Supplementary Information (SI) for Polymer Chemistry.
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Supporting information

Aromatic vs. Aliphatic Linkers: Impact on Dye Loading and Stability in Oligoglycerol-Derived Dendronized Polymersomes

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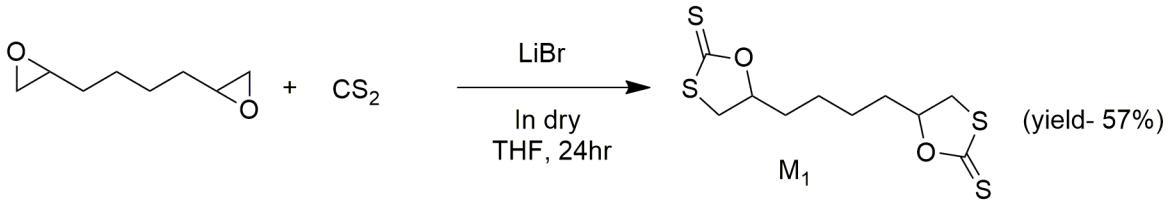
Synthesis and Characterization

Synthesis of M1



Scheme S1. Synthesis of M1

M1 was synthesized following the scheme S1. 1,2,7,8-diepoxyoctane (1 eq., 1.5 g, 10.54 mmol) was taken in 250 ml round bottom to it 2 ml of anhydrous THF was added and the solution was purged with N_2 gas and kept stirring for 5 minutes. Then in a vial CS_2 (4 eq., 3.2 g, 42.16 mmol) was taken and dissolved it in 1 ml of anhydrous THF after that LiBr (0.3 eq., 0.275 g, 3.162 mmol) was added to that vial (Molar ratio of Diepoxyoctane: CS_2: LiBr = 1: 4.0 : 0.3). Then the resulting mixture was added dropwise to that solution of the 1,2,7,8-diepoxyoctane while stirring via a syringe and the mixture was kept stirring for 24 hr at room temperature under N_2 atmosphere. The reaction mixture was then poured into water and extracted with ethyl acetate (3×100 mL). The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated in vacuo. Solid yellow crude resulted with yield 1.1 g (57%).

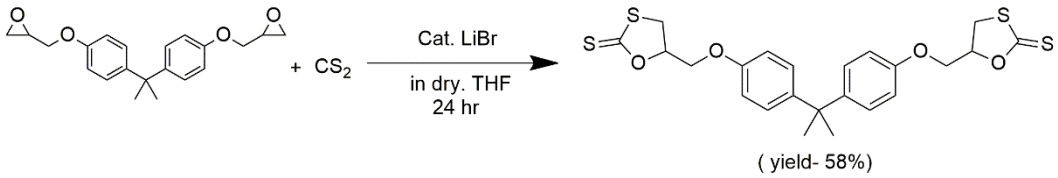
^{1}H NMR (400 MHz, $CDCl_3$, TMS): δ (ppm) =5.15- 5.08 (m, 2H), 3.64-3.62 (m, 2H), 3.48-3.36 (dd, 2H), 2.16-2.01 (m, 2H), 1.89-1.84 (m, 2H), 1.83-1.52 (m, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm)- 211.31, 91.61, 39.38, 33.16, 25.32.

HRMS (ESI): $(M + H)^+$ = 294.9944 (observed) and 294.9949 (calculated).

FTIR (cm^{-1})- 2972, 2932, 1612, 1501, 1459, 1436, 1355, 1239, 1188, 1043, 1008, 731, 650.

Synthesis of M2:



Scheme S2. Synthesis of M2

M2 was synthesized following the scheme S2. 2,2-Bis(4-glycidyloxyphenyl) propane (1 eq., 1.55 g, 4.55 mmol) was taken in a 250 ml round bottom flask equipped with a magnetic bead. To it 2 ml of anhydrous THF was added and the solution was purged with N_2 gas and kept stirring for 5 minutes. Then CS_2 (4 eq., 1.383 g, 18.2 mmol) was taken in a glass vial and dissolved it in 1 ml of anhydrous THF. After that LiBr (0.3 eq., 0.12 g, 1.4 mmol) was added to that vial (Molar ratio of Bis(4-glycidyloxyphenyl) propane: CS_2: LiBr = 1: 4.0 : 0.3). Then the resulting mixture was added dropwise to that solution of 2,2-Bis(4-glycidyloxyphenyl) propane while stirring via a syringe and the mixture was kept stirring for 24 hr at room temperature. The reaction mixture was then poured into water and extracted with ethyl acetate (3×100 mL). The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated in vacuo. Solid yellow crude resulted with yield 0.841 g (yield 58 %).

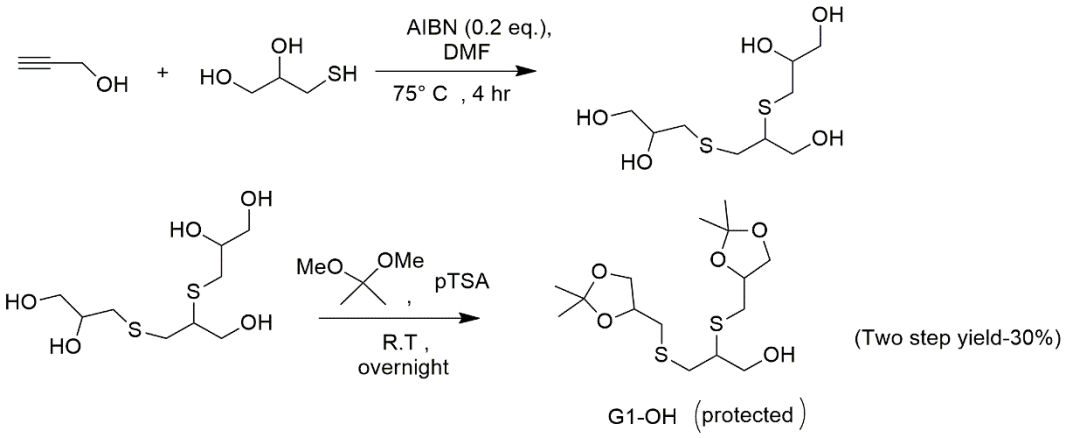
^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 7.16- 7.13 (d, 4H), 6.83-6.80 (d, 4H), 5.46-5.40 (m, 2H), 4.36-4.24 (m, 4H), 3.81-3.71 (m, 4H), 1.68-1.61 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) = 211.31, 155.37, 144.14, 127.97, 113.72, 87.65, 60.26, 41.50, 35.74, 30.99,

HRMS: $(M + H)^+$ = 493.0631 (observed) and 493.0632 (calculated).

FTIR (cm^{-1}) - 2933, 2876, 1732, 1605, 1513, 1455, 1362, 1305, 1235, 1188, 1051, 935, 831, 658, 565.

Synthesis of HO-G_1-P:



Scheme S3. Synthesis of HO-G_1-P

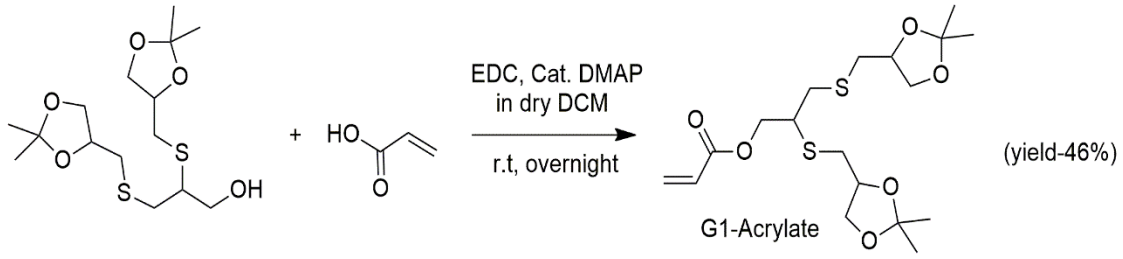
HO-G_1-P was synthesized following the scheme S3. Propargyl alcohol (1 eq., 3.0 g, 53.51 mmol) and 1-thioglycerol (3 eq., 1.7g, 160.5 mmol) were taken in a 250 ml round bottom flask filled with N_2 gas. The mixture was stirred for 10 minutes at 70°C, then AIBN (0.1 eq., 0.878 g, 5.35 mmol) was added during stirring, then this reaction was kept for 4.5 hr at 75°C (Molar ratio of Propargyl alcohol: 1-thioglycerol: AIBN = 1: 3.0 : 0.1). Then the solvent was evaporated in rotary evaporator and concentrated in vacuo. The acetal protection was carried out adding 2, 2'-dimethoxypropane (8 eq., 44.6 g, 428 mmol), and p-toluenesulfonic acid monohydrate (pTSA. H_2O) (0.1 eq., 1.027 g, 5.35 mmol) were added to the crude product The mixture was stirred overnight at room temperature. Then the mixture was quenched by triethylamine (1.5 eq., 8.1 g, 80.27 mmol). Then the solvent was evaporated in rotavapor. Next the crude was suspended in water and extracted with DCM. The organic layer was dried over Sodium sulphate and solvent was evaporated to yield the crude product, which had been purified by column chromatography with hexane and ethyl acetate to give compound pure HO-G_1-P with yield 30% (5.8 g).

^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) = 4.29- 4.22 (m, 2H), 4.14-4.05 (dd, 2H), 3.88-3.65 (dd, m, 4H), 3.07-2.61 (m, 7H), 1.45-1.40 (s, 6H), 1.38-1.32 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) = 109.75, 75.61, 68.69, 63.12, 35.66, 35.05, 33.97, 26.82, 25.34

HRMS: $(M + H)^+$ = 353.1387 (observed) and 353.1405 (calculated).

Synthesis of Acr-G_1-P:



Scheme S4. Synthesis of Acr-G_1-P

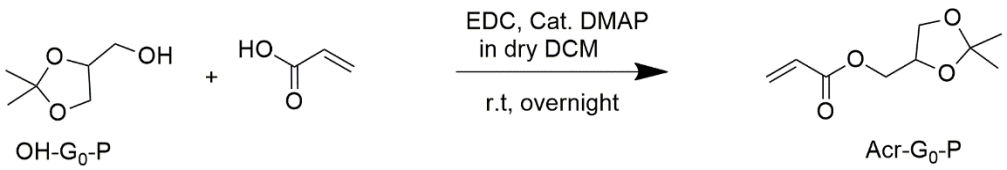
Acr-G_1-P was synthesized following the scheme S4. HO-G_1-P (1 eq., 1.0 g, 2.8 mmol) and DMAP (0.2 eq., 0.135 g, 1.1 mmol) were taken in a 250 mL round bottomed flask filled with N_2 atmosphere. Then, 2 ml of dry DCM was added. Acrylic acid (2 eq., 0.525 g, 5.524 mmol), was added to the reaction mixture by dissolving in dry DCM. EDC (3.6 eq., 1.9 g, 9.94 mmol) was taken in a vial and dissolved it in dry DCM (Molar ratio of HO-G_1-P: DMAP: Acrylic acid : EDC.HCl = 1: 0.2 : 2.0 : 3.6). The EDC solution was dropwise added to the above reaction

mixture at 4 ^{o}C and the reaction mixture was stirred overnight at room temperature. Afterwards, the reaction mixture was washed with sodium bicarbonate solution, 1 M HCl, and brine solution and finally combined organic layer was dried over sodium sulphate and evaporated to yield brownish yellow liquid (0.51g) with yield 46%.

^{1}H NMR (400 MHz, $CDCl_3$): δ(ppm) = 6.42(d, 1H), 6.12(dd,1H), 5.86 (d,1H), 4.44- 4.30 (m, 2H), 4.27-4.22 (dd, 2H), 4.10-3.67 (m, 4H), 3.24-2.60 (m, 7H), 1.45-1.37 (s, 6H), 1.37-1.31 (s, 6H).

HRMS: $(M + H)^+$ = 407.1766 (observed) and 407.1556 (calculated).

Synthesis of Acr-G_0-P:



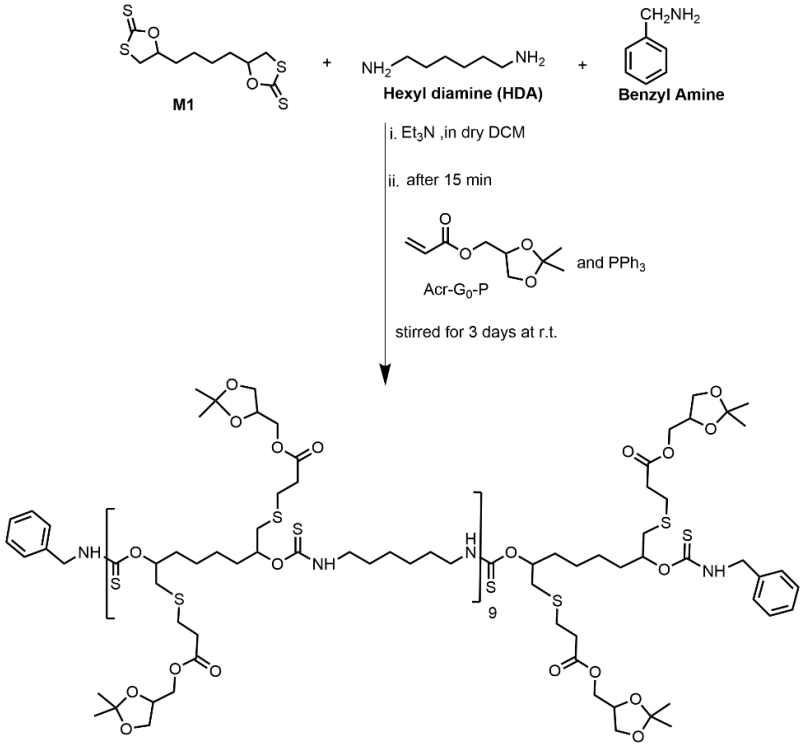
Scheme S5. Synthesis of Acr-G_0-P

Acr-G_0-P was synthesized following the scheme S5. HO-G_0-P (1eq., 1.2 g, 9.1 mmol) and DMAP (0.2 eq., 0.222 g, 1.82 mmol) were taken in a 250 mL round bottomed flask filled with N_2 atmosphere. Then 2 ml of dry DCM was added. Acrylic acid (2 eq., 1.3 g, 18.1 mmol), was added to the reaction mixture by dissolving in dry DCM. EDC (3.6 eq., 6.3 g, 32.6 mmol) was taken in a vial and dissolved it in dry DCM (Molar ratio of HO-G_0-P: DMAP: Acrylic acid : EDC.HCl = 1: 0.2 : 2.0 : 3.6). The EDC solution was dropwise added to the above reaction mixture at 4 ^{o}C and then the reaction mixture was stirred overnight at room temperature. Afterwards, the reaction mixture was washed with sodium bicarbonate solution, 1M HCl, and brine solution and finally combined organic layer was dried over sodium sulphate and evaporated to yield brownish yellow liquid (0.772 g) with yield 46 %.

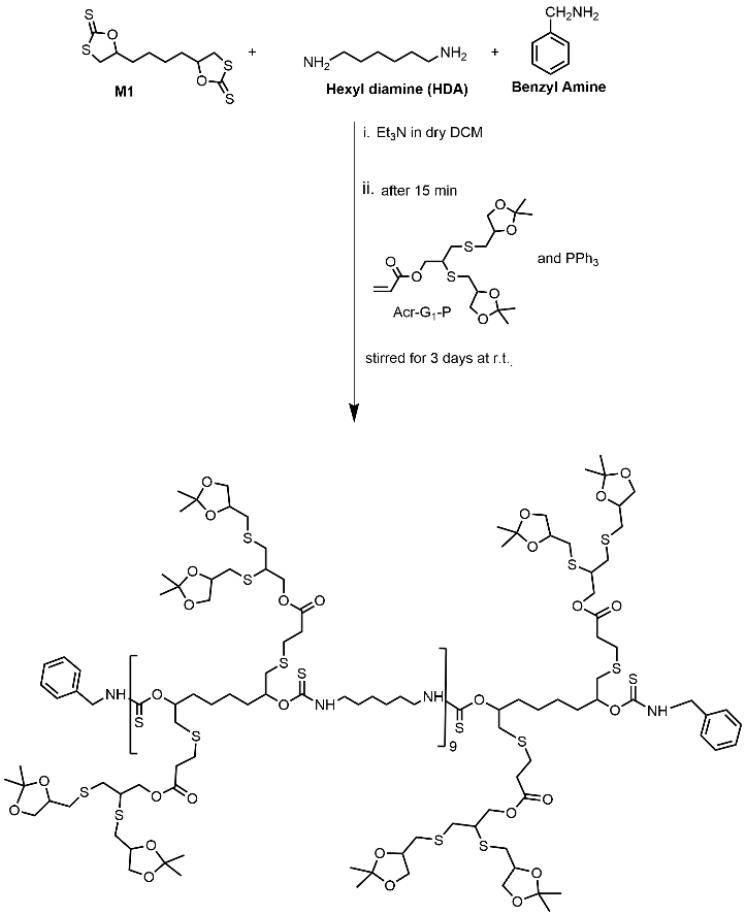
^{1}H NMR (400 MHz, $CDCl_3$): δ(ppm) = 6.26-6.22 (d,1H), 6.00-5.93 (dd, 1H), 5.69-5.66 (d,1H), 4.19- 4.13 (m, 1H), 4.07-4.03 (dd, 1H), 4.00-3.95 (dd, 1H), 3.92-3.88 (dd, 1H), 3.60-3.57 (dd, 6H), 1.25-1.21 (s, 3H), 1.18-1.14 (s, 3H).

HRMS: $(M + H)^+$ = 187.0912 (obtained) and 187.0964 (calculated).

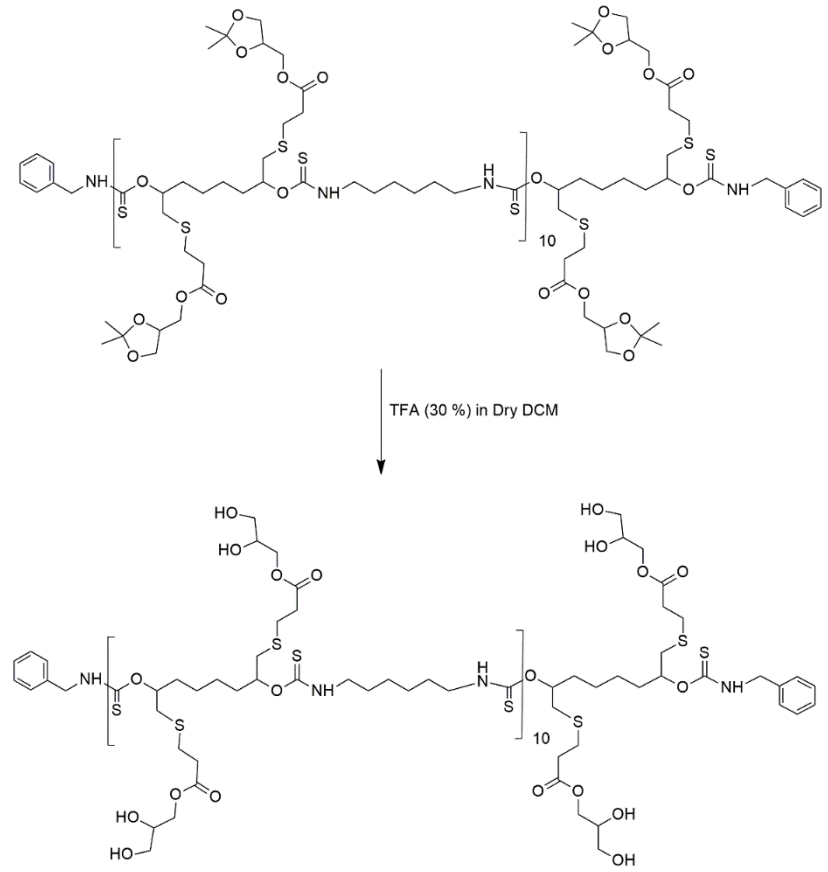
Synthetic Schemes for Polymers



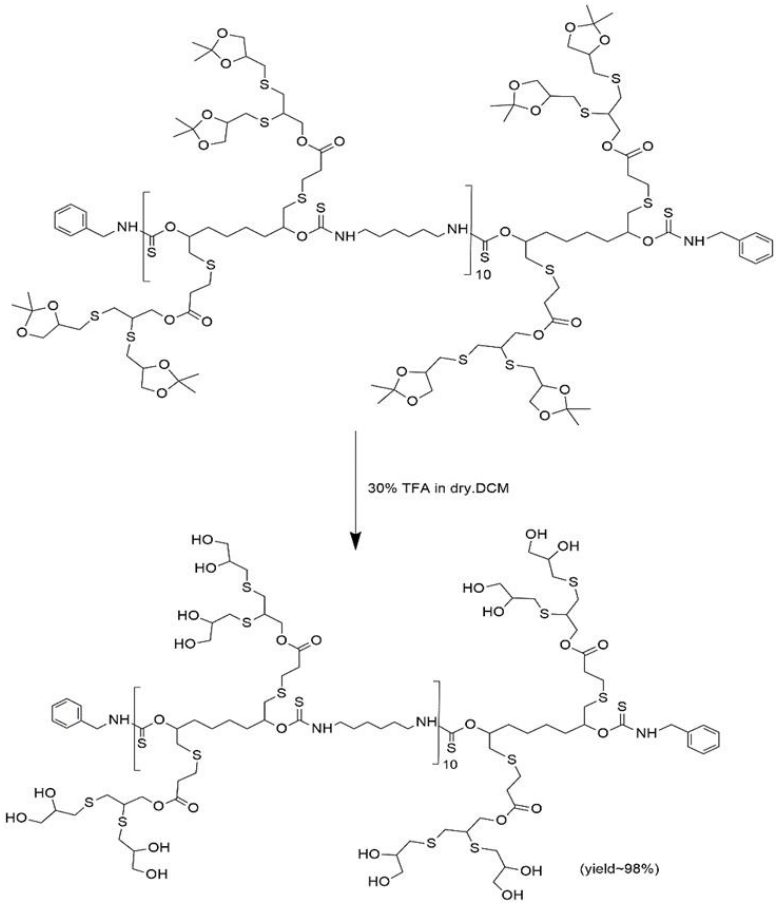
Scheme S6. Synthesis of ALP-PTU-G$_0$-P.



Scheme S7. Synthesis of ALP-PTU-G$_1$-P.



Scheme S8. Synthesis of ALP-PTU-G$_0$-OH



Scheme S9. Synthesis of ALP-PTU-G$_1$-OH

Additional Figures.

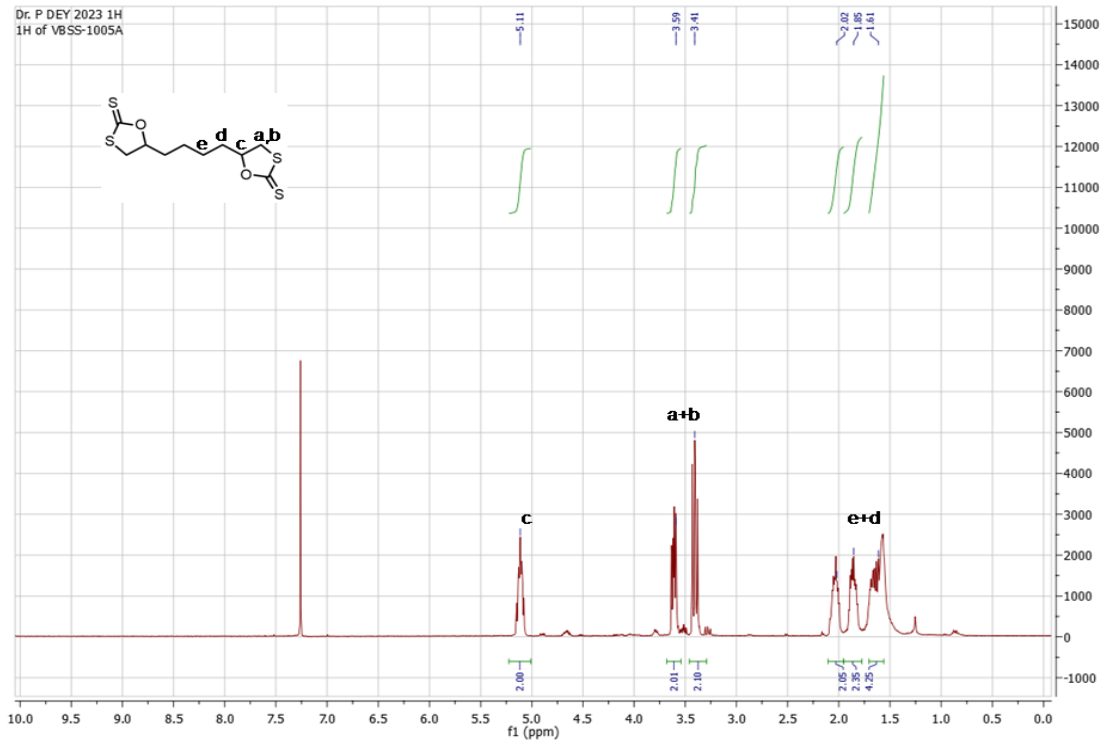


Figure S1. ^{1}HNMR of M1 in $CDCl_3$

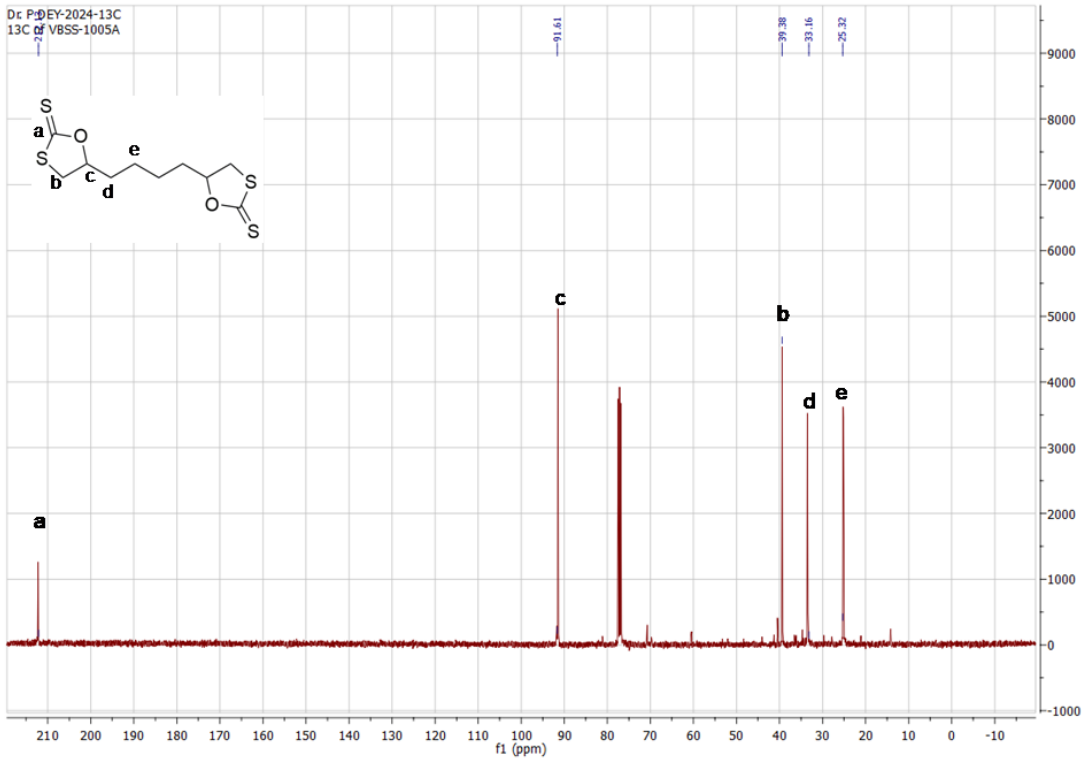


Figure S2. ^{13}C NMR of M1 in $CDCl_3$

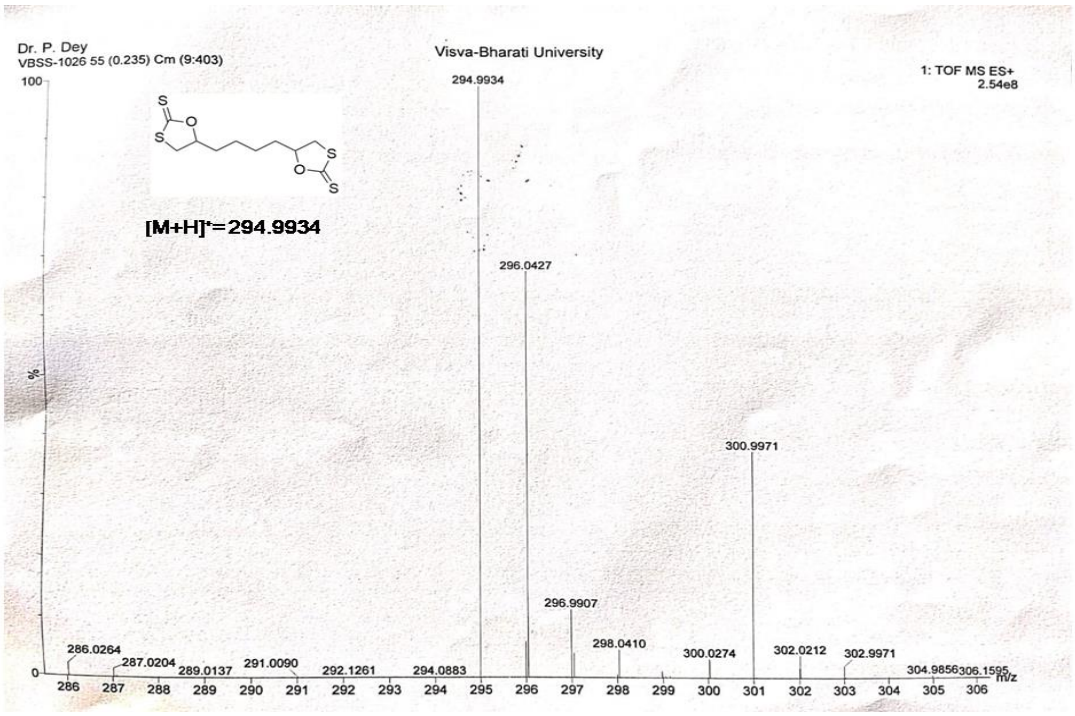


Figure S3. HRMS of M1. $(M + H)^+$ = 294.9944 (observed) and 294.9949 (calculated).

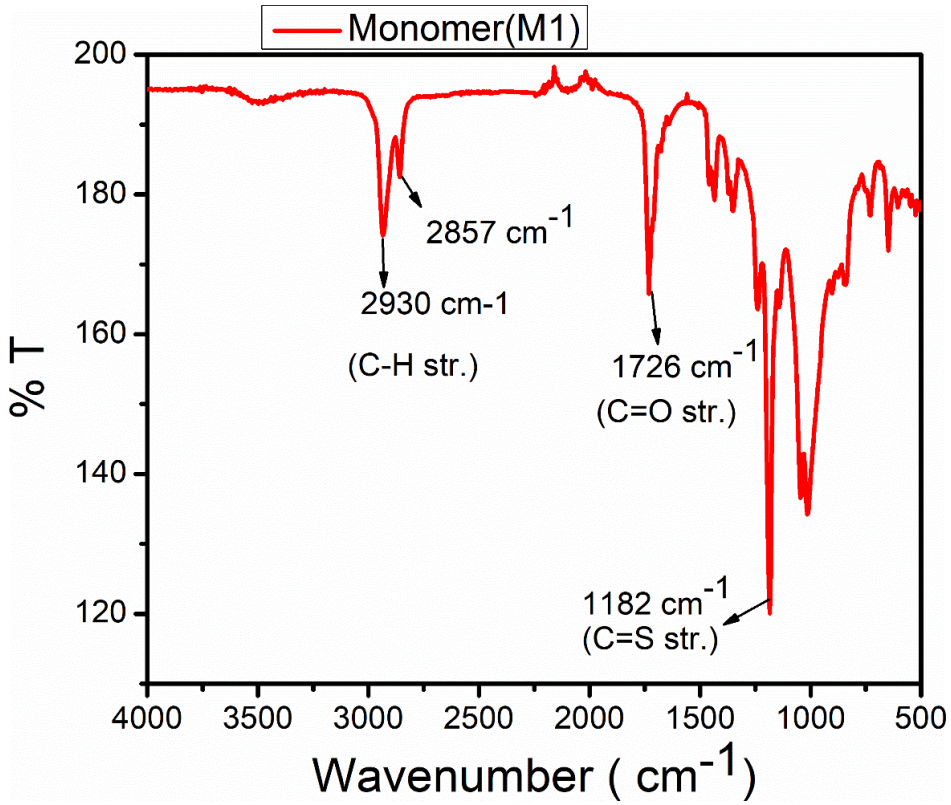


Figure S4. FTIR spectrum of M1

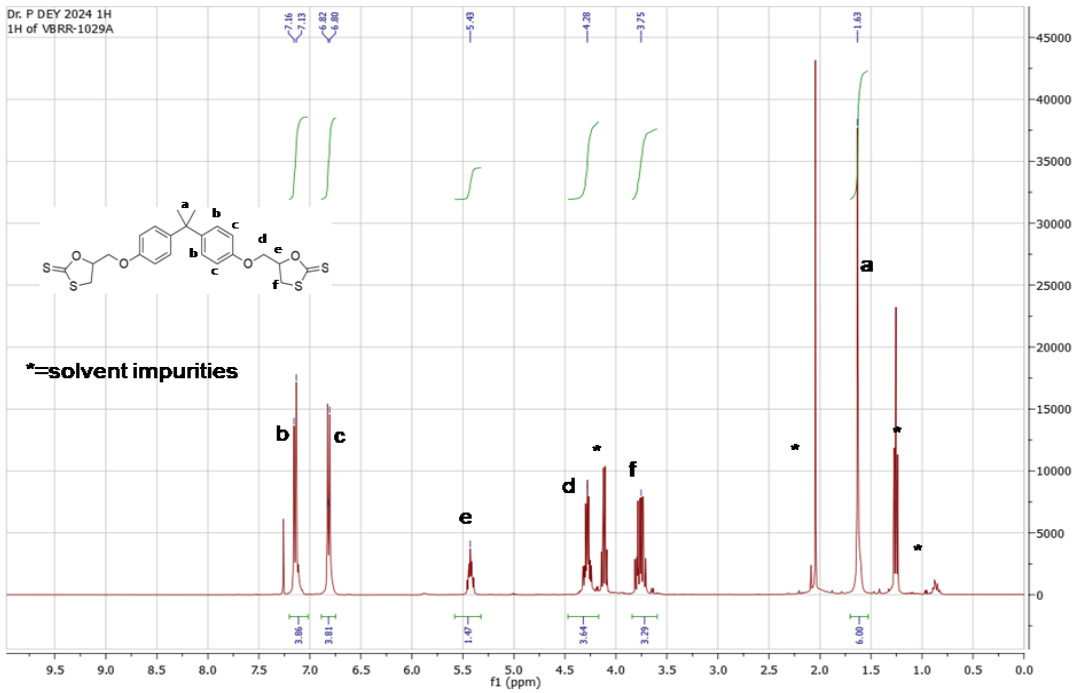


Figure S5. ^{1}H NMR of M2 in $CDCl_3$

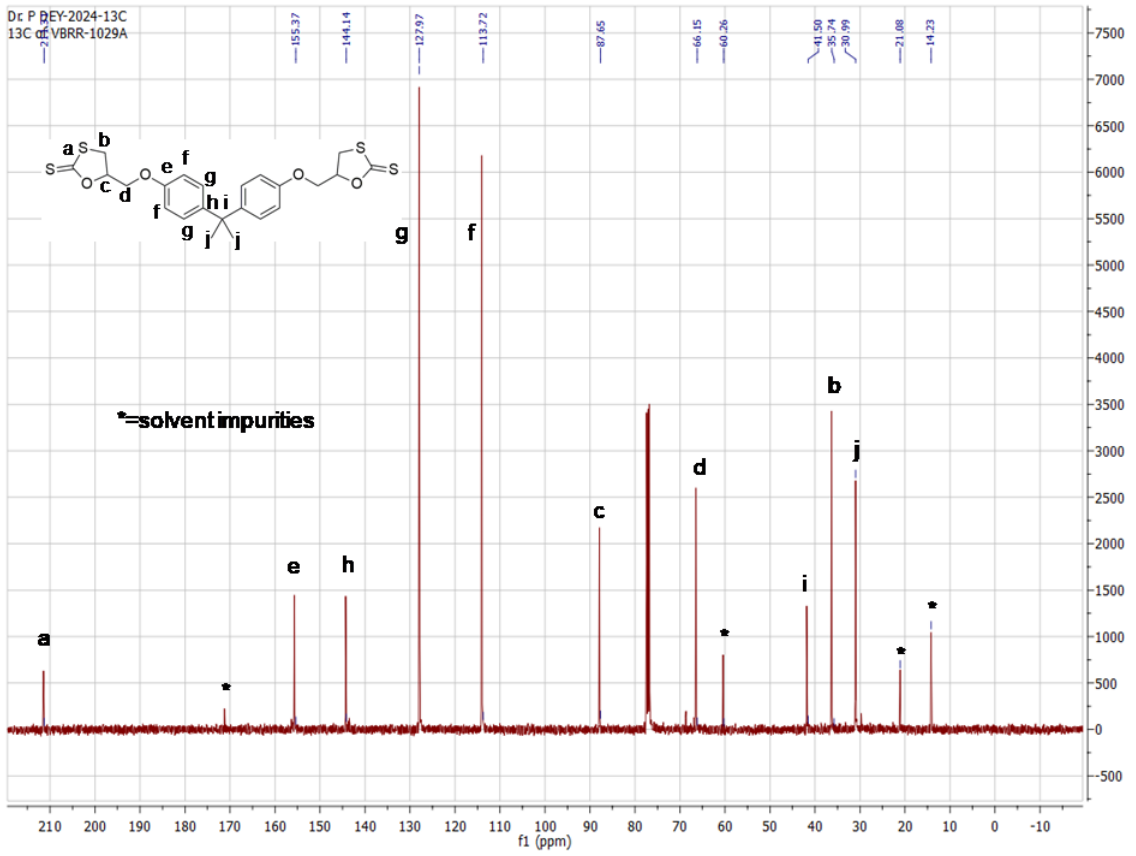


Figure S6. ^{13}C NMR of M2 in $CDCl_3$.

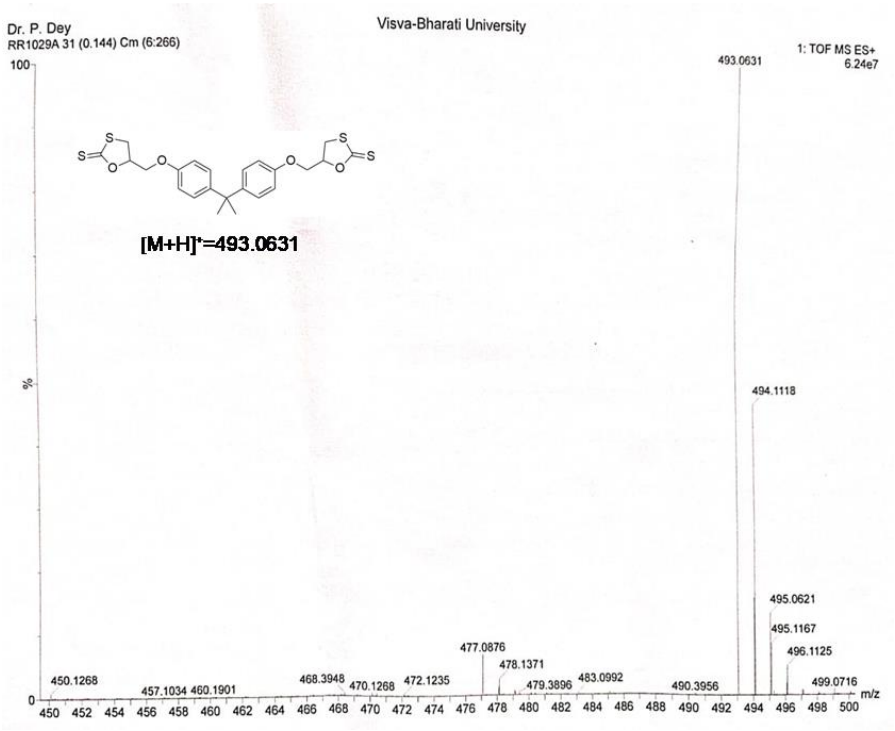


Figure S7. HRMS of M2. $(M + H)^+$ = 493.0631 (observed) and 493.0632 (calculated).

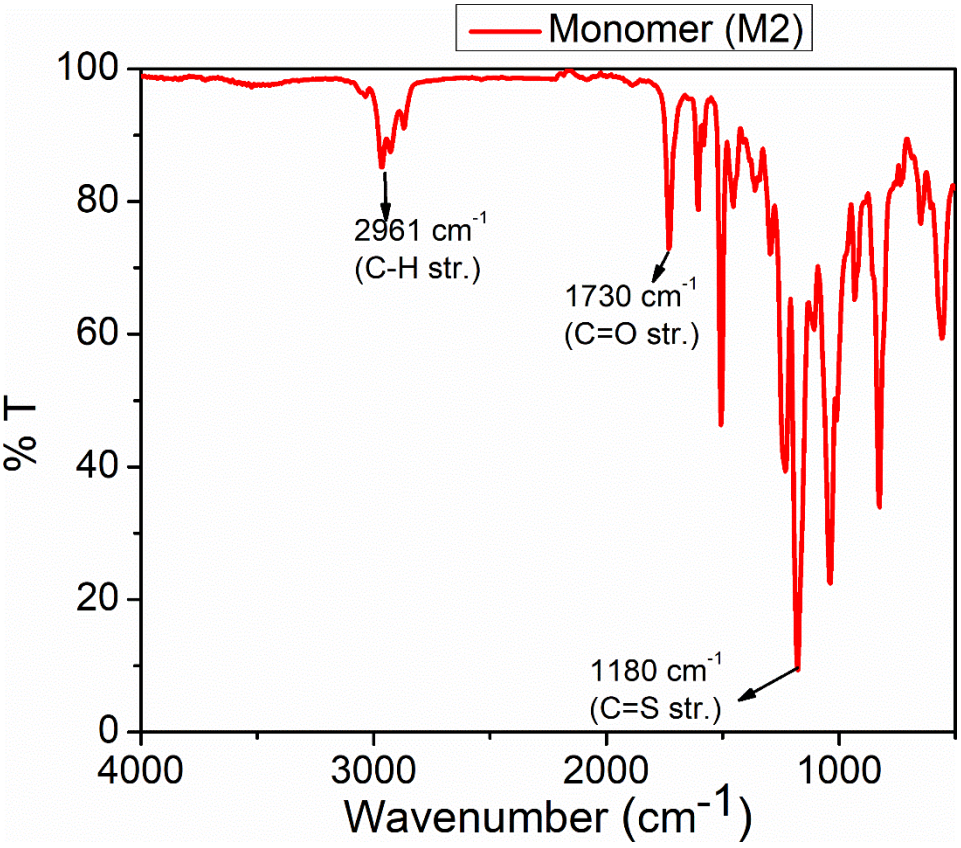


Figure S8. FTIR of M2

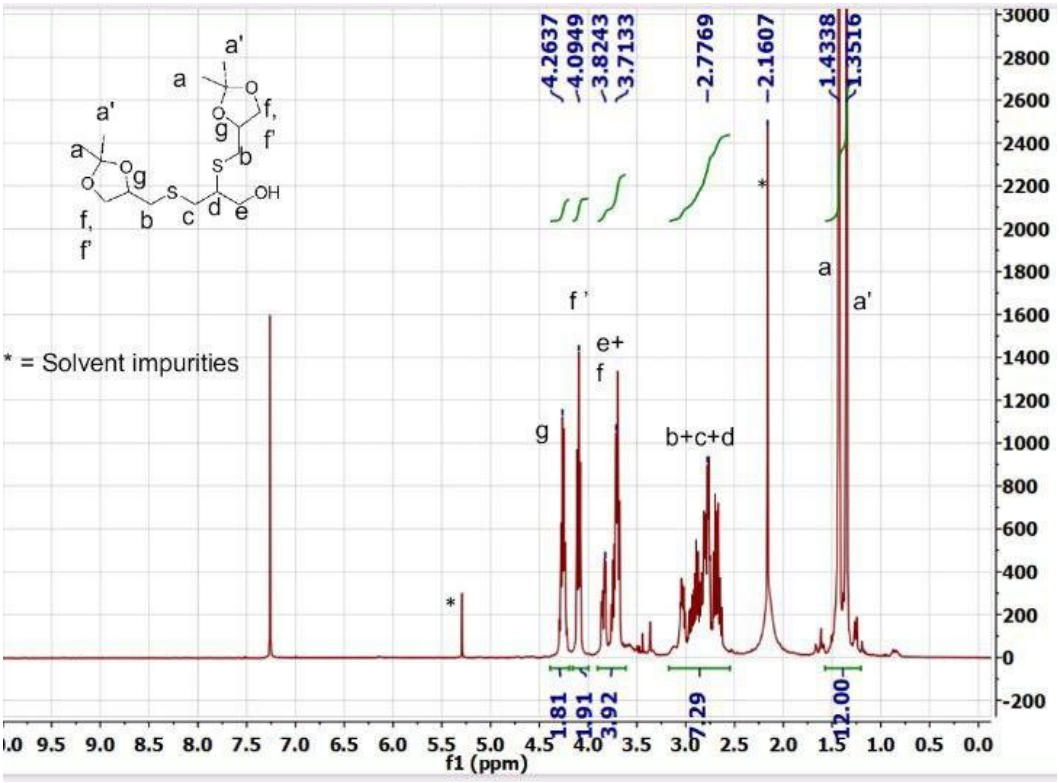


Figure S9. ^{1}H NMR of OH-G_1-P in $CDCl_3$

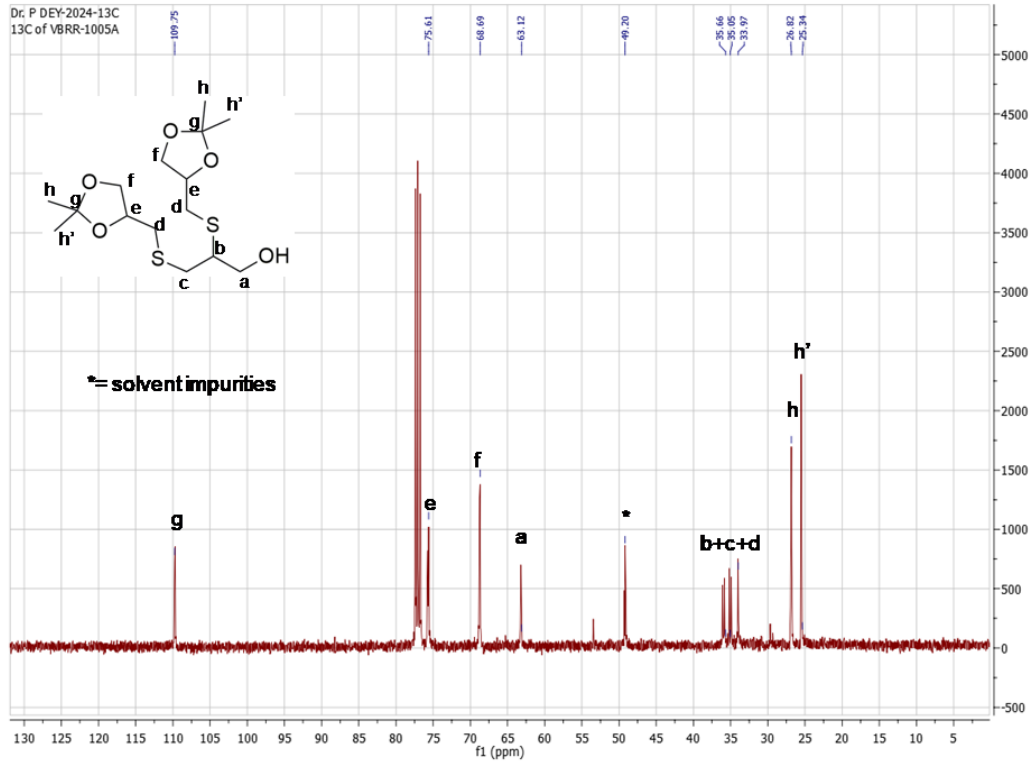


Figure S10. ^{13}C NMR of OH-G_1-P in $CDCl_3$

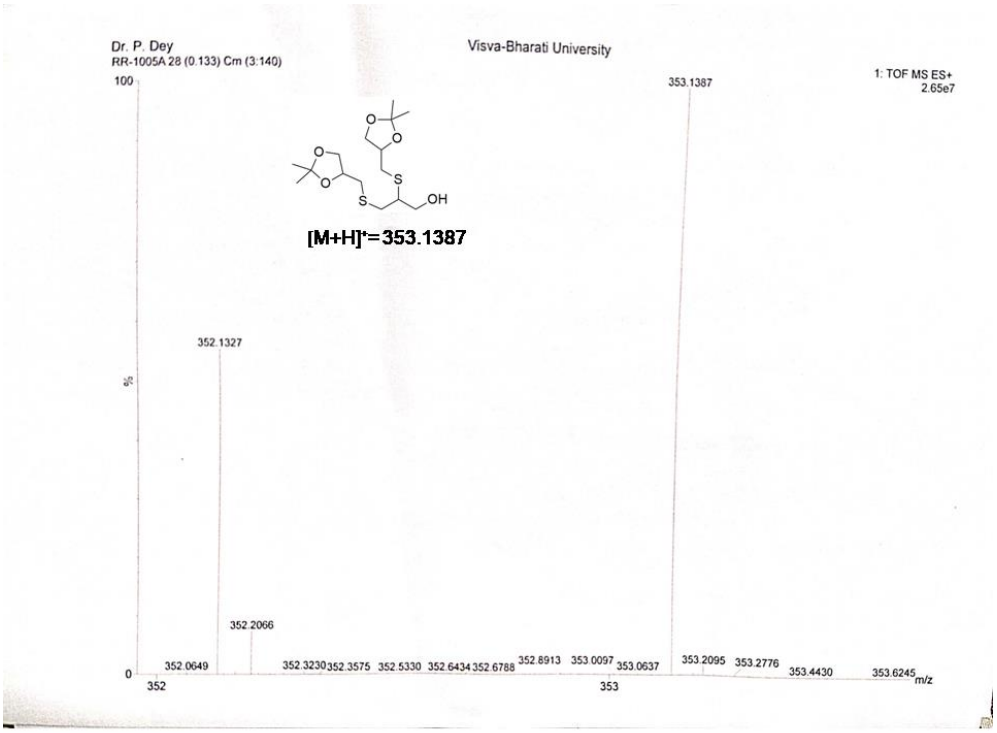


Figure S11. HRMS of OH-G_1-P. $(M + H)^+$ = 353.1387 (observed) and 353.1405 (calculated).

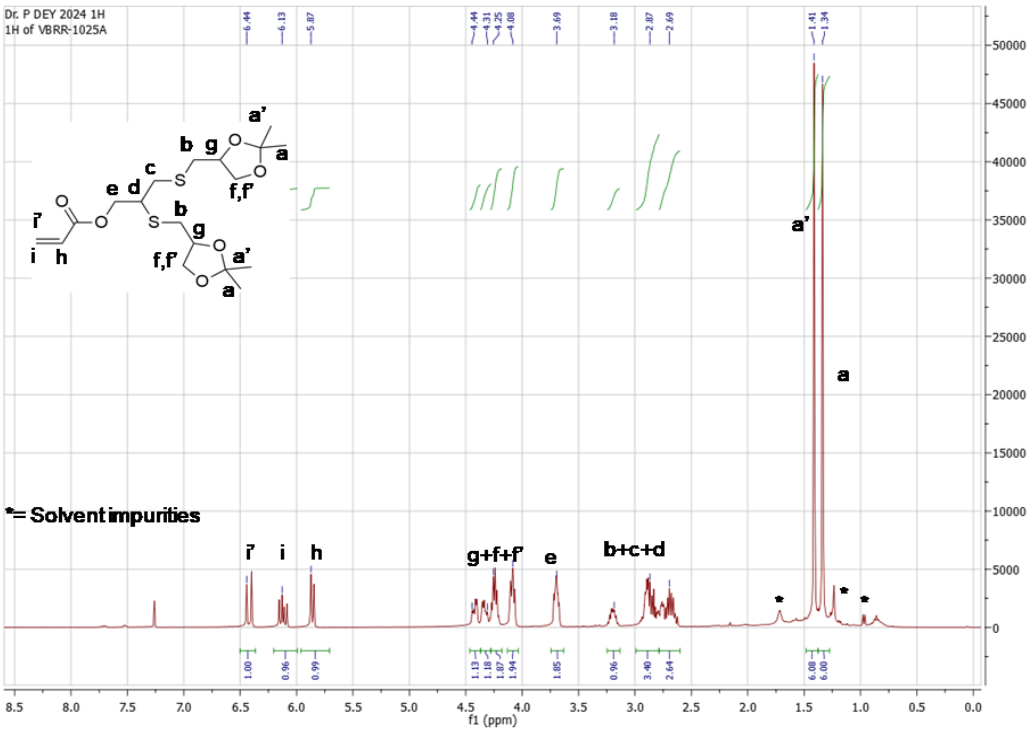


Figure 12. ^{1}H NMR of Acr-G_1-P in $CDCl_3$

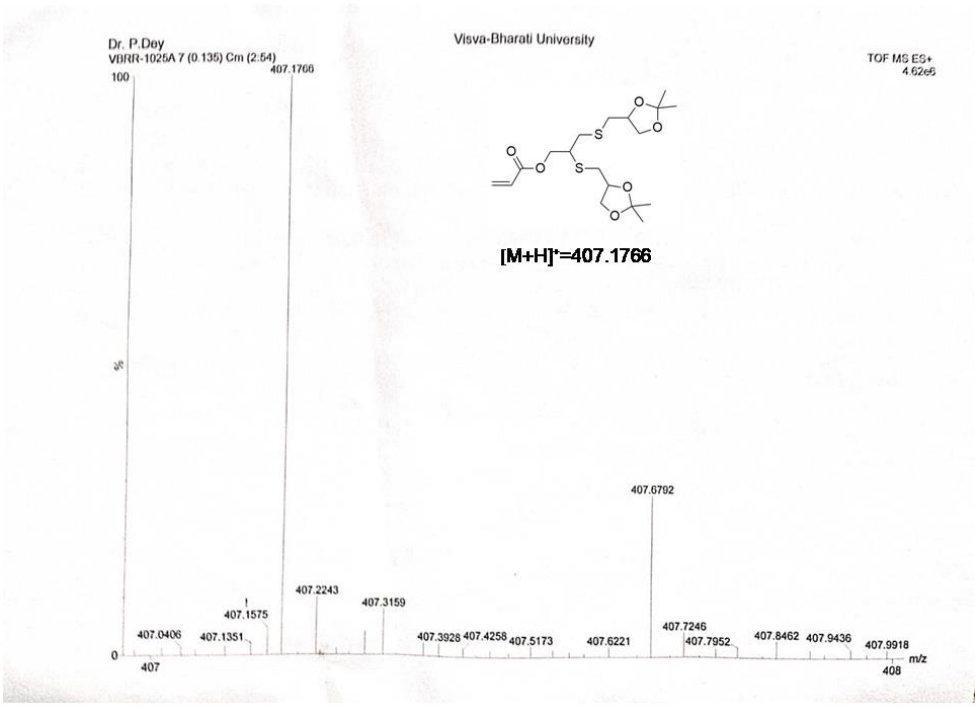


Figure S13. HRMS of Acr-G_1-P. $(M + H)^+$ = 407.1766 (observed) and 407.1556 (calculated).

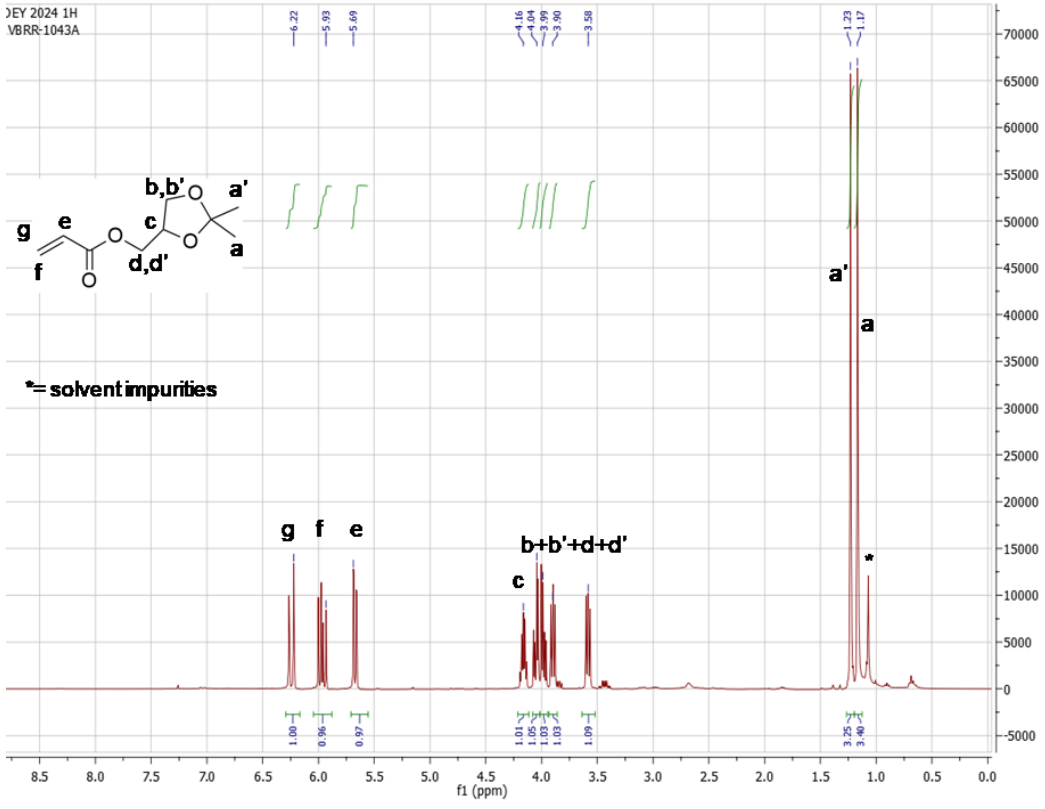


Figure S14. ^{1}HNMR of Acr-G_0-P in $CDCl_3$

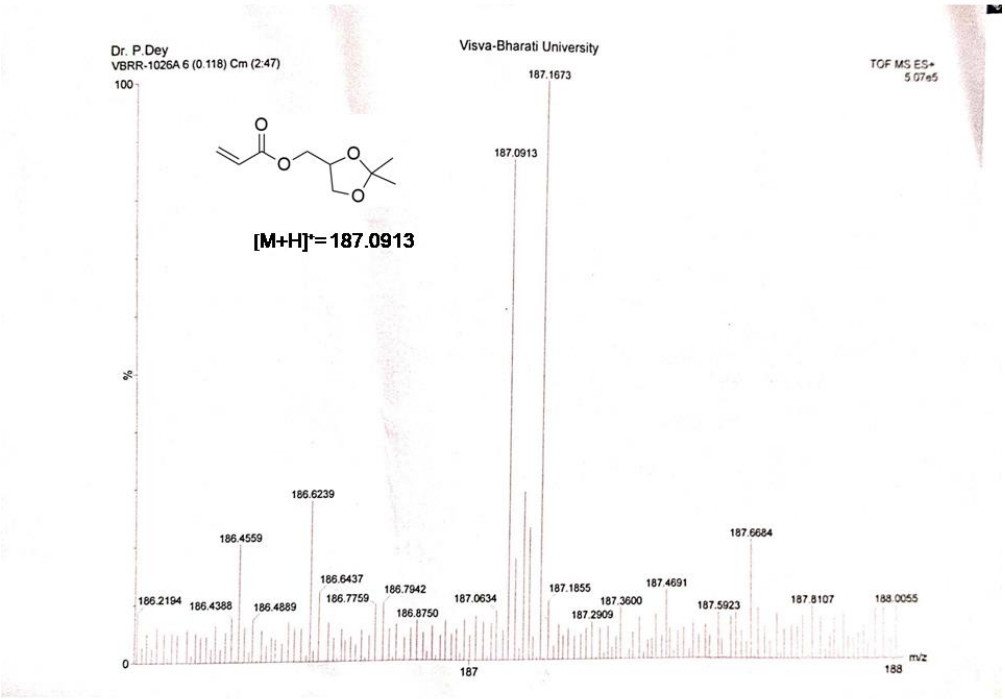


Figure S15. HRMS of Acr-G_0-P. $(M + H)^+$ = 187.0913 (obtained) and 187.0964 (calculated).

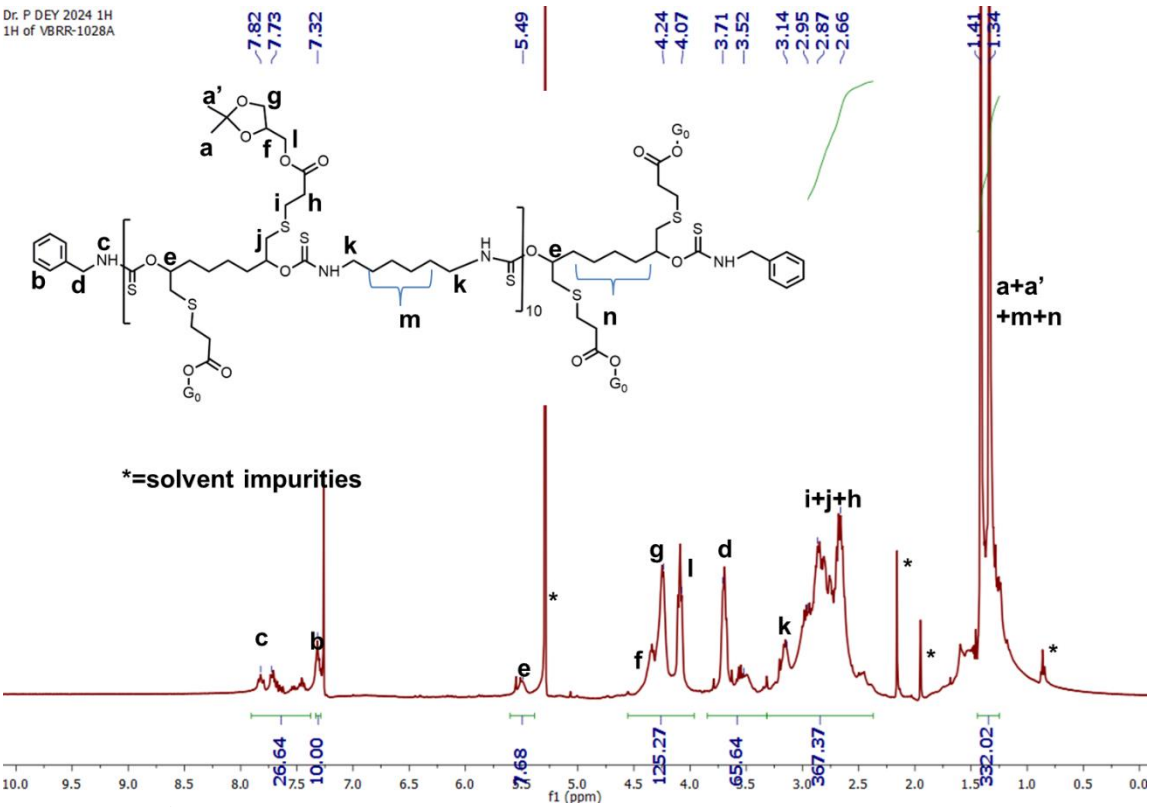


Figure S16. ^{1}HNMR of ALP-PTU-G_0 -P in $CDCl_3$

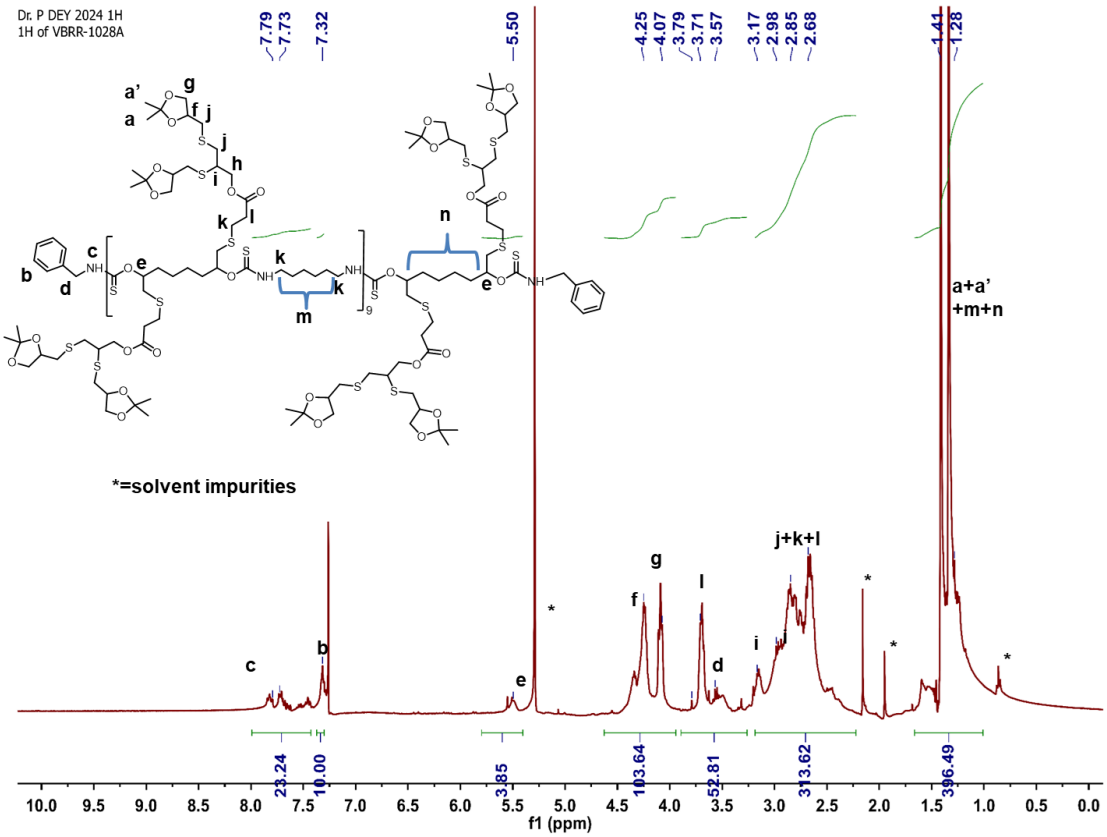


Figure S17. ^{1}H NMR of ALP-PTU-G_1-P in $CDCl_3$

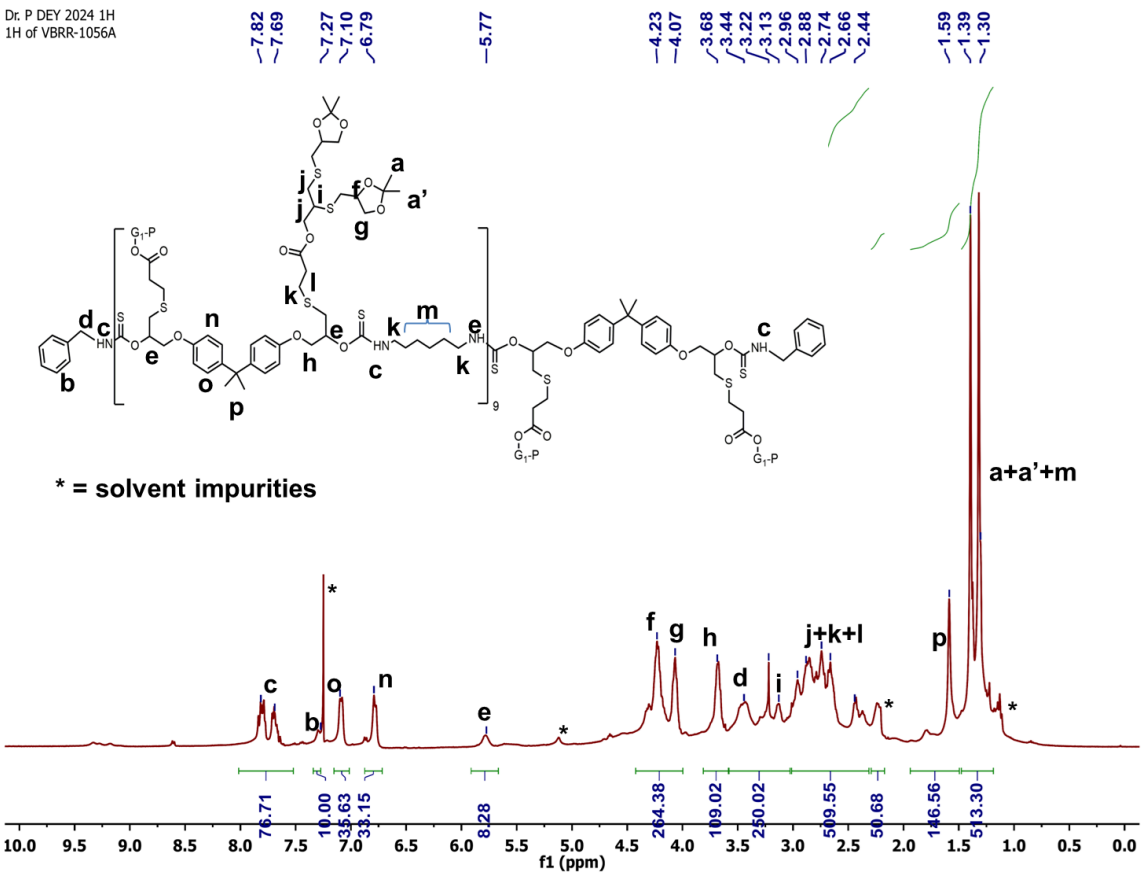


Figure S18. ^{1}H NMR of ARM-PTU-G_1-P in $CDCl_3$

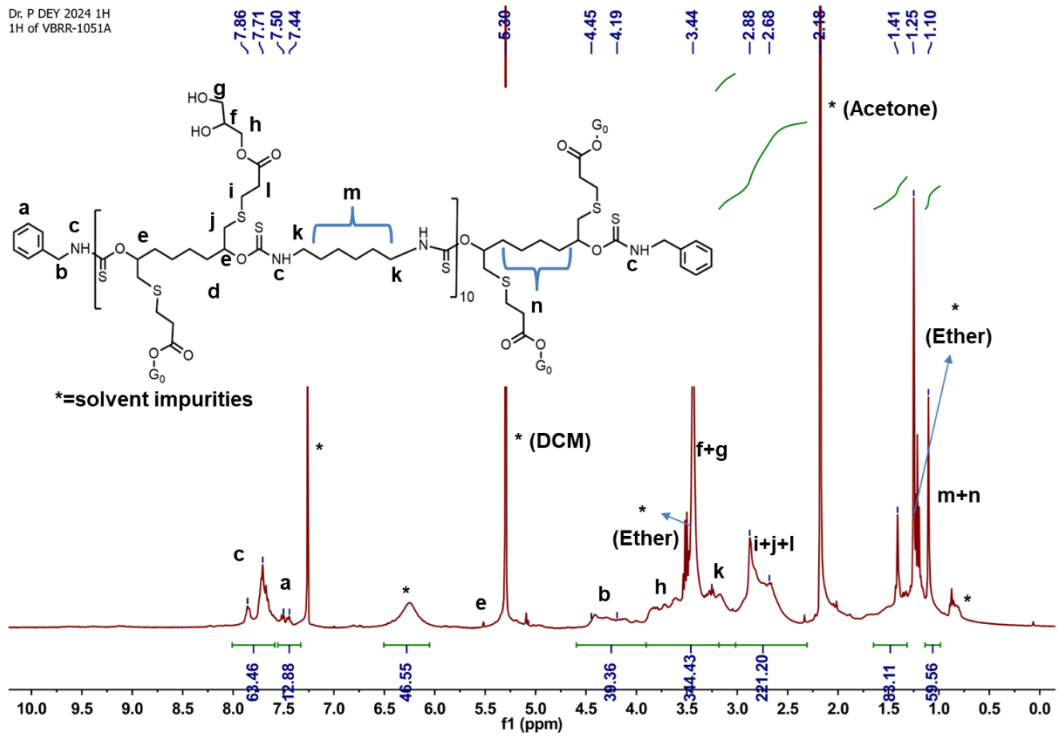


Figure S19. ^{1}H NMR of ALP-PTU-G_0-OH in $CDCl_3$

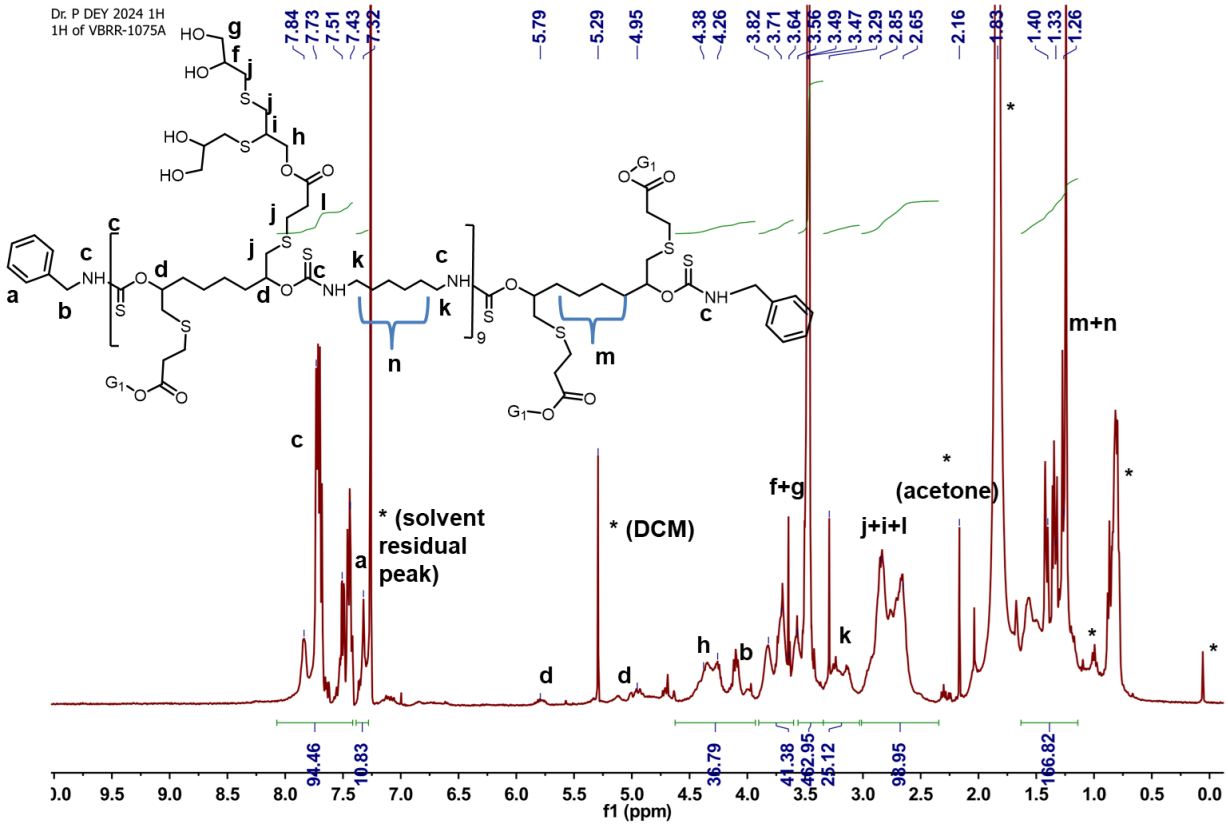


Figure S20. ^{1}H NMR of ALP-PTU-G_1-OH in $CDCl_3$

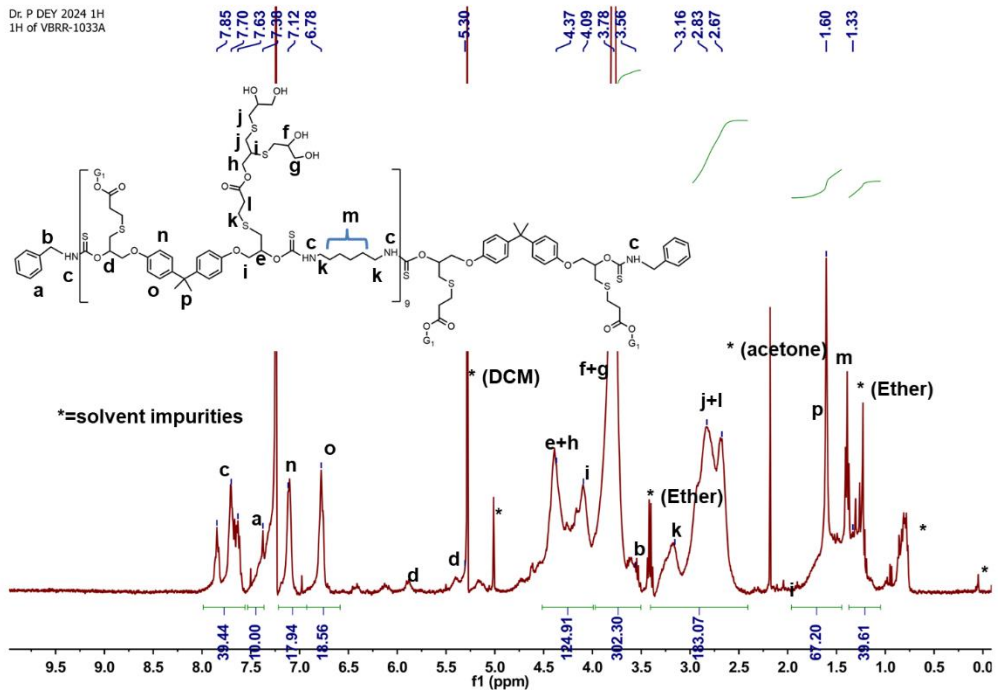


Figure S21. ^{1}H NMR of ARM-PTU-G_1-OH in $CDCl_3$

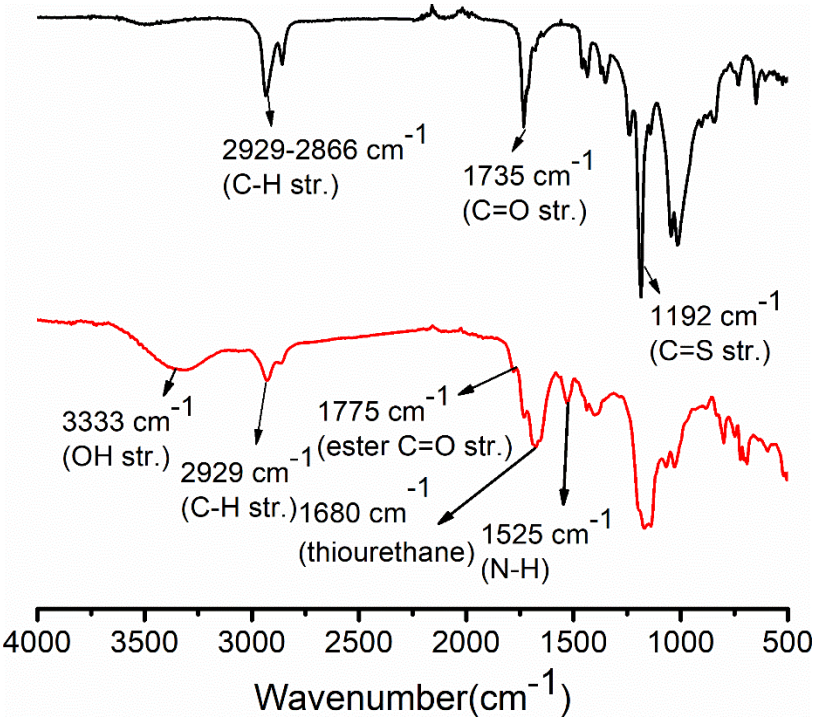


Figure S22. FTIR spectrum of Monomer (M1) vs ALP-PTU-G_1-OH**.** Dissappearance of $\bar{\nu}_{C=S}$ (1192 cm^{-1}) and appearance of the $\bar{\nu}_{HN-C=S}$ (1525 cm^{-1}) absorption band in the ALP-PTU-G_1-OH.

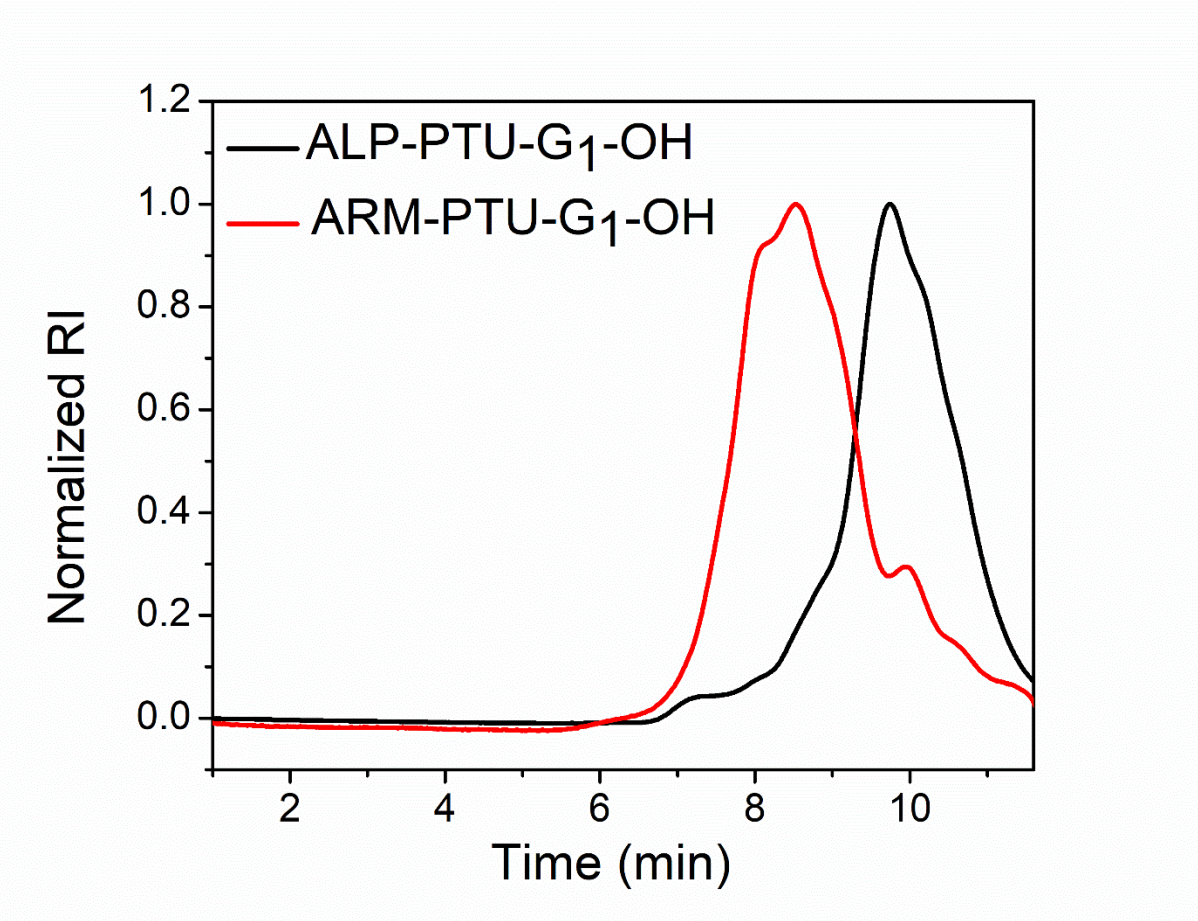


Figure S23. SEC comparison of ALP-PTU-G$_1$-OH and ARM-PTU-G$_1$-OH

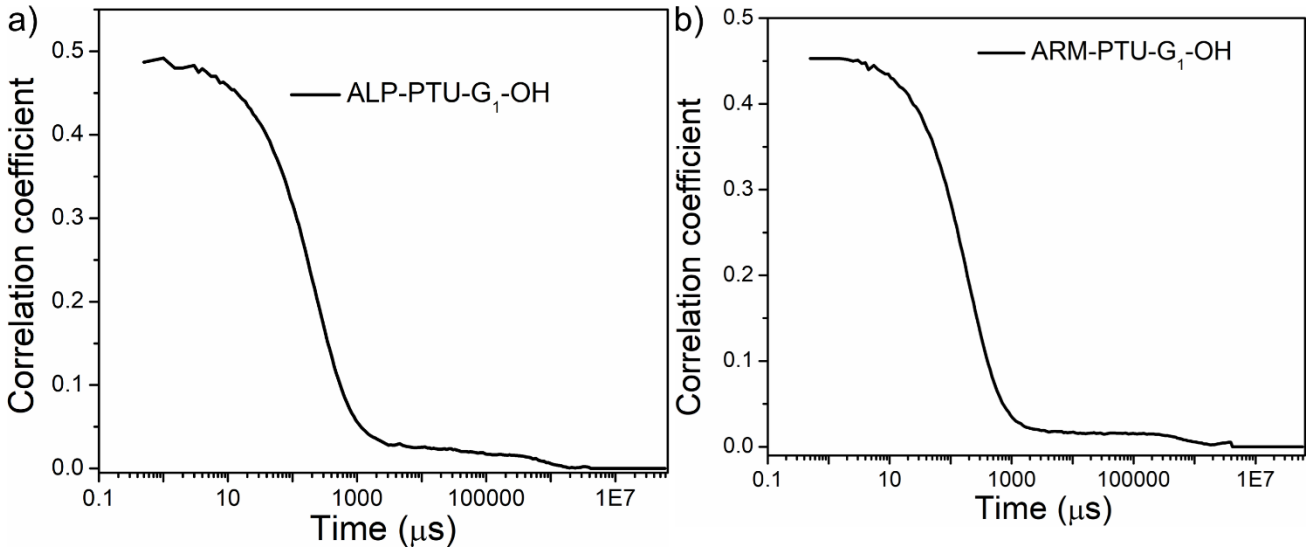


Figure S24. Correation function of a) ALP-PTU-G$_1$-OH and b) ARM-PTU-G$_1$-OH.

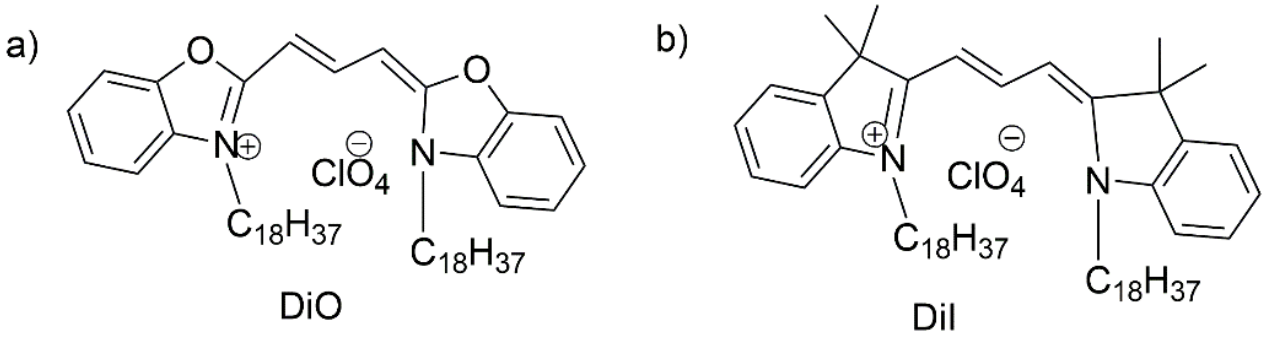


Figure S25. Structure of a) DiO and b) DiI

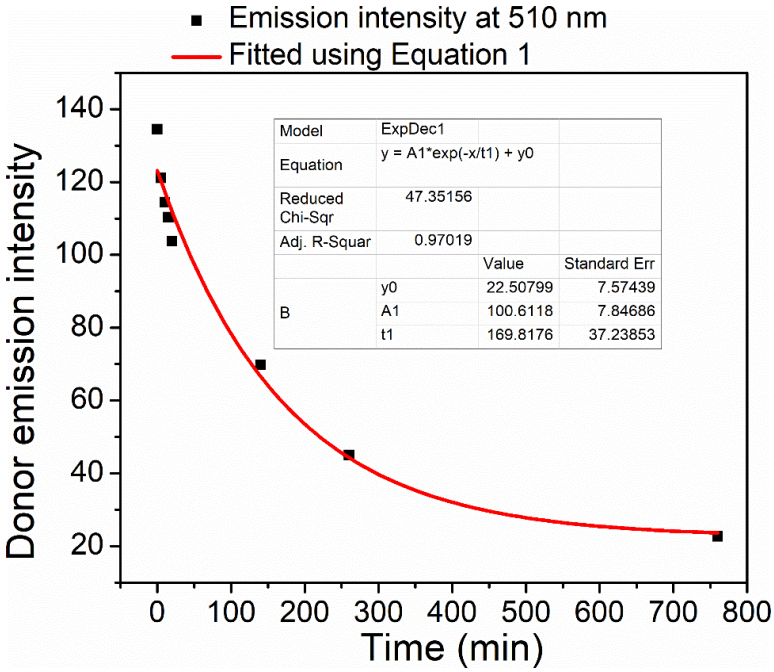


Figure S26. The plot of the donor emission intensity (λ_{em} = 510 nm) vs time of FRET studied in ARM-PTU-G_1-OH. The red line is the fitted data using the equation 1.

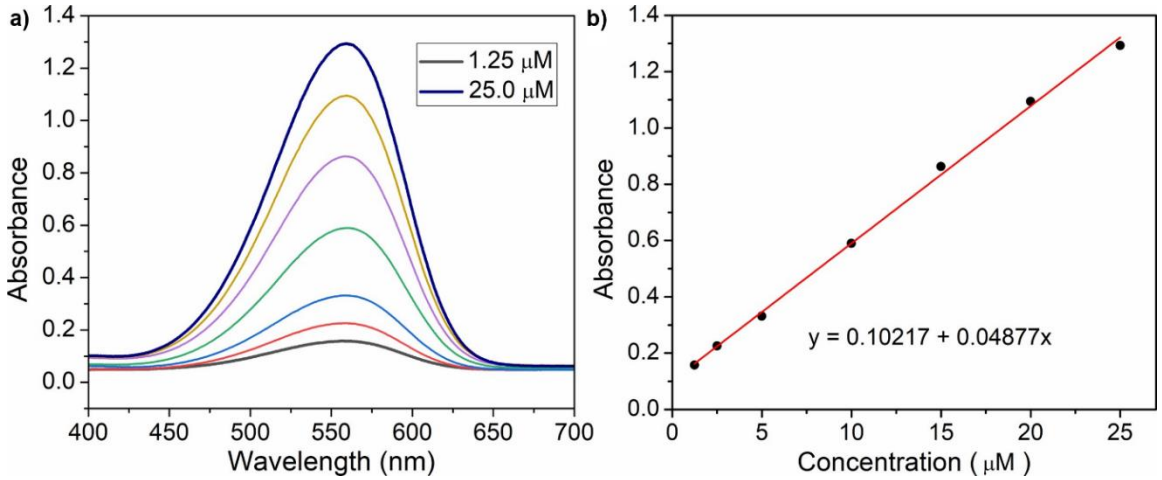


Figure S27. a) UV/Vis spectra of different conc. of Nile Red in 60 % dioxane-water (v/v) and b) calibration curves of Nile Red by plotting the absorbance at λ_{max} = 559 nm with concentration of Nile Red.

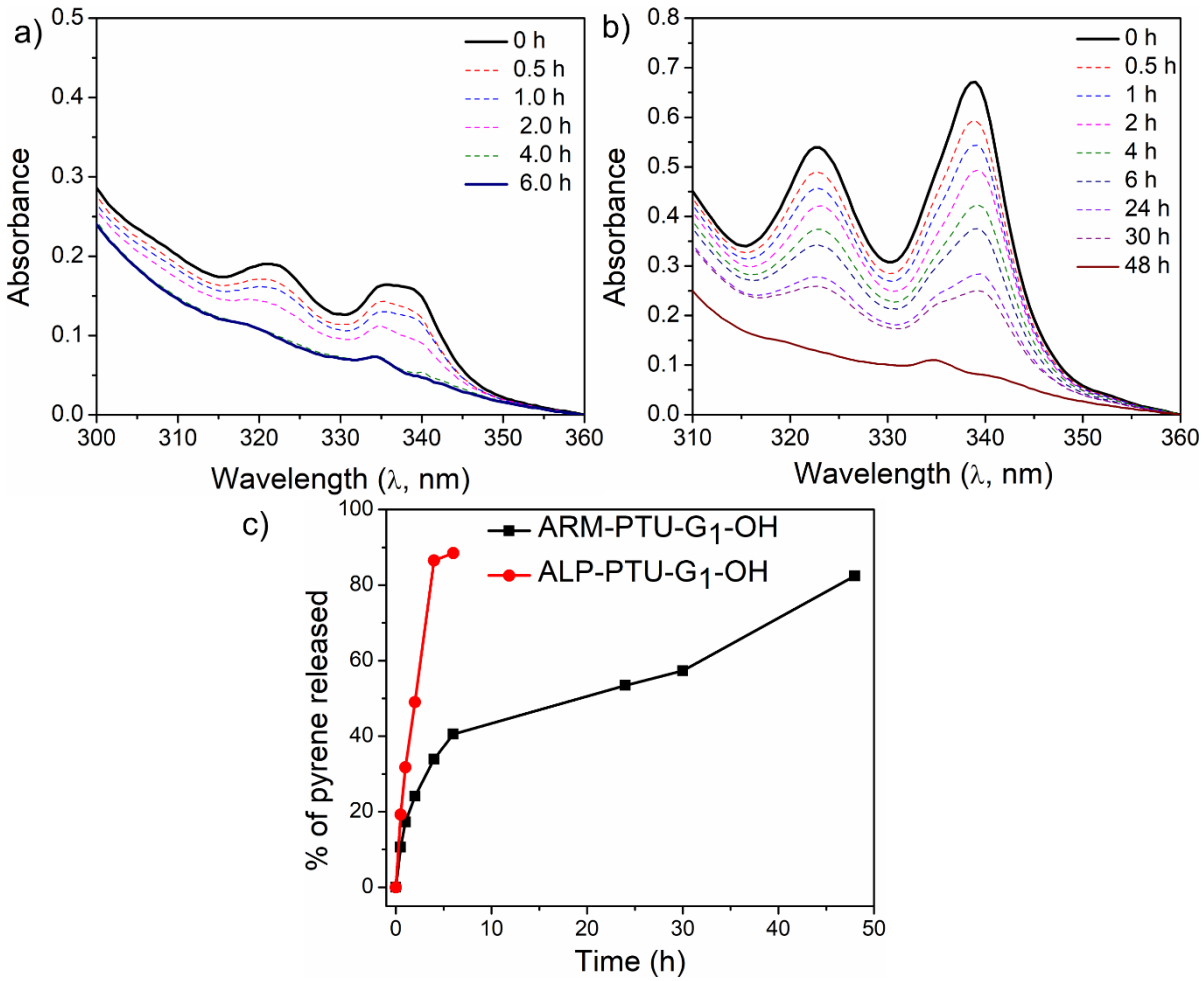


Figure S28. UV/Vis spectra of pyrene encapsulated in aqueous solution of a) ALP-PTU-G_1-OH and b) ARM-PTU-G_1-OH (c= 1 mg/mL) at different time points, c) % of pyrene released plotted versus time. Here 0 h is considered after encapsulation of pyrene overnight.

Table S1. Theoretical and Estimated Molecular Weight and Dispersity of the Polymers

Polymer	F^{M}	F^{DA}	$F^{Bn\text{-}NH_2}$	DPn (estd.)	DPn (NMR)	M_n (g/mol) (NMR)	M_n (g/mol) (SEC)	Đ	Retention time (min)
ALP-PTU-G_1-OH	0.472	0.412	0.126	10	10	13,672	2144	1.12	9.744
ARM-PTU-G_1-OH	0.472	0.412	0.126	10	10	15,156	2237	1.17	8.375

DP_n = degree of polymerization; Đ = polydispersity index; M_n = number average molecular weight

Table S2. Details about the encapsulation of hydrophobic dyes in polymers

Polymer	Critical aggregation conc. (µM)	Solubility of Nile Red in polymer (mg/g)	Solubility of pyrene in polymer (mg/g)
ALP-PTU-G_1-OH	66	0.795	1.32
ARM-PTU-G_1-OH	56	0.995	3.6