

Supporting Information

Fluorescent DNA-Poly(phenylenevinylene) Hybrid Hydrogels for Monitoring Drug Release

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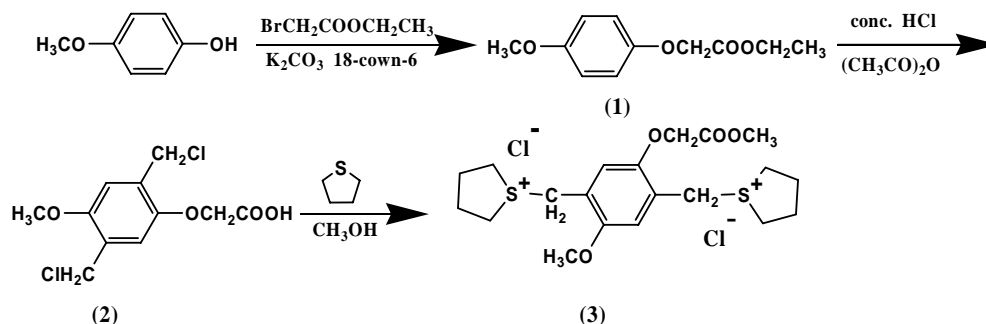
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Materials and Measurements.

Sodium salt of DNA from salmon tests was purchased from Sigma-Adrich. Ethyl 2-(4-methoxyphenoxy) acetate (1) was synthesized according to literature.¹ Fluorescence spectra were obtained from a Hitachi F-4500 fluorometer using a Xeron-lamp as the excitation source. Circular dichroism spectra were performed on JASCO J-815 spectropolarimeter. Images of scanning electron microscopy (SEM) were taken on Hitachi S-4300 scanning electron microscopy. The photographs were obtained by Canon digital camera. Fluorescent microscope images were taken on Olympus IX-71 with Hg-lamp as excitation source and GFP fluorescence filter cube. The water was purified using a Millipore filtration system.

Synthesis of monomer



Scheme S1. The synthesis route of PPV monomer.

2-(2,5-Bis(chloromethyl)-4-methoxyphenoxy)acetic acid (2)

To a stirred mixture of ethyl 2-(4-methoxyphenoxy) acetate (1.35 g, 6.4 mmol) and paraformaldehyde (0.53 g, 18 mmol) was dropwisely added 3.1 mL of concentrated HCl under N₂ atmosphere. Subsequently, acetic anhydride (6.2 mL) was added at such a rate that the temperature did not exceed 70 °C and the resulting solution was stirred at 60 °C for 3h. Then the solution was cooled down to room temperature and poured into 20 mL of water. The resulting precipitate was filtered off, dissolved in CH₂Cl₂ (20 mL) and dried over anhydrous MgSO₄. Evaporation of the solvent gave a white solid in 74.4% yield. ¹H NMR (400 MHz, DMSO-*d*₆): δ = 12.97 (s, 1H), 7.14 (s, 1H), 7.10 (s, 1H), 4.76 (s, 2H), 4.71 (s, 2H), 4.66 (s, 2H), 3.80 (s, 3H); ¹³C NMR (100 MHz, DMSO-*d*₆): δ = 170.8, 152.0, 150.0, 128.0, 127.1, 116.0, 114.4, 67.6, 56.6.

Bis-tetrahydrothiophenium salt of 6-(2,5-bischloromethyl-4-methoxy-phenoxy)-acetic acid methyl ester (3)

To a solution of **2** (0.33 g, 1.2 mmol) in 4 mL of methanol, was added 0.4 mL tetrahydrothiophene. The mixture was allowed to react at 50 °C for 14h, and then was cooled down to room temperature. The solution was poured into cold acetone and the resulting precipitate was filtered off to afford a white solid (0.19 g, 33% yield). ¹H NMR (400 MHz, D₂O): δ = 7.21 (s, 1H), 7.08 (s, 1H), 4.91 (s, 2H), 4.57 (s, 2H), 4.47(s, 2H), 3.89 (s, 3H), 3.79 (s, 3H), 3.50-3.39 (m, 8H), 3.37-2.26 (m, 8H); ¹³C NMR (100 MHz, CD₃OD): δ = 169.5, 152.9, 150.5, 121.0, 118.6, 116.6, 115.4, 65.5, 57.3, 51.6, 46.9, 41.6 28.5. MS (ESI): 199.3 (M-2Cl)²⁺.

Synthesis of DNA hydrogels

To a solution of salmon DNA (13.2 mg, 20 μmol/base pair) in 1.0 mL water were added 2 mL of dimethylsulfoxide and 375 μL of 0.04 M monomer aqueous solution. Then 40 μL of 1.0 M NaOH was added under continuous stirring and the mixture was allowed to react at 25°C for 40 min. After reaction, the solution was poured into acetone, centrifugated and dried under vacuum to obtain the dry **Gel 2** (17 mg). The other three hydrogels (**Gel 1**, **Gel 3** and **Gel 4**) were synthesized under the same condition except for using 0.5, 1.0 and 1.25 as feed molar ratio of monomer to DNA instead of 0.75.

Measurement of swelling degrees

The dry DNA–PPV hydrogels (**Gel 1-4**) were placed in water at room temperature for 12h, and then swelling degrees (Q) were measured according to following equation:²

$$Q = (W_{\text{wet}} - W_{\text{dry}})/W_{\text{dry}}$$

where W_{dry} and W_{wet} are the weight of the dried hydrogel and wet hydrogel, respectively.

Digestion of DNA–ppv hydrogel with DNase I

The DNA (30 μ g/100 μ L) and DNA–PPV hydrogel were placed in buffer (40mM Tris-HCl, pH 7.5, 10mM Mn^{2+}) containing 5mM dithiothreitol, respectively. Then DNase I (final concentration was 1U/100 μ L) was added and allowed to digest at 37°C for 15min. The digestive products were allowed to take gel electrophoresis by using 1% agarose gel in the electrolyte of 1X TAE buffer with voltage of 100 V for 30 min. Tiangen 1 kb DNA marker was used. The volume of sample for gel electrophoresis was 6 μ L.

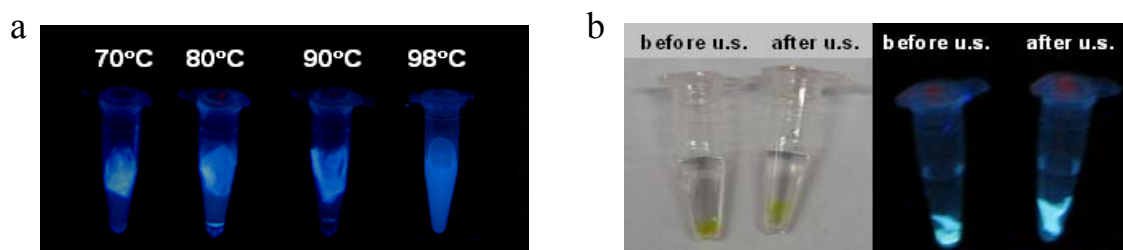


Figure S1. Effects of temperature and ultrasound upon Gel 2. (a) Photographs of **Gel 2** treated at different temperatures under UV transilluminator with excitation at 365 nm. (b) Photographs of **Gel 2** before and after treatment under ultrasound. Right one was taken under UV transilluminator with excitation at 365 nm.

Reference

1. Benjamin, I.; Hong, H.; Avny, Y.; Davidov, D.; Neumann, R. *J. Mater. Chem.* **1998**, *8*, 919-924.
2. Ono, T.; Sugimoto, T.; Shinkai, S.; Sada, K. *Nat. Mater.* **2007**, *6*, 429.