

Electronic Supplementary Information

Photoresponsive vesicle permeability based on intramolecular host-guest inclusion

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Synthesis

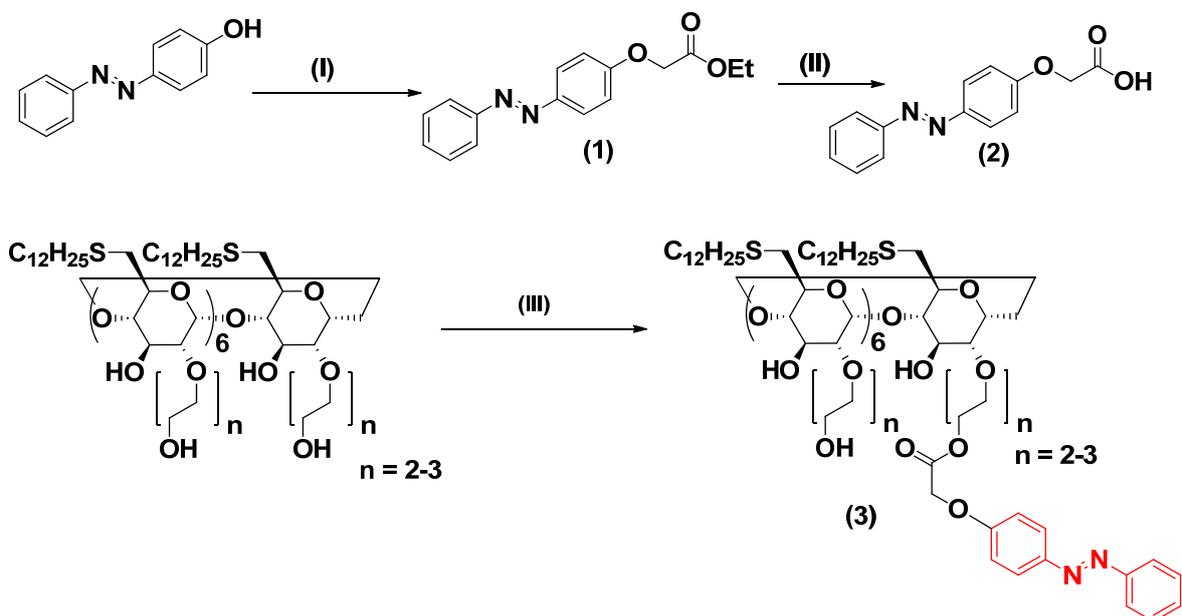
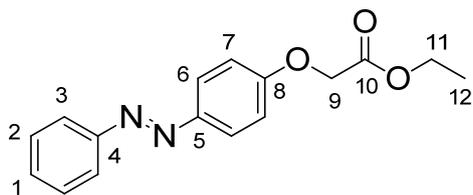


Figure S1: Synthesis of amphiphilic cyclodextrin modified with azobenzene (Azo-CD). (I) ethyl bromoacetate, K_2CO_3 , 15h, reflux, 88%, (II) EtOH, NaOH, 3h, reflux, 70%, (III) DMF, EDCI, HOBt, (*E*)-2-(4-(phenyldiazenyl)phenoxy)acetic acid, NMM, 12h, rt.

(E)-ethyl 2-(4-(phenyldiazenyl)phenoxy)acetate (1)



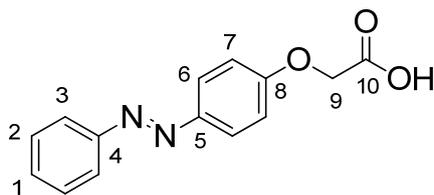
To a solution of 2.97 g (15.0 mmol) of 4-phenylazophenol in 100 ml dry acetone, 4.97 ml (45 mmol) of ethyl bromoacetate and 8.29 g (60.0 mmol) of K_2CO_3 were added. The reaction mixture was refluxed for 15 h and then allowed to cool to room temperature. After evaporation of the solvent with a rotary evaporator, the mixture was diluted with 150 ml EtOAc and washed with brine. The organic layer was dried over $MgSO_4$ and evaporated. The crude product was purified by silica gel chromatography (eluent, EtOAc/cyclohexane 10:90) to afford the title compound as orange solid (3.755 g, 13.2 mmol, 88%).

ESI-HRMS (m/z): Calculated for $[C_{16}H_{16}N_2O_3H]^+$: 285.1234; Found 285.1252.

1H NMR (300 MHz, MeOH-*d*4): δ = 7.86 (m, 4H, 3, 6-H), 7.62 – 7.33 (m, 3H, 1, 2-H), 7.29 – 6.91 (m, 2H, 7-H), 4.78 (s, 2H, 9-H), 4.39 – 4.05 (q, 2H, J = 7.1 Hz, 11-H), 1.24 (t, 3H, J = 7.1 Hz, 12-H) ppm.

^{13}C NMR (75 MHz, MeOH-*d*4): δ = 170.45, 161.91, 154.02, 148.72, 131.76, 130.20, 125.67, 123.58, 116.07, 66.25, 62.49, 14.48 ppm.

(E)-2-(4-(phenyldiazenyl)phenoxy)acetic acid (2)



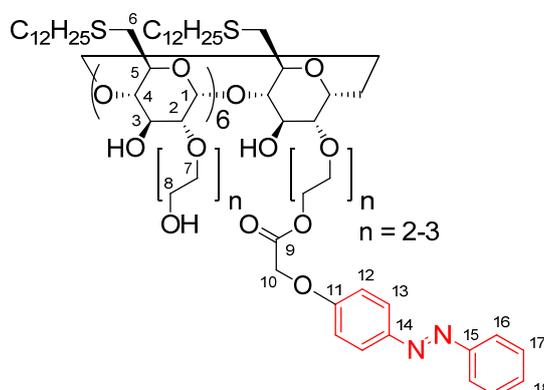
To a stirred solution of (*E*)-ethyl 2-(4-(phenyldiazenyl)phenoxy)acetate (2.93 g, 10.2 mmol) in 100 ml of ethanol was added 25 ml of sodium hydroxide (1N solution) and refluxed for 3 h. Then, ethanol was evaporated with a rotary evaporator and the remaining solution was acidified to a pH of 2 with 1 N HCl. The aqueous phase was extracted two times with EtOAc. The organic phase was dried over MgSO₄ and concentrated to afford the desired product as orange solid (1.83 g, 7.14 mmol, 70%).

ESI-HRMS (m/z): Calculated for [C₁₄H₁₁N₂O₃]: 255.0775; found: 255.0764.

¹H NMR (300 MHz, MeOH-*d*₄): δ = 7.96 – 7.78 (m, 4H, 3, 6-H), 7.59 – 7.33 (m, 3H, 1, 2-H), 7.18 – 6.94 (m, 2H, 7-H), 4.79 (d, s, 2H) ppm.

¹³C NMR (75 MHz, MeOH-*d*₄): δ = 172.20, 161.99, 154.03, 148.68, 131.73, 130.19, 125.66, 123.56, 116.06, 65.97 ppm.

Heptakis (6-dodecylthio-2-oligo(ethylenoxide)- β -cyclodextrin-2-(4-(phenyldiazenyl)phenoxy) acetate [Azo-CD] (3)



To a stirred solution of amphiphilic β -cyclodextrin (500mg, 0.16mmol, 1eq) in 10ml dry DMF EDCI (31mg, 0.16mmol, 1eq) and HOBT (15mg, 0.11 mmol, 0.7eq) was added. The solution was stirred for 30 minutes. Afterwards (E)-2-(4-(phenyldiazenyl)phenoxy)acetic acid (2) (41mg, 0.16mmol, 1eq) and NMM (25mg, 0.24 mmol, 1.5eq) was added and the reaction was stirred over night. Solvents were then evaporated off and the crude product was purified by sephadex LH20 size chromatography (145mg, 0.04mmol, 25%).

MALDI-MS (m/z): Calculated for $[C_{172}H_{313}O_{46}S_7N_2Na_2]^{2+}$: 1707.50453; found: 1707.50458.

1H NMR (600 MHz, MeOH- d_4): δ = 8.03 – 7.79 (m, 4H, 13, 16-H), 7.57 – 7.42 (m, 3H, 17, 18-H), 7.11 (m, 2H, 12-H), 5.18 (s, 7H, 1-H), 4.57 (m, 14H, 2, 3, 4, 5-H), 3.88 (m, 14H, 2, 3, 4, 5-H), 3.79 – 3.46 (m, 64H, 7, 8-H), 3.35 (s, 2H, 10-H), 2.70 (m, 14H, SCH₂), 1.74 – 1.22 (m, 154H, CH₂), 0.94 (t, J = 6.7 Hz, 21H, CH₃) ppm.

^{13}C NMR (151 MHz, MeOH- d_4): δ = 170.92, 161.90, 154.01, 148.75, 131.80, 130.23, 130.19, 125.74, 124.54, 123.63, 120.94, 116.13, 115.68, 73.71, 71.53, 66.19, 62.27, 52.80, 34.97, 33.47, 31.40, 30.98, 24.11, 15.19 ppm.

Encapsulation of sulphorhodamine B in LUVs

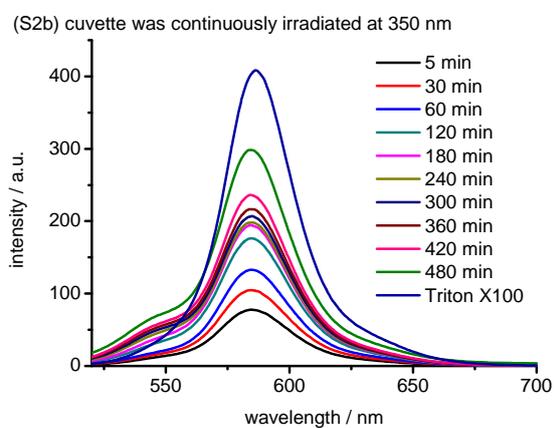
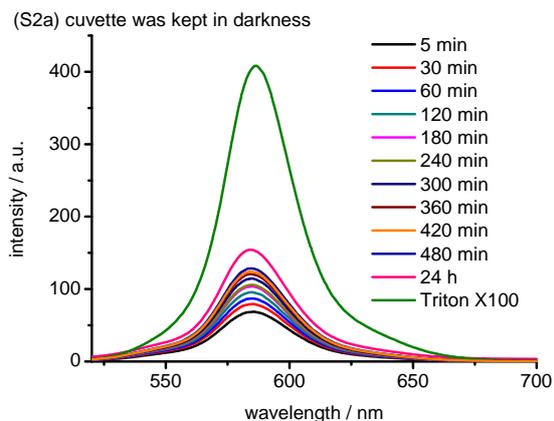


Figure S2: Encapsulation of sulforhodamine B in large unilamellar vesicles (LUVs) with 10% of Azo-CD. All experiments were performed at room temperature. Fluorescence spectra collected after elution through a sephadex column (a) at different times and finally after addition of 0.1% TritonX 100 (b) at different times of UV irradiation ($\lambda = 350$ nm) and finally after the addition of 0.1% Triton X100.

Influx of sulphorhodamine B into GUVs

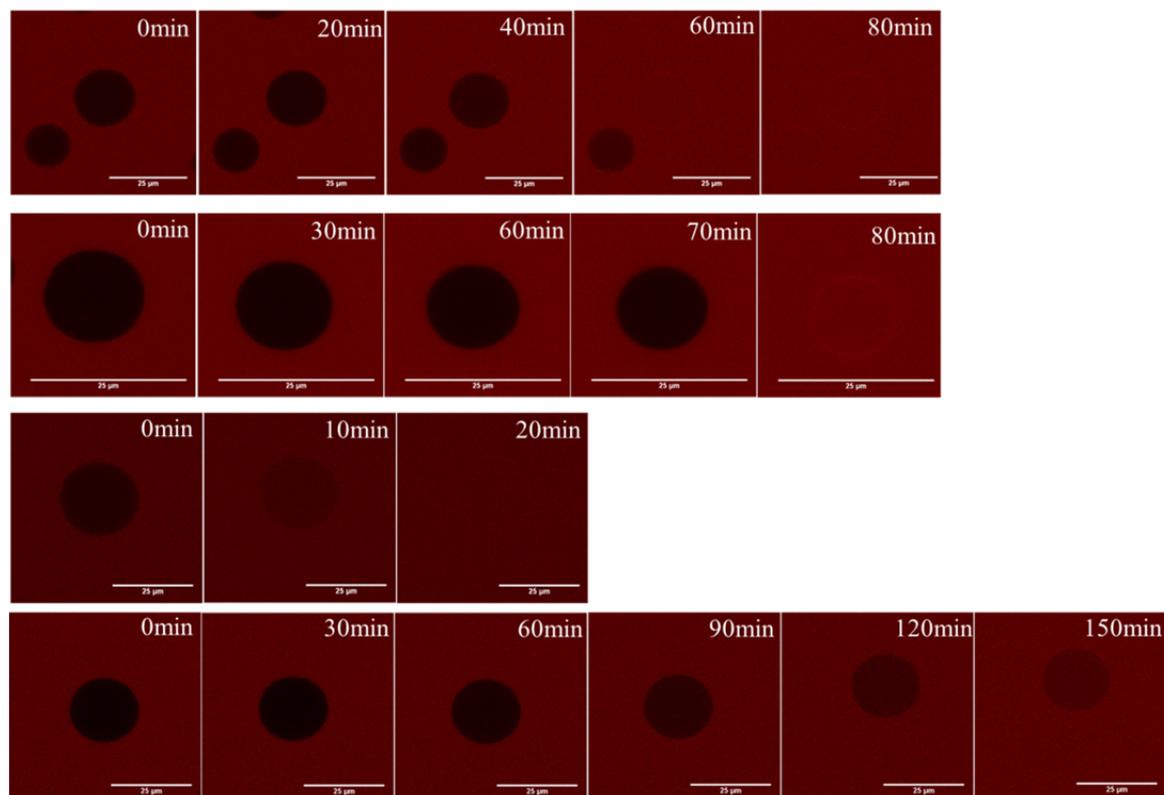


Figure S3: Permeation of sulphorhodamine B into giant unilamellar vesicles (GUVs) with 30 mol% of Azo-CD with UV irradiation. LSCM single image slices through the GUV equator during irradiation. Scale bar is 25 μm. All experiments were performed at room temperature.

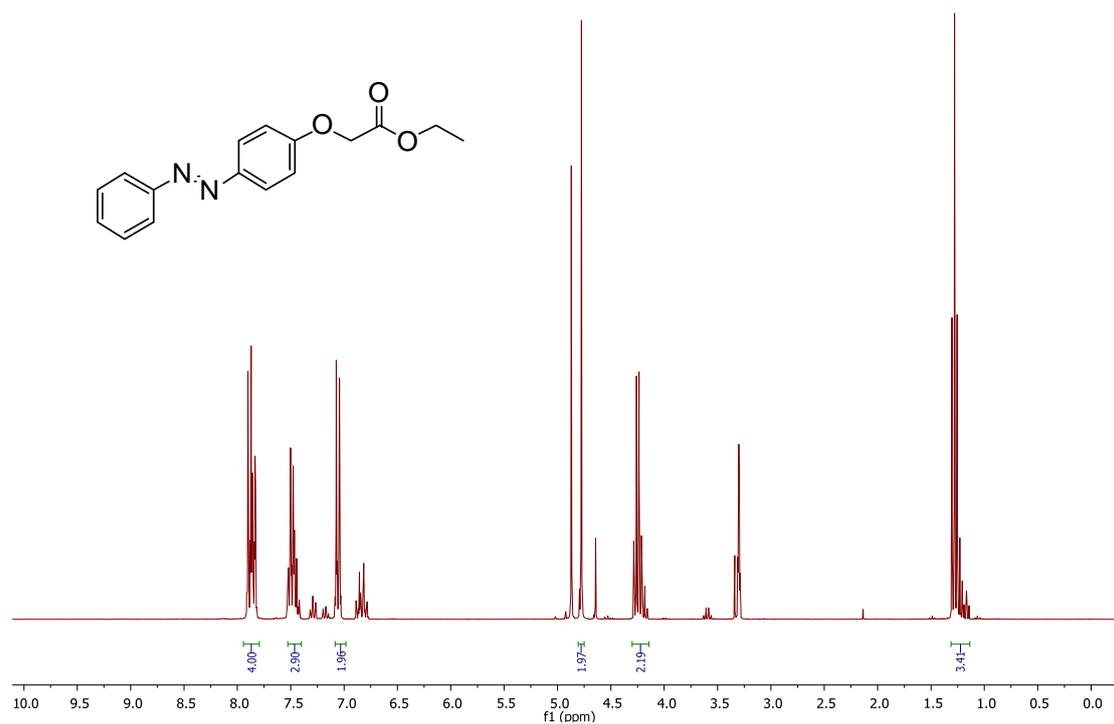


Figure S4: ^1H NMR of 1 in $\text{MeOH-}d_4$ at 298 K.

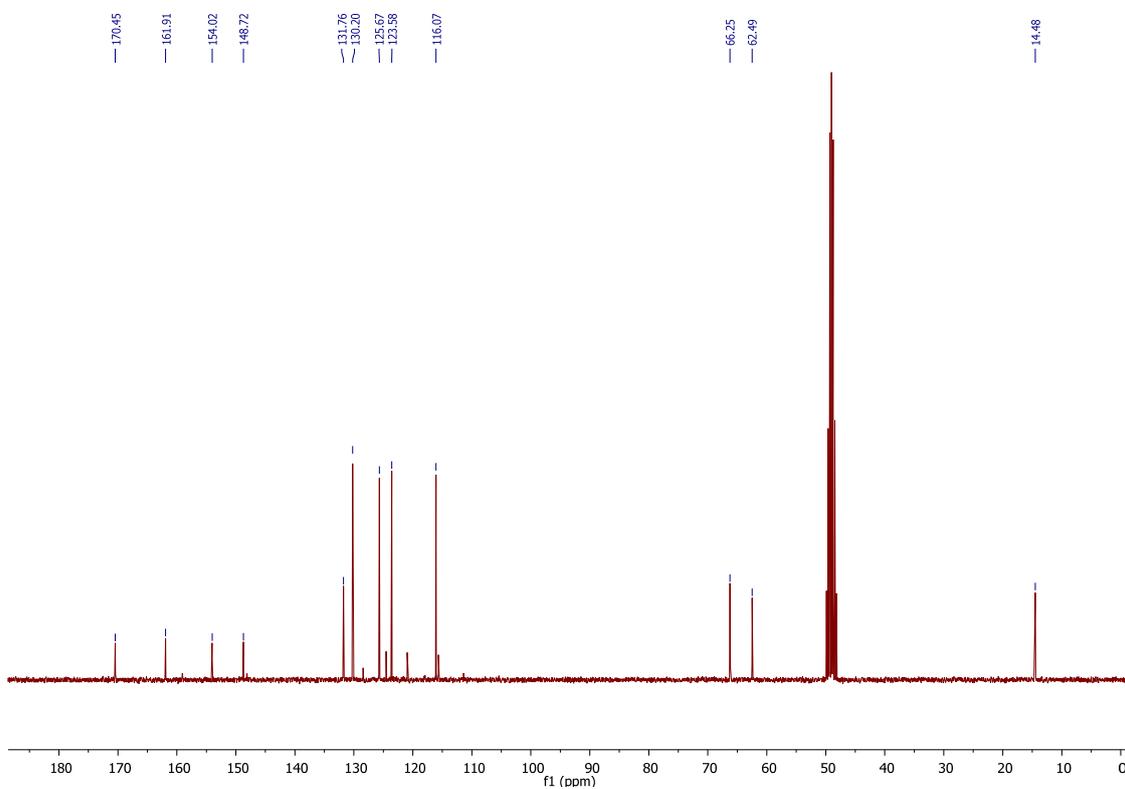


Figure S5: ^{13}C NMR of 1 in $\text{MeOH-}d_4$ at 298 K.

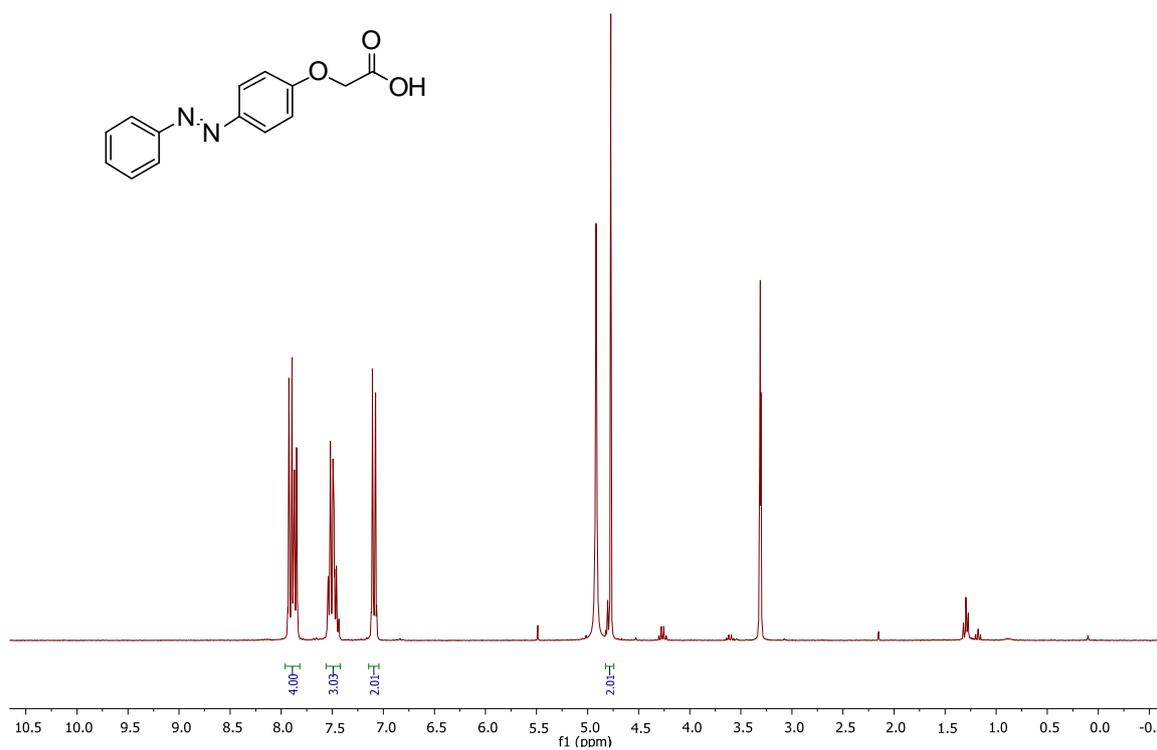


Figure S6: ^1H NMR of **2** in $\text{MeOH-}d_4$ at 298 K.

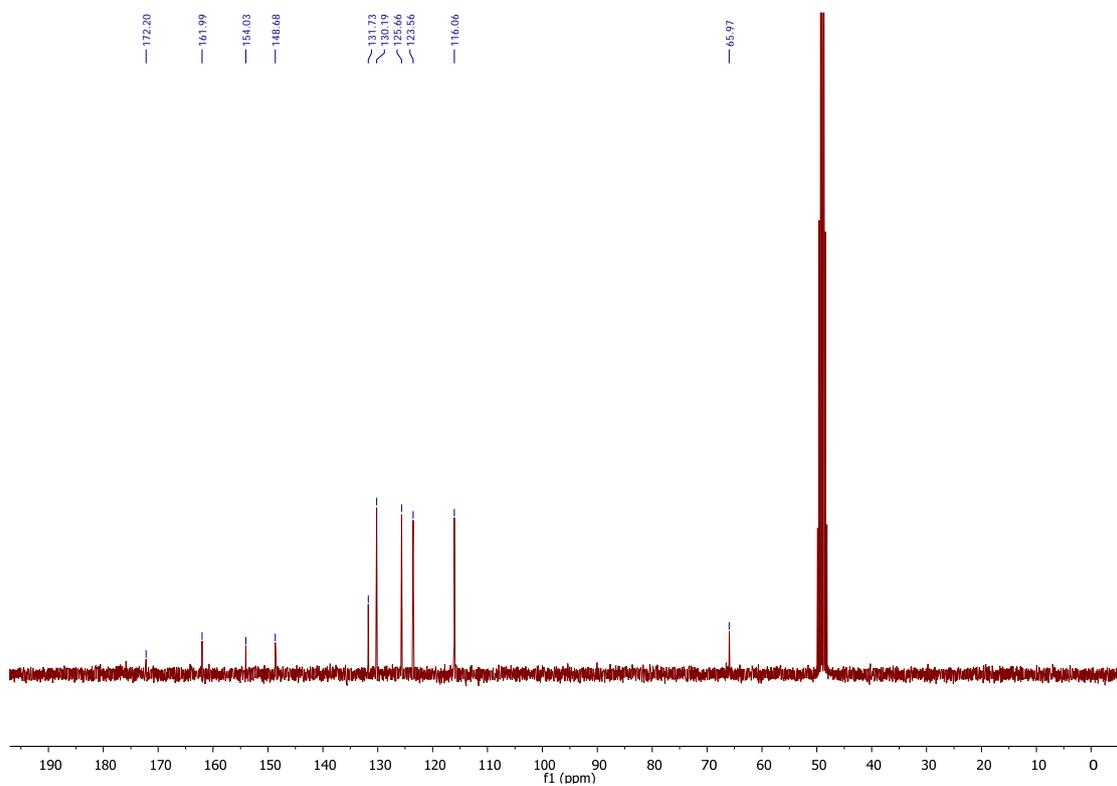


Figure S7: ^{13}C NMR of **2** in $\text{MeOH-}d_4$ at 298 K.

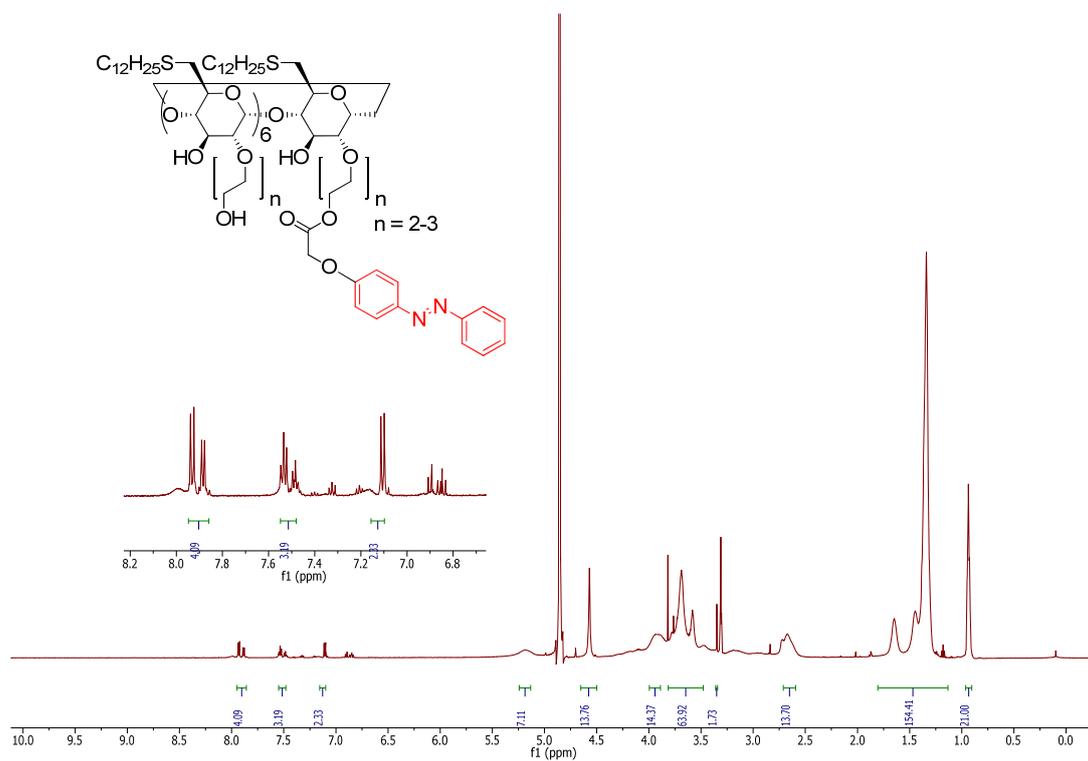


Figure S8: ^1H NMR of **3** in $\text{MeOH-}d_4$ at 298 K.

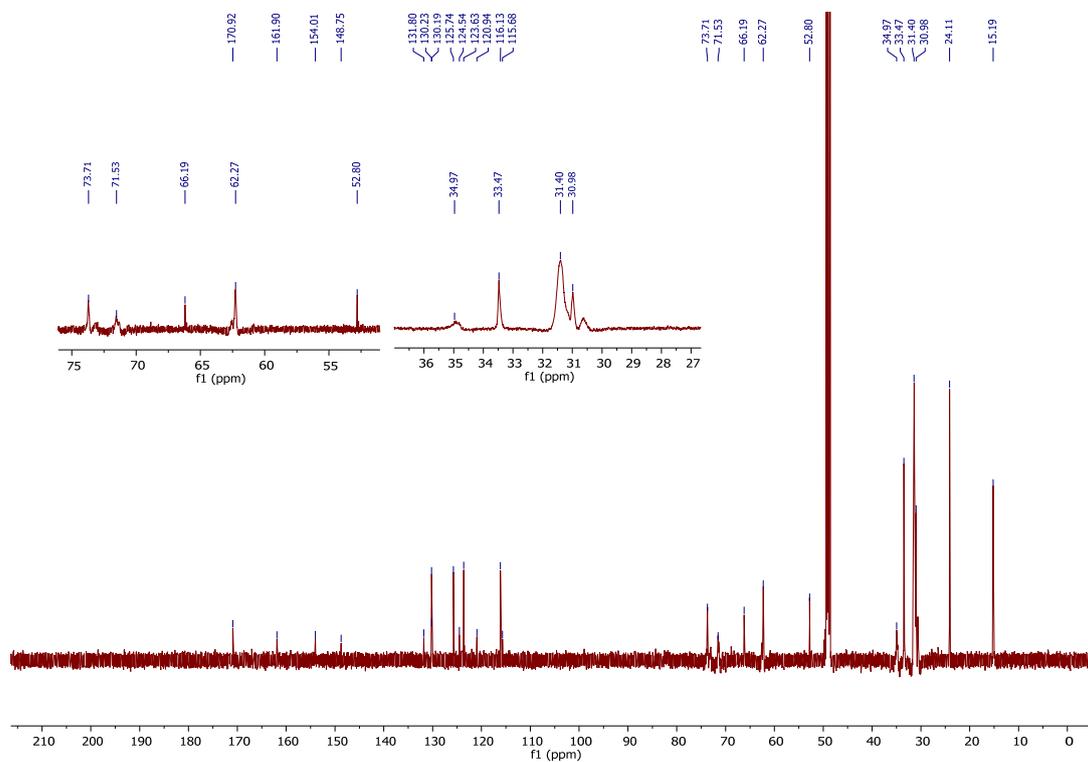


Figure S9: ^{13}C NMR of **3** in $\text{MeOH-}d_4$ at 298 K.