Enantioselective recognition of a fluorescence-labeled phenylalanine by self-assembled chiral nanostructures

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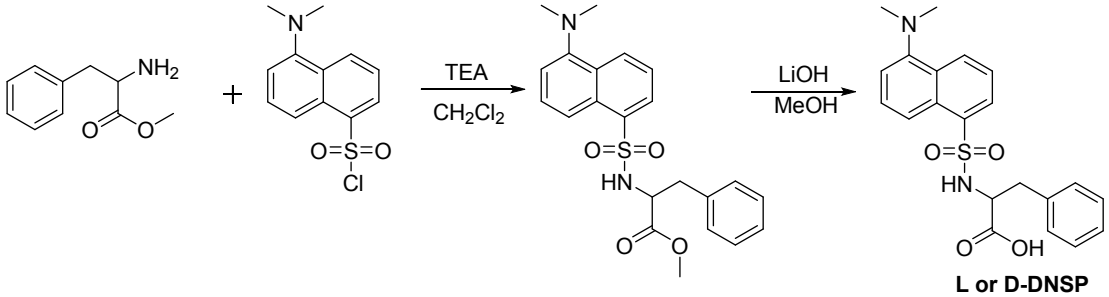
Materials: The chemical reagents dansyl chloride was purchased from TCI chemical company and common chemical reagents were used as purchased without further purification. The synthesis method of the N,N'-bisoctadecyl-L-glutamicdiamide (LGAm) was reported previously by our group[13], LGAm has been produced at large-scale.

The synthesis of L or D-DNSP



L or D-DNSP

L or D-Phenylalanine methyl ester (18g, 0.1mol) and TEA (12.1g, 0.12mol) were dissolved in CH_2Cl_2（500mL), and dansyl chloride (27g, 0.1mol) was dropped into the solution. After the mixture was stirred for 12 hour at room temperature, the resulting solution was washed with water(200mL), brine, dried over Na_2SO_4, and concentrated under reduced pressure. The residue was purified by flash chromatography (2:5, PE/EtOAc) to give 36.8g (80 %) of the corresponding ester. ESI-MS: $[M+1]^+$: m/z = 413.

the corresponding ester (20.6g, 0.05mol) was dissolved in MeOH（200mL), and then LiOH (4.2g, 0.1mol) was added, the solution was stirred for overnight at room temperature, 3M HCl was added to adjust pH to 3-4, concentrated under reduced pressure and extracted with EA, the solvent was removed to obtained the crude product, crystallized from EA:PE=1:1 to offer the light yellow solid

L-DNSP:ESI-MS: m/z calcd for $[C_{21}H_{22}N_2O_4S+H]^+$: 399.

^{1}H NMR(400 MHz, $CDCl_3$): ^{1}H NMR(400 MHz, $CDCl_3$): δ 8.45-8.43 (d, 1H), 8.19-8.17 (d, 1H), 8.11-8.09 (d, 1H), 7.59-7.55 (m, 2H), 7.25-7.23 (d, 1H), 7.06 (m, 5H), 3.34-3.32 (m, 1H), 3.02-3.01 (d, 1H), 2.87-2.85 (d, 1H) 2.83 (s, 6H).

Elemental analysis: Calcd. for $[C_{21}H_{22}N_2O_4S+H_2O]$: C 60.56, H 5.81, N 6.73. Found: C 60.84, H 5.58, N 6.58.

D-DNSP:ESI-MS: m/z calcd for $[C_{21}H_{22}N_2O_4S+H]^+$: 399.

^{1}H NMR(400 MHz, $CDCl_3$): δ 8.39-8.37 (d, 1H), 8.18-8.16 (d, 1H), 7.94-7.92 (d, 1H), 7.54-7.46 (m, 2H), 7.23-7.21 (d, 1H), 6.99 (m, 5H), 3.60-3.58 (m, 1H), 2.89-2.88 (d, 1H), 2.86-2.85 (d, 1H) 2.82 (s, 6H).

Elemental analysis: Calcd. for $C_{21}H_{22}N_2O_4S$: C 63.30, H 5.56, N 7.03. Found: C 63.64, H5.65, N 6.89.

The synthesis of PPLGOEt

L-Glutamic diethyl ester hydrochloride (240 mg, 1.0mmol) was dissolved in dry CH_2Cl_2 (100 mL, 250 mL flask), and triethylamine (TEA) (0.5 mL) was added to the solution. The mixture was stirred for 30 min at room temperature. Then 2-(3-(pyridin-2-yl)-1H-pyrazol-1-yl) acetic acid (304 mg, 1.5 mmol) with 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide hydrochloride (EDC·HCl, 385 mg, 2.0 mmol) and 1-hydroxybenzotrizole (HOBt, 270 mg, 2.0 mmol) were added to the above mixture. The reaction system was stirred for 72 h at room temperature. After the reaction, the solution was washed with an aqueous saturated solution of sodium chloride (3×30 mL) and water. The organic phase was dried over magnesium sulphate. The solvent was removed by rotary evaporation, and the crude product was obtained. The crude product was purified with silica column chromatography (CH_2Cl_2/CH_3OH = 50:1), the target product was obtained as a fine white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ = 8.64 (d, 1H), 8.56 (m, 1H), 7.89 (m, 1H), 7.78 (m, 2H), 7.27 (m, 1H), 6.82 (s, 1H), 4.94 (s, 2H), 4.10 (m, 1H), 4.08-4.03 (m, 4H), 2.41-2.39 (m, 2H), 2.12-1.92 (m, 1H), 1.78-1.92 (m, 1H), 1.22-1.15 (m, 6H); ESI-MS: Calcd. for $C_{19}H_{24}N_4O_5$, 388.4; Found: $(M+H)^+$, 389.3; $(M+Na)^+$ 411.3.

Self-assembly experiments: PPLG (2mg-10mg) in solvent (1 mL) was heated until dissolved, then the resulting solution was cooled naturally and gelated. The PPLG xerogels were prepared by removing organic solvents. The DNSP was dissolved into water/ethanol mixture (9:1 V:V) to get the concentration at 5×10^{-4} M. Then the DNSP solution (2mL) was added into the PPLG xerogels. As comparison, the PPLGOEt (2mg) was heated in ethanol (1mL)and then cooling at room temperature. The precipitation was formed due to the weak interaction between PPGOEt. The precipitation removing organic solvents was put into DNSP solution. After ultrasonication 20mins, the suspensions containing DNSP and PPLG (or PPLGOEt) were monitored by Fluorescence spectrometer and UV-Vis spectrometer.

Instruments and methods: 1H NMR spectra were recorded on a Bruker AV300 spectrometer. Electron spray ionization-mass spectrometers were recorded on Bruker APEXII instrument. Scanning electron microscopy (SEM) was performed on a Hitachi S-4800 FE-SEM microscope. Fluorescence spectra and UV-Vis spectra were recorded on Hitachi F-4600 spectrometer and Hitachi UV 3900 spectrometer, respectively.

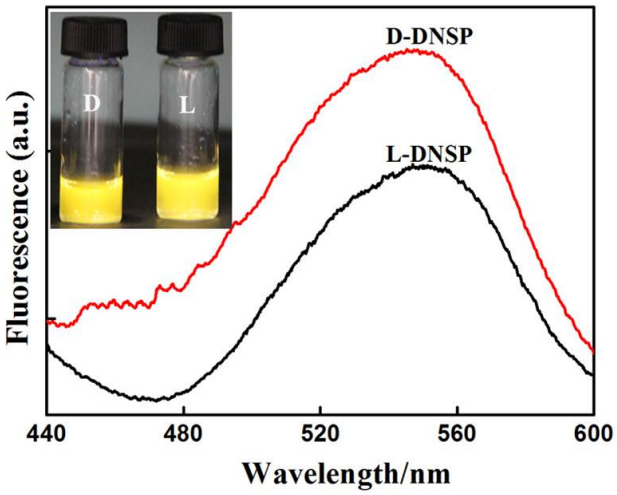


Figure S1. The fluorescence of dispersion of DNSP with PPLGOEt. The concentration of DNSP

is 1×10^{-4}M, PPLGOEt is 4mg/mL.

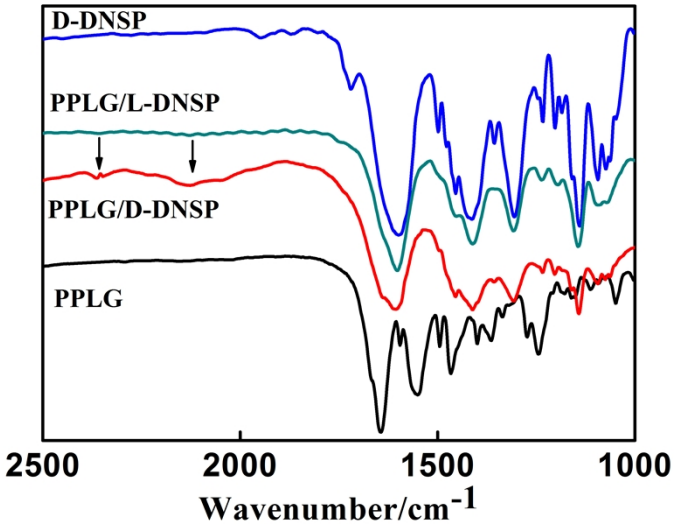


Figure S2. FTIR spectra of the PPLG xerogels obtained from ethanol, DNSP and the mixture of PPLG with DNSP.

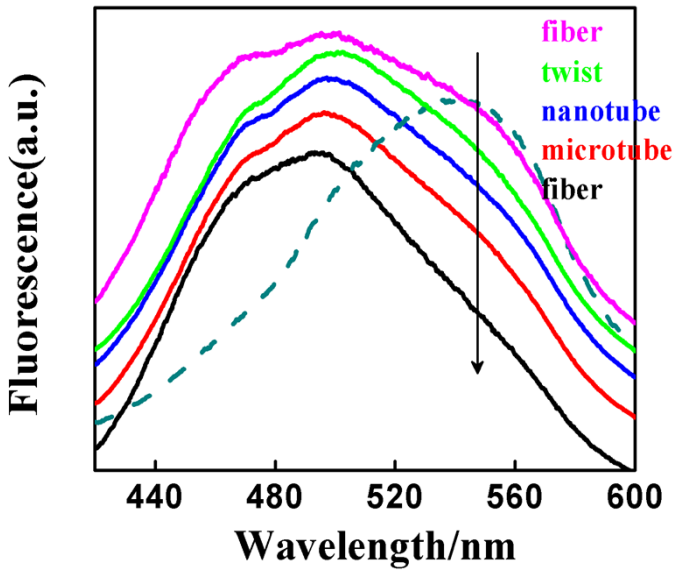


Figure S3. The fluorescence spectra of D-DNSP dispersion contained various PPLG nanostructures. The dash line represents the emission spectrum of L-DNSP dispersion containing PPLG nanostructures.