Electronic Supplementary Information

Synthesis and DNA interactions of a bis-phenothiazinium photosensitizer

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Experimentals

Phenothiazin-5-ium tetraiodide hydrate (**1**). Preparation of known compound **1**[1] afforded a dark-blue solid product (1.63 g, 80%), mp 170 ºC (from $CHCl_3$, decomp.); R_f = 0.09 ($CHCl_3$); ν_{max} (film)/cm^{-1} 2967, 1558, 1467, 1440, 1311, 1233, 1131, 1067, 1023, 841, and 705; δ_H (300 MHz; Acetone-d_6; Me_4Si) 8.01 (2H, m), 7.92 (2H, m), and 7.64 (4H, m); δ_C (75 MHz; acetone-d_6; Me_4Si) 153.6, 130.7, 129.5, 128.6, 125.5, and 123.5; *m*/*z* (LR-ESI) 199.0 (M^+ - $C_{12}H_8NS$ requires 198.04).

3-(Dimethylamino)phenothiazin-5-ium triiodide (**2**). Known compound **2** was prepared by making a minor modification to a published literature procedure.[1] To a solution of phenothiazin-5-ium tetraiodide hydrate (0.400 g, 0.553 mmol) in 20 mL of chloroform was added a 2 M solution of dimethylamine in methanol (0.553 mL, 1.106 mmol) drop-wise over 4 h. The reaction progress was monitored by silica gel TLC (3:7 10% aqueous ammonium acetate/methanol). The resultant precipitate was filtered, washed with chloroform and allowed to air dry. Product **2** (189 mg, 55%) was obtained as a dark-blue solid, mp 144 – 145 ºC (from MeOH); R_f = 0.28 (3:7 10% aqueous ammonium acetate / methanol); (Found: C, 27.1; H, 1.9; N, 4.4; S, 5.2; I, 60.9. $C_{14}H_{13}N_2SI_3$ requires C, 27.0; H, 2.1; N, 4.5; S, 5.15; I, 61.2%); ν_{max} (film)/cm^{-1} 2800, 1617, 1559, 1489, 1429, 1411, 1252, 1118, 1411, 1078, 887, 835, and 772; δ_H(300 MHz; DMSO-d_6; Me_4Si) 8.22 (1H, dd, *J* 8.0 and 1.6, H-9), 8.17 (1H, dd, *J* 8.0 and 1.6, H-6), 8.10 (1H, d, *J* 10, H-1), 8.04 (1H, dd, *J* 10 and 2.4, H-2), 8.00 (1H, d, *J* 2.4, H-4), 7.85 (2H, m, H-7, H-8), 3.64 and 3.60 (6H, s, 2 x N(CH_3)$_2$); δ_C(75 MHz, DMSO-d_6; Me_4Si) 156.1, 144.1, 139.8, 139.6, 138.0, 134.6, 133.2, 129.8, 126.3, 126.1, 125.8, 109.7, 43.3, and 42.9; *m*/*z* (LR-ESI) 241.1 (M^+ - $C_{14}H_{13}N_2S$ requires 240.08).

Figures

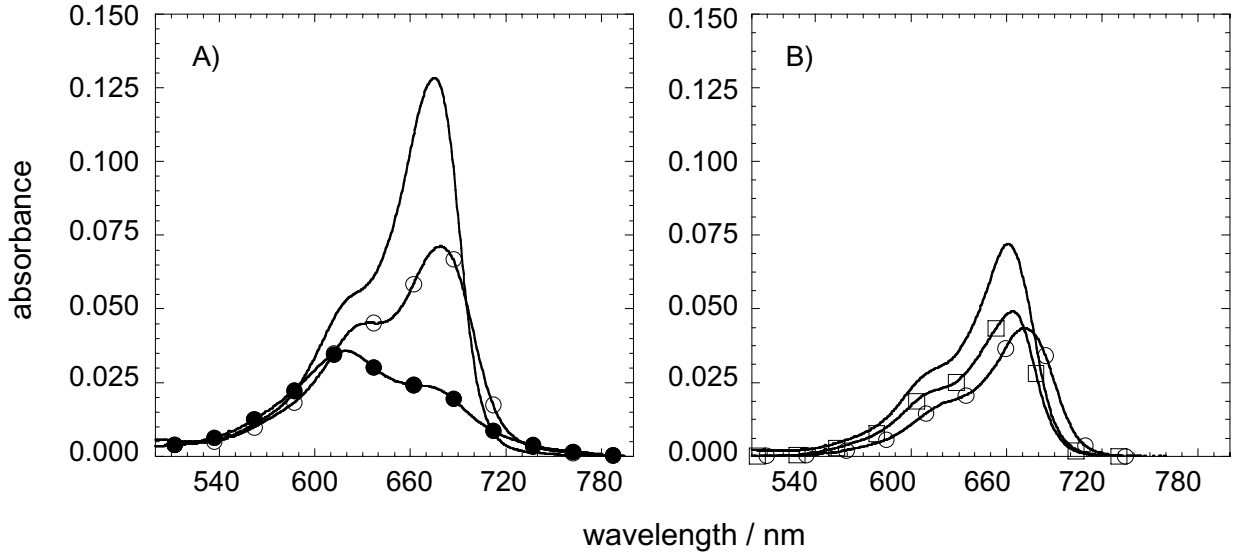
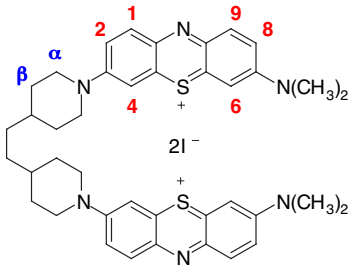


Fig. S1 UV-visible spectra recorded at 22 °C in 10 mM sodium phosphate buffer pH 7.0 of: **a)** 1 μM compound **3** (●, λ_{max} = 620 nm) in the presence of 38 μM bp CT DNA (○, λ_{max} = 680 nm) or 1% SDS (w/v) (solid line, λ_{max} = 676 nm); **b)** 1 μM **MB** (□, λ_{max} = 664 nm) in the presence of 38 μM bp CT DNA (○, λ_{max} = 671 nm) or 1% SDS (w/v) (solid line, λ_{max} = 661 nm). Line markers (●,○,□) are placed at every 50th data point. Prior to data acquisition, the samples containing DNA were pre-equilibrated for 12 h in the dark at 22 °C.



compound **3**

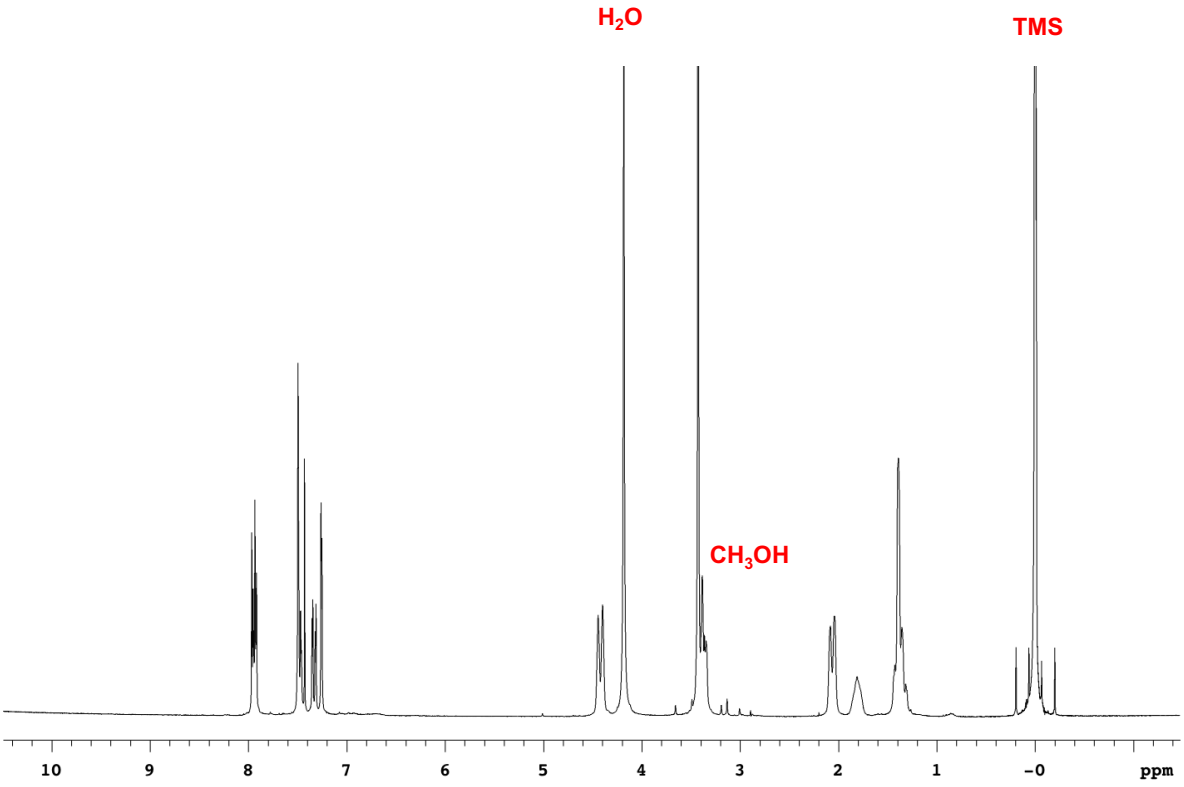


Fig. S2 ^{1}H NMR spectrum of compound **3**: δ_H(300 MHz, 4:6 $CDCl_3/CD_3OD$; Me_4Si) 7.95 (2H, d, *J* 9.6, H-1), 7.94 (2H, d, *J* 9.6, H-9), 7.50-7.46 (4H, m, H-6, H-8), 7.33 (2H, dd, *J* 9.6 and 2.7, H-2), 7.26 (2H, d, *J* 2.7, H-4), 4.42 (4H, d, *J* 13.5, 2 x CH_2-α), 3.43 (12H, s, 2 x $N(CH_3)_2$), 3.38 (4H, m, overlap with CH_3OH, 2 x CH_2-α), 2.06 (4H, d, *J* 11.7, 2 x CH_2-β), 1.81 (2H, broad, 2 x C*H*), and 1.44-1.31 (8H, m, CH_2-CH_2, 2 x CH_2-β).

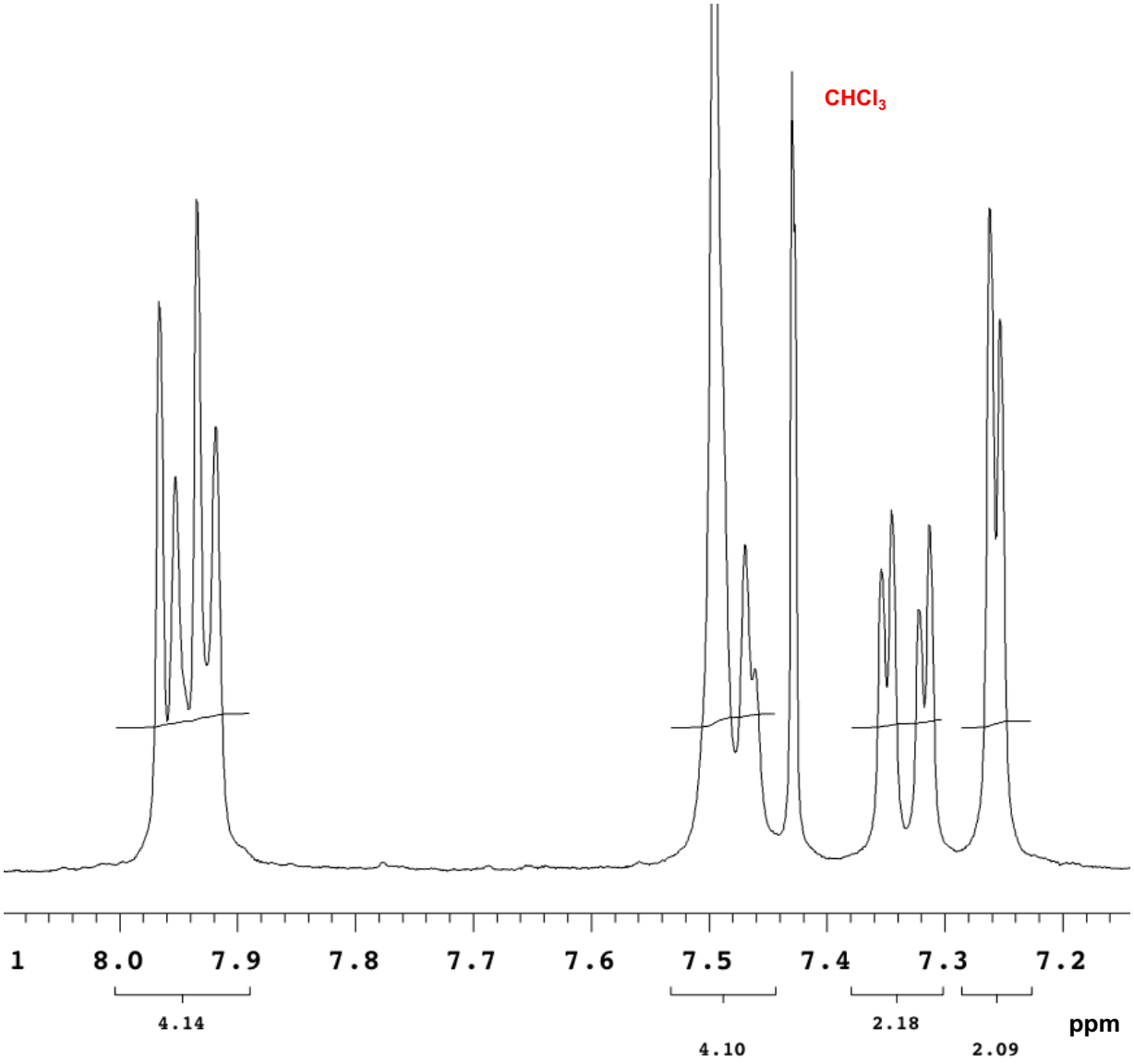


Fig. S3 Aromatic region with integration, enlarged from Fig. S2: δ_H = 7.95 (2H, d, *J* 9.6, H-1), 7.94 (2H, d, *J* 9.6, H-9), 7.50-7.46 (4H, m, H-6, H-8), 7.33 (2H, dd, *J* 9.6 and 2.7, H-2), 7.26 (2H, d, *J* 2.7, H-4). Note: resonance at 7.43 ppm is a residual solvent peak from $CHCl_3$.

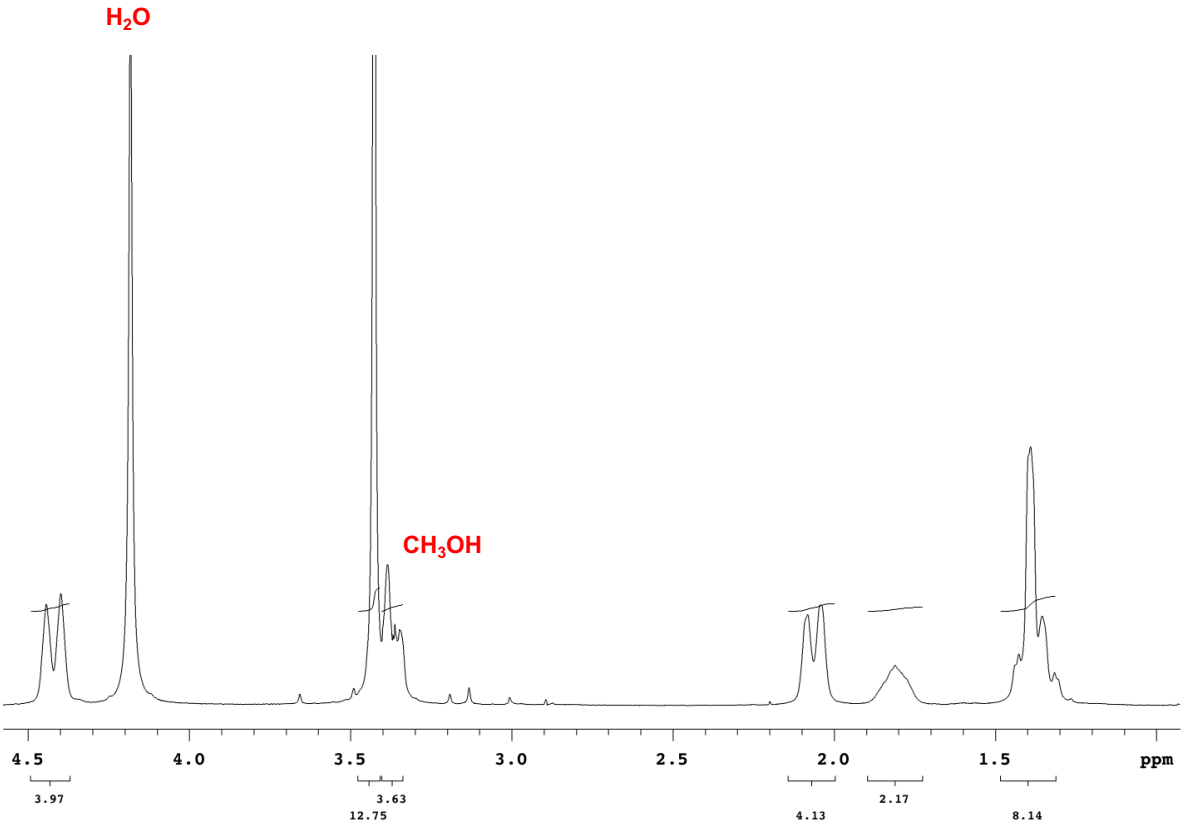


Fig. S4 Aliphatic region with integration, enlarged from Fig. S2: δ_H = 4.42 (4H, d, *J* 13.5, 2 x C*H*$_2$-α), 3.43 (12H, s, 2 x N(C*H*$_3$)$_2$), 3.38 (4H, m, overlap with CH_3OH, 2 x C*H*$_2$-α), 2.06 (4H, d, *J* 11.7, 2 x C*H*$_2$-β), 1.81 (2H, broad, 2 x C*H*), and 1.44-1.31 (8H, m, C*H*$_2$-C*H*$_2$, 2 x C*H*$_2$-β).

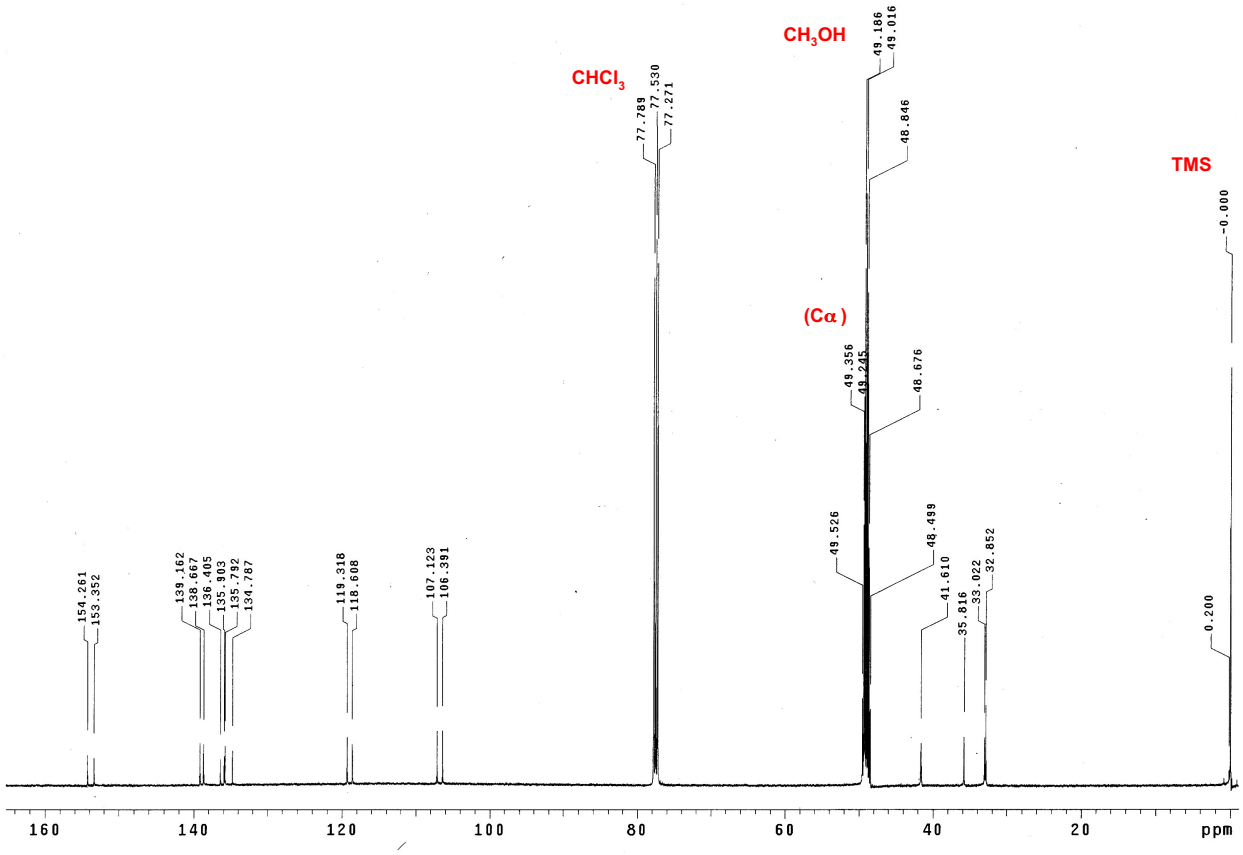


Fig. S5 ^{13}C NMR spectrum of compound **3:** δ_C(75 MHz, 4:6 $CDCl_3/CD_3OD$; Me_4Si) 154.3 and 153.3 (C-3, C-7), 139.2 and 138.7 (C-1, C-9), 136.4, 135.9, 135.8, and 134.8 (C4a, C5a, C9a and C10a), 119.3 and 118.6 (C-2, C-8), 107.1 and 106.4 (C-4, C-6), 49.3 (C-α), 41.6 (NCH_3), 35.8 (CH), 33.0 and 32.9 (C-β, CH_2-CH_2).

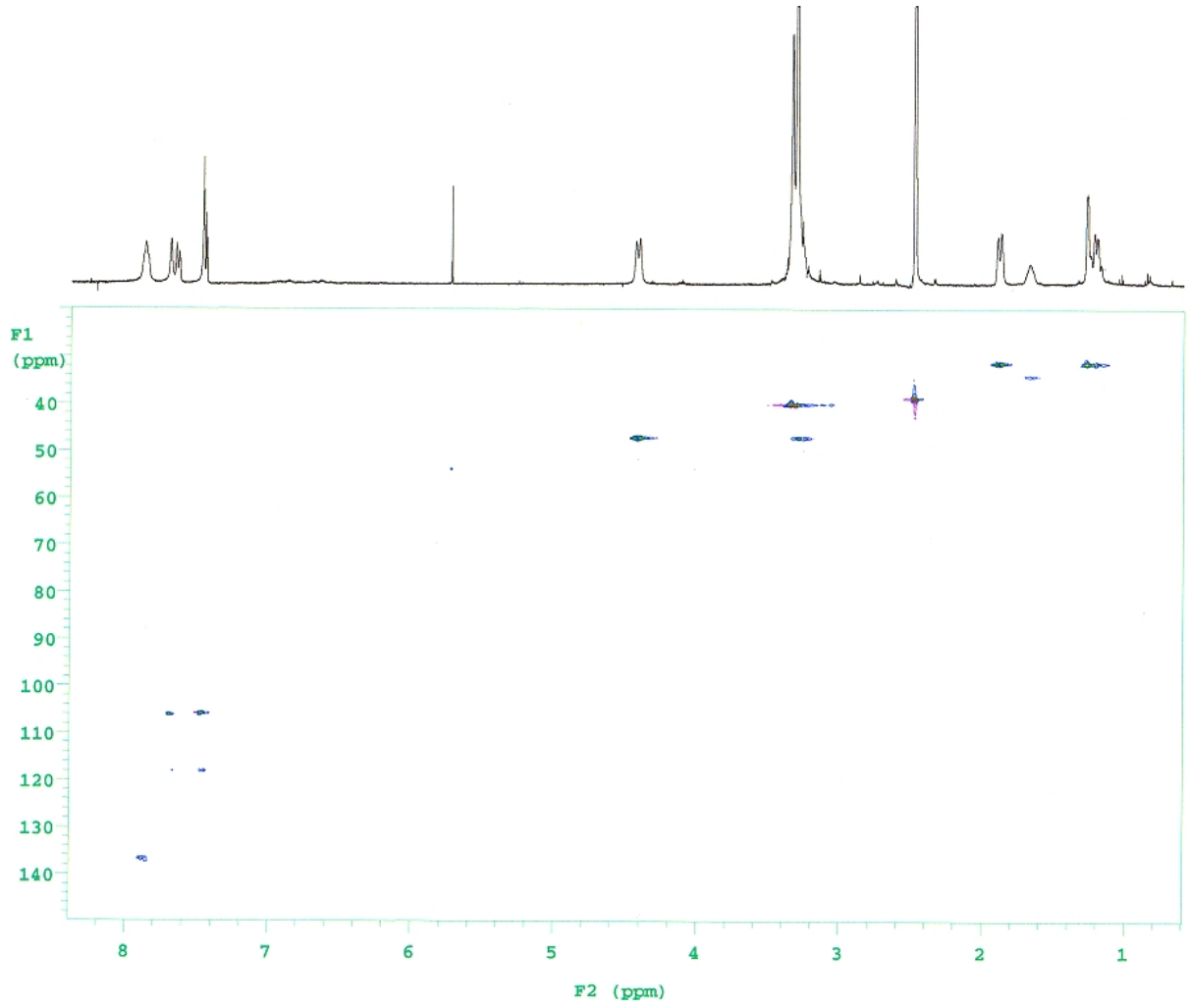


Fig. S6 HMQC NMR spectrum of compound **3** in DMSO-d_6 at 25 ºC recorded using a Varian Unity Plus 500 MHz instrument. The ^{1}H - ^{13}C correlations in this spectrum were utilized to assign the proton and carbon resonances in the spectra shown in Figs. S2 –S5.

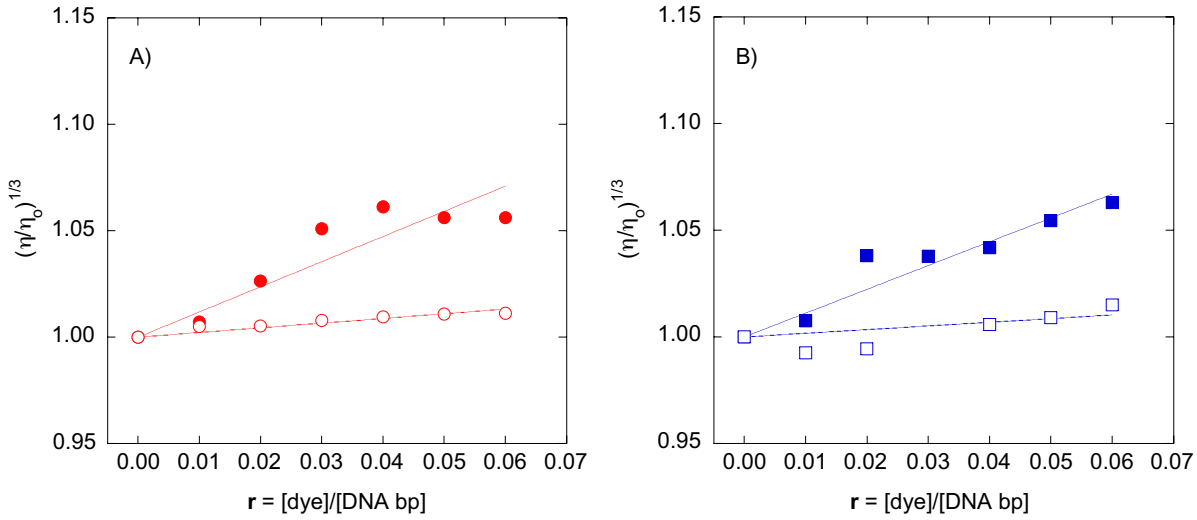


Fig. S7 Viscometric measurements conducted at 25 ± 0.1 °C in 10 mM sodium phosphate buffer pH 7.0 of 50 μM bp alternating poly[(dA-dT)]$_2$ and 50 μM bp poly(dA)•poly(dT) DNA pre-equilibrated for 12 h in the dark at 22 °C with 0.0 to 3 μM of the phenothiazines **a)** compound **3** and **b) MB**.

●: compound **3**:	alternating poly[(dA-dT)]$_2$	slope = 1.18	R = 0.9066
O: compound **3**:	poly(dA)•poly(dT)	slope = 0.22	R = 0.9202
■: **MB**:	alternating poly[(dA-dT)]$_2$	slope = 1.11	R = 0.9518
□: **MB**:	poly(dA)•poly(dT)	slope = 0.17	R = 0.7111

Table

Table S1 UV-visible absorbance at 1 μM of phenothiazine[a]

	Absorbance	
Wavelength (nm)	Compound **3**	**MB**
676	0.0707	0.0424
700	0.0414	0.0107
710	0.0204	0.0034

[a] 1 μM of each phenothiazine was pre-equilibrated with 38 μM bp of CT DNA in 10 mM sodium phosphate buffer pH 7.0 for 12 h at 22 °C.

Reference

1 L. Strekowski, D-F. Hou and R. L. Wydra, *J. Heterocyclic Chem.*, 1993, **30**, 1693-1695.