBEDOT-Pyr.

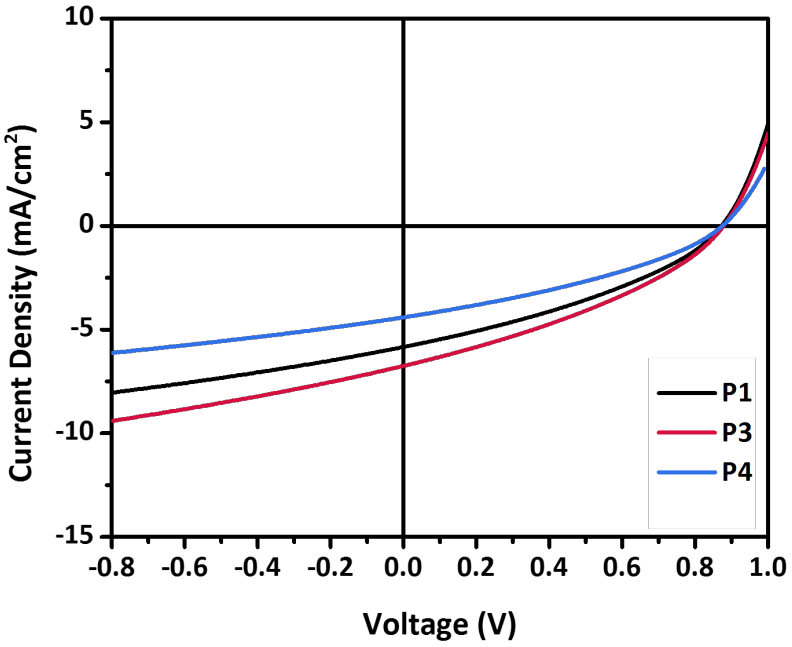

Figure S18. JV-Curves for PCDTBT Series of Copolymers

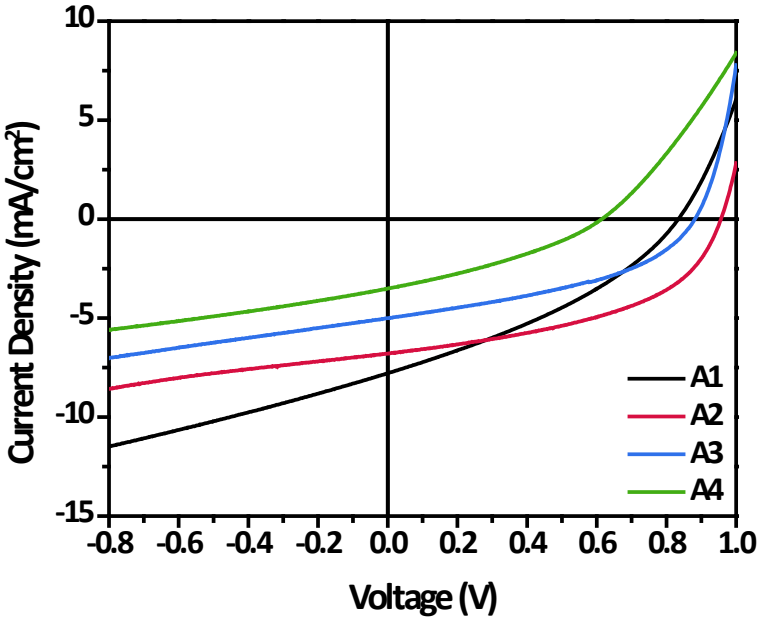

Figure S19. JV-Curves for Carbazole Series of Copolymers with Various Acceptors

Table S1. Summary of raw short-circuit current densities ($J_{sc,raw}$), spectral-mismatch factor (M), spectral mismatch-corrected short-circuit current densities ($J_{sc,corr}$) and integrated shortcircuit current densities ($J_{sc,EQE}$) for BHJ solar cells

PCDTBT:$PC_{61}BM$	***$J_{sc,raw}$*** **(mA/cm^2)**	**M**	***$J_{sc,corr}$*** **(mA/cm^2)**	***$J_{sc,EQE}$*** **(mA/cm^2)**	***J_{sc}*** **error (%)**
P1	5.80	0.94	6.17	6.13	0.7
P3	6.69	0.99	6.76	6.93	2.5
P4	4.03	0.97	4.15	4.33	4.2
Polymer:$PC_{61}BM$	***$J_{sc,raw}$*** **(mA/cm^2)**	**M**	***$J_{sc,corr}$*** **(mA/cm^2)**	***$J_{sc,EQE}$*** **(mA/cm^2)**	***J_{sc}*** **error (%)**
A1	6.51	0.83	7.84	7.69	2.0
A2	6.02	0.91	6.62	6.66	0.1
A3	4.49	0.91	4.93	5.16	4.7
A4	2.77	0.79	3.51	3.70	5.1

Table S2. Averages and Standard Deviations for Polymer Solar Cell Data

Polymer: $PC_{61}BM$	**J_{sc} [a] (mA/cm^2)**	**(±)**	***σ***	**V_{oc} (V)**	**(±)**	***σ***	**FF**	**(±)**	***σ***	**PCE [a] (%)**	**(±)**	***σ***
P1	6.17	±	0.1	0.87	±	0.01	0.35	±	0.01	1.88	±	0.03
P3	6.76	±	0.1	0.88	±	0.01	0.35	±	0.01	2.08	±	0.01
P4	4.15	±	0.3	0.87	±	0.01	0.31	±	0.01	1.12	±	0.03
Polymer: $PC_{61}BM$	**J_{sc} [a] (mA/cm^2)**	**(±)**		**V_{oc} (V)**	(±)		**FF**	(±)		**PCE [a] (%)**	(±)	***σ***
A1	7.84	±	0.1	0.83	±	0.002	0.38	±	0.04	2.44	±	0.1
A2	6.62	±	0.1	0.96	±	0.001	0.47	±	0.05	2.98	±	0.1
A3	4.93	±	0.1	0.88	±	0.004	0.42	±	0.07	1.68	±	0.1
A4	3.51	±	0.4	0.61	±	0.004	0.33	±	0.06	0.71	±	0.2