Supporting Information for:

Amphiphilic Poly(disulfide) Micelle and Remarkable Impact of the Core Hydrophobicity on Redox Responsive Disassembly

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Synthesis of P1:

P1a: The polymer P1a was synthesized by following literature reported protocol.1 M1 (0.867 g, 3.94 mmol) was taken in a reaction tube equipped with a magnetic stirrer, septum and gas inlet/outlet. After degassing for five minutes, 0.8 mL of dry and degassed dichloromethane was added and stirred for 10 minutes at room temperature (25 °C) to obtain a homogeneous solution. To this stirring solution 0.7 g (3.84 mmol) of M2 and catalytic amount of acetic acid (10 μL) were added sequentially and the reaction mixture was stirred further at room temperature for 3 h. Afterwards the yellow suspension was dissolved in CHCl3 (200 μL) and precipitated from excess of methanol. The yellow precipitate was re-dissolved in CHCl3, and re-precipitated from methanol and dried under vacuum to obtain P1a as sticky light yellow liquid (0.57 g, 81%).

P1a: 1H NMR (CDCl3, 500 MHz) δ: 8.458 (d, g, J = 4Hz, 2H); 7.778 (bs, e, 2H); 7.684-7.649 (m, f, 2H); 7.108-7.084 (m, d, 2H ); 3.82- 3.664 (m, b, 4H), 3.635-3.484 (m, a, 4H) , 3.014-2.878 (m, c, 4H) ,

P1b: Synthesis same as P1a (Yield 76%). (CDCl3, 500 MHz) δ: 8.72 (bs, g, 2H); 8.20 (bs, e+ f, 4H); 7.55 (bs, d, 2H); 2.75-2.64 (m, c, 4H), 1.77-1.71 (m, b, 4H), 1.49-1.42 (m, a, 4H).

P2a: To a glass ampule containing disulfide polymer P1a (0.184 g, 0.059 mmol) was added 0.5 mL of CH2Cl2. To this stirring solution one drop of acetic acid and 2-Mercaptoethanol (1.2 eq w.r.t the pyridyl sulfide group) were added and the resulting
solution was stirred at room temperature under argon for 3 h. Afterwards, the polymer was precipitated from methanol, washed repeatedly with methanol and dried under vacuum to furnish P2a as colorless waxy material (0.14 g, 78%). $^1$H NMR (CDCl$_3$, 500 MHz) $\delta$: 3.885 (t, $h$, $J = 6.0$Hz, 4H), 3.768- 3.724 (m, $b$, 4H), 3.644-3.635 (m, $a$, 4H), 2.929-2.861 (m, $c$, 4H),

P2b: same as P2a, yield: 79%, $^1$H NMR (CDCl$_3$, 500 MHz) $\delta$: 3.91 (t, $h$, $J = 6.0$ Hz, 4H), 2.87-2.68 (m, $c$, 4H); 1.78-1.71 (m, $b$, 4H), 1.52-1.43 (m, $a$, 4H).

P3a: The disulfide polymer P2a (0.137 g, 0.043 mmol) was taken in a reaction tube, equipped with a magnetic stirrer, septum and gas inlet/outlet and dissolved in 0.4 mL of dry and degassed dichloromethane. To this stirring solution triethylamine (119 $\mu$L, 0.853 mmol) was added drop wise and stirred for 10 min. A solution of 2-Bromoisobutyryl bromide (105 $\mu$L, 0.853 mmol, dissolved in 100 $\mu$L of CH$_2$Cl$_2$) was added drop wise for 10 min at 0 °C and the solution was allowed to come to room temperature and further stirred at this temperature for 12 h. After the course of the reaction, 0.4 mL CH$_2$Cl$_2$ was added and the organic layer was washed with aqueous solution of saturated sodium bicarbonate (3 x 0.5 mL). The organic layer was collected, dried over anhydrous sodium sulfate, and evaporated under vacuum. The resulting liquid was further dissolved in 200 $\mu$L of CHCl$_3$ and precipitated from methanol to yield P3a as solid powder (0.101 g, 68%). $^1$H NMR (CDCl$_3$, 500 MHz) $\delta$: 4.44 (t, $h$', $J = 6.5$Hz, 4H), 3.74 (t, $b$, $J = 6.5$ Hz, 4H), 3.64 (s, $a$, 4H), 2.97-2.88 (m, $c$, 4H), 1.94 (s, $i$, 6H).

P3b: same as P3a, yield: 67%, $^1$H NMR (CDCl$_3$, 400 MHz) $\delta$: 4.43 (t, $h''$, $J = 6.8$ Hz, 4H), 2.73-2.66 (m, $c$, 4H); 1.95 (s, $i$) 1.69-1.67 (m, $b$, 4H), 1.43-1.39 (m, $a$, 4H).

P4a: PTEGMA-b-PDS-b-PTEGMA block copolymers were synthesized using standard ATRP technique. In a typical polymerization run, Cu(I)Br (2.45 mg, 0.017 mmol) was taken in a glass ampule equipped with a septum and gas inlet/outlet. After degassing for 5 min, M4 (0.397 g, 1.708 mmol) and a solution of PMDETA (7.2 $\mu$L, 0.034 mmol; a stock solution of PMDETA was prepared by adding 36 $\mu$L PMDETA in 100 $\mu$L of dry and degassed anisole, from which 20 $\mu$L was added) in dry and degassed anisole were added to the glass ampule and stirred for 10 min at room temperature to allow catalyst
formation while the solution (total volume 100 μL) turned into light green color. To it a homogeneous solution of P3a (0.03 g, 0.0085 mmol) dissolved in 100 μl of degassed anisole was added and the resulting mixture was transferred to a pre-heated oil bath at 90 °C and stirred for 3 h at this temperature under argon atmosphere. Polymerization was rapidly quenched after dipping the reaction ampule into liquid nitrogen and then the green viscous product was dissolved in 0.2 mL of CHCl₃ and precipitated from diethyl ether. The precipitate was centrifuged and dried in vacuum to obtain P4a as slightly bluish sticky polymer (0.145 g, 52%).

¹H NMR (CDCl₃, 500 MHz) δ: 4.088 (bs, d, 2H ), 3.757 (t, b, J = 6.5Hz, 4H) 3.665-3.651 (m, a+e+f, 12H), 3.558 (s, g, 2H ), 3.384 (s, h, 3H) , 3.00-2.953 (m, e, 4H) , 1.897-1.801 (m, polymer backbone), 1.631 (s, i, 2H), 1.032-0.86 (bs, i, 3H )

P4b: same as P4a, yield: 41%, ¹H NMR (CDCl₃, 500 MHz) δ: 4.09 (bs, g, 2H), 3.66-3.57 (bs, c+d, 8H), 3.57 (bs, h, 2H), 3.39 (bs, b, 3H), 2.79-2.73 (m, e, 4H), 1.91-1.74 (m, f, 4H), 1.61 (bs, i, 2H), 1.56 (bs, g, 4H), 1.25-0.87 (b, i, 3H)

Additional Figures:

Table S1: Solubility tests of P4a (c = 1.0 mg/mL) in different solvents at room temperature (25 °C)

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>water</td>
<td>insoluble</td>
</tr>
<tr>
<td>methanol</td>
<td>insoluble</td>
</tr>
<tr>
<td>ethanol</td>
<td>insoluble</td>
</tr>
<tr>
<td>t-butanol</td>
<td>insoluble</td>
</tr>
<tr>
<td>chloroform</td>
<td>soluble</td>
</tr>
<tr>
<td>tetrahydrofuran</td>
<td>soluble</td>
</tr>
<tr>
<td>acetone</td>
<td>soluble</td>
</tr>
<tr>
<td>1,4-dioxane</td>
<td>soluble</td>
</tr>
<tr>
<td>DMF</td>
<td>soluble</td>
</tr>
<tr>
<td>diethyl ether</td>
<td>partially soluble</td>
</tr>
</tbody>
</table>
Table S2: Comparative physical parameters of P4a and P4b obtained using pyrene as a hydrophobic probe

<table>
<thead>
<tr>
<th>Entry</th>
<th>CAC(M)</th>
<th>Encapsulation efficiency/1.0mg polymer</th>
<th>$I_{373}/I_{384}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>P4a</td>
<td>$1 \times 10^{-5}$</td>
<td>0.0046 mg</td>
<td>1.36 CH$_2$Cl$_2$(1.37) 8.93$\varepsilon_0$ at 20°C</td>
</tr>
<tr>
<td>P4b</td>
<td>$7.5 \times 10^{-6}$</td>
<td>0.0061 mg</td>
<td>1.31 CHCl$_3$(1.28) 4.8$\varepsilon_0$ at 20°C</td>
</tr>
</tbody>
</table>

Fig. S1 GPC traces of P1a (in black) and P2a (in red) in THF
Fig. S2 UV-vis spectrum of **P1a** (black) and **M2** (red) after treating with Ellman’s reagent \((c = 0.1 \text{ mg/mL polymer/M2}, 1.0 \text{ cm pathlength})\)

Fig. S3 \(^1\)H NMR spectra of **P1b-P3b** in CDCl\(_3\), X indicates peaks corresponding to residual CHCl\(_3\) in CDCl\(_3\)

Fig. S4 MALDI-ToF spectrum of **P1b**. \(m/z = 2616.8\) matches with \((16 \times 148.5 \text{ (mass of repeat unit)} + 2 \times 110.01 \text{ (mass of pyridyl sulfide)} + 22.99 \text{ (mass of sodium)}\)
**Fig. S5** UV-vis spectra of **P1b** (black) and **P2b** (red) in CHCl₃ (c = 1.0 mg/10 mL, 1.0 cm pathlength) showing absence of pyridyl group in **P2b**

**Fig. S6** Comparative FT-IR spectra of **P1b** (black) and **P2b** (red) show absence of the peaks corresponding to C=N stretching (at 1574 and 1560 cm⁻¹) in **P2b** (KBr window)
Fig. S7 MALDI-ToF spectrum of P2b. \( m/z = 2846.6 \) matches with \((18 \times 148.5 \text{(mass of repeat unit)} + 2 \times 77.13 \text{(mass of 2-mercaptoethanol)} + 22.99 \text{(mass of sodium)}\)

Fig. S8 Selective region of comparative FT-IR spectra of P3b (red) and P2b (black) (KBr window)
Fig. S9 GPC traces of P4b (red) and P3b (black) in THF

Fig. S10 $^1$H NMR of P4b in CDCl$_3$, X indicates peak corresponding to the residual CHCl$_3$ in CDCl$_3$
Fig. S11 Influence of temperature on transmittance of (left) P4a and (right) P4b ($c = 5 \times 10^{-5} \text{ M}$, 1.0 cm pathlength)

Fig. S12 Absorption spectra of pyrene in dichloromethane (pyrene concentration: $1 \times 10^{-5} \text{ M}$), pathlength of cuvette = 1 cm, temperature = 25 °C
Fig. S13 Emission spectra of pyrene encapsulated in aqueous solution of P4b at varying concentrations; (inset) Variation of I_{373}/I_{384} in pyrene emission spectra as a function of P4b concentration, pyrene concentration was kept constant (c = 1x10^{-5} M) in all cases.

Fig. S14 Comparison of Nile red (NR) emission in water (black) and NR-encapsulated P4a polymer (red), λ_{ex} = 530 nm.
**Fig. S15** Comparative NR release profile of P4b upon treatment with different GSH concentrations: 20.0 mM (red circle), 60.0 mM (black box)

**References:**