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Electronic Supplementary Information

Photoluminescent organic polymer nanofilms formed in water through a self-assembly formation mechanism

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S1. SEM images of polymer powders (PPs)

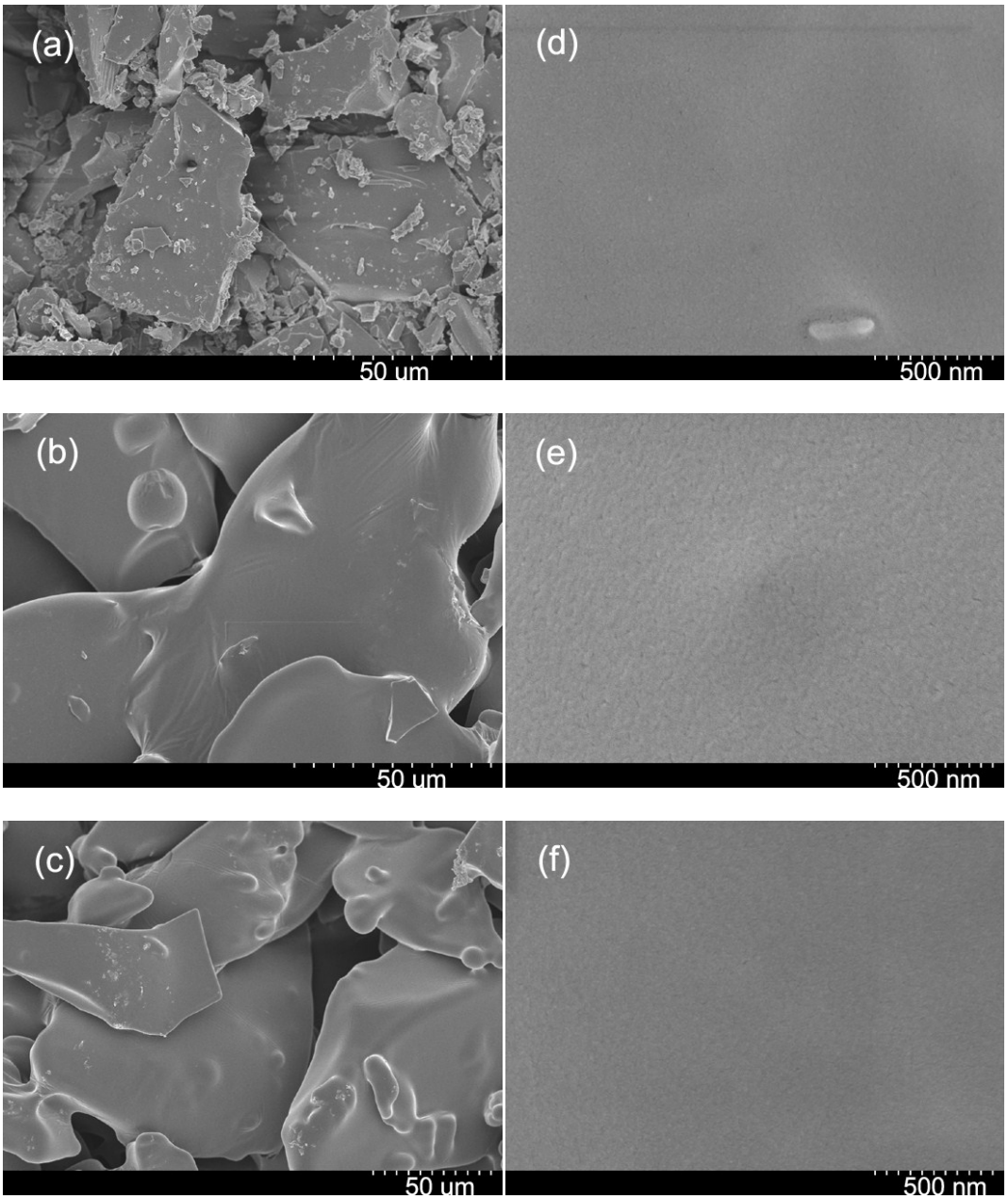


Fig. S1 SEM images of PPs prepared with different CA/LCy molar ratios at 160 °C for 1 h: (a,d) 1:1; (b,e) 2:1; (c,f) 3:1.

S2. Influence of polymer concentration

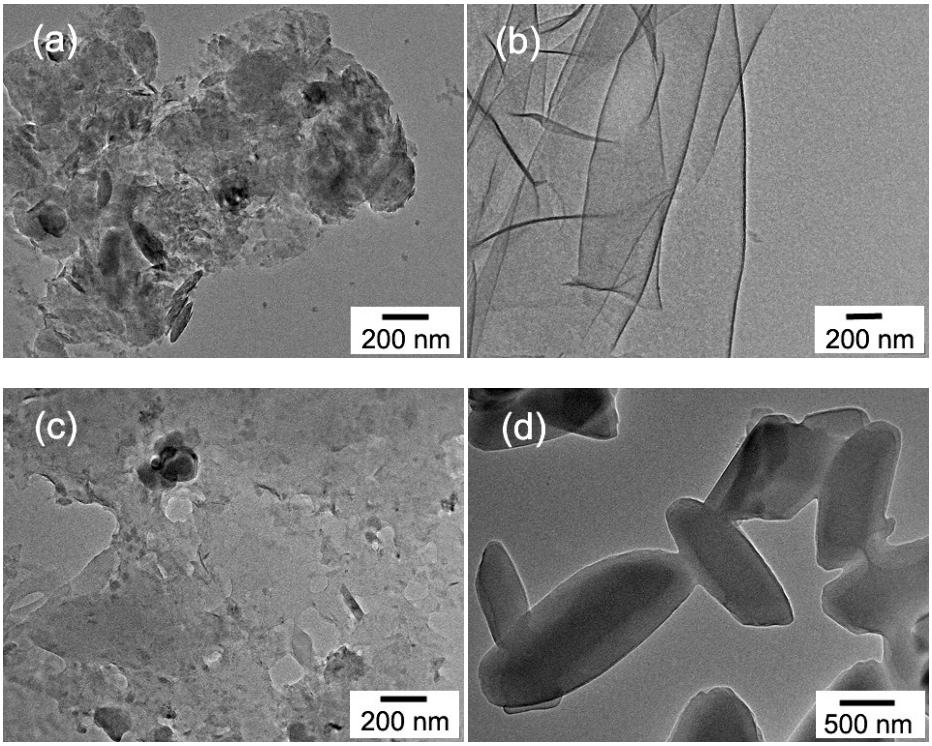


Fig. S2 TEM images of samples obtained by dissolving PPs in water with different polymer concentrations (mg mL^{-1}), where PPs were prepared with CA/LCy molar ratio being 2:1 at 160 °C for 1 h: (a) 0.005; (b) 2; (c) 16; (d) 32.

S3. Influence of CA/LCy molar ratios

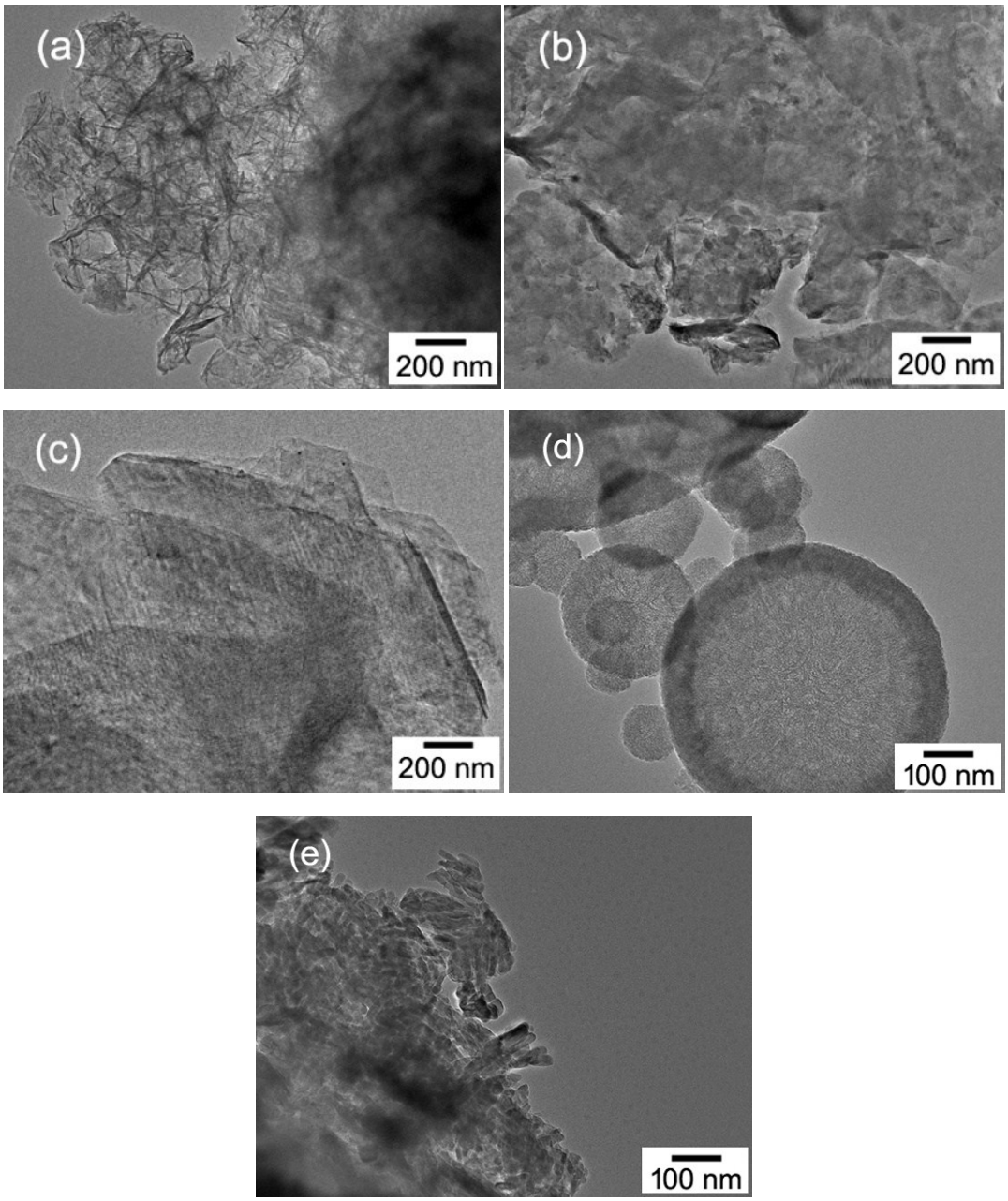


Fig. S3 TEM images of samples obtained by dissolving PPs in water with polymer concentration of 1 mg mL^{-1}, where PPs were prepared at 160 °C for 1 h with CA/LCy molar ratio of: (a) 1:1; (b) 2:1; (c) 3:1; (d) 0.6:1; (e) 4:1.

For PPs obtained with CA/LCy molar ratio ranging from 1:1 to 3:1, PNFs with relatively thicker thickness (Fig. S3a–c) and relatively thinner thickness (Fig. 1a–f, see the text) are produced by

dissolving corresponding PPs into distilled water (1 mg mL^{-1}). With decreasing CA/LCy molar ratio to 0.6:1, polymer spheres with size ranging from 80 nm to 2 μm are dominant (Fig. S3d). With increasing CA/LCy molar ratio to 4:1, the dissolution of PPs in water presents aggregated particles constituted by cross-linking of polymer nanorods (Fig. S3e).

S4. Influence of reaction temperature

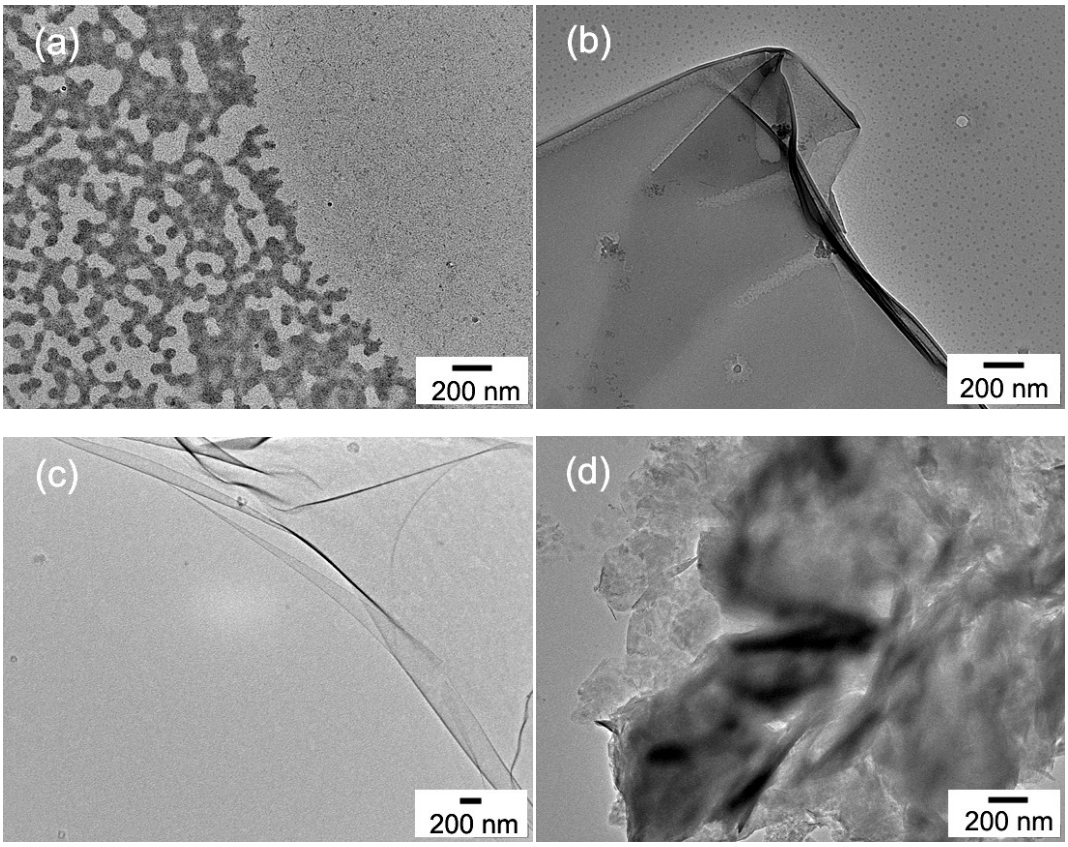


Fig. S4 TEM images of samples obtained by dissolving PPs in water with polymer concentration of 1 mg mL^{-1}, where PPs were prepared with CA/LCy molar ratio being 2:1 at different temperatures for 1 h: (a) 140 °C; (b) 150 °C; (c) 170 °C; (d) 180 °C.

S5. Influence of reaction time

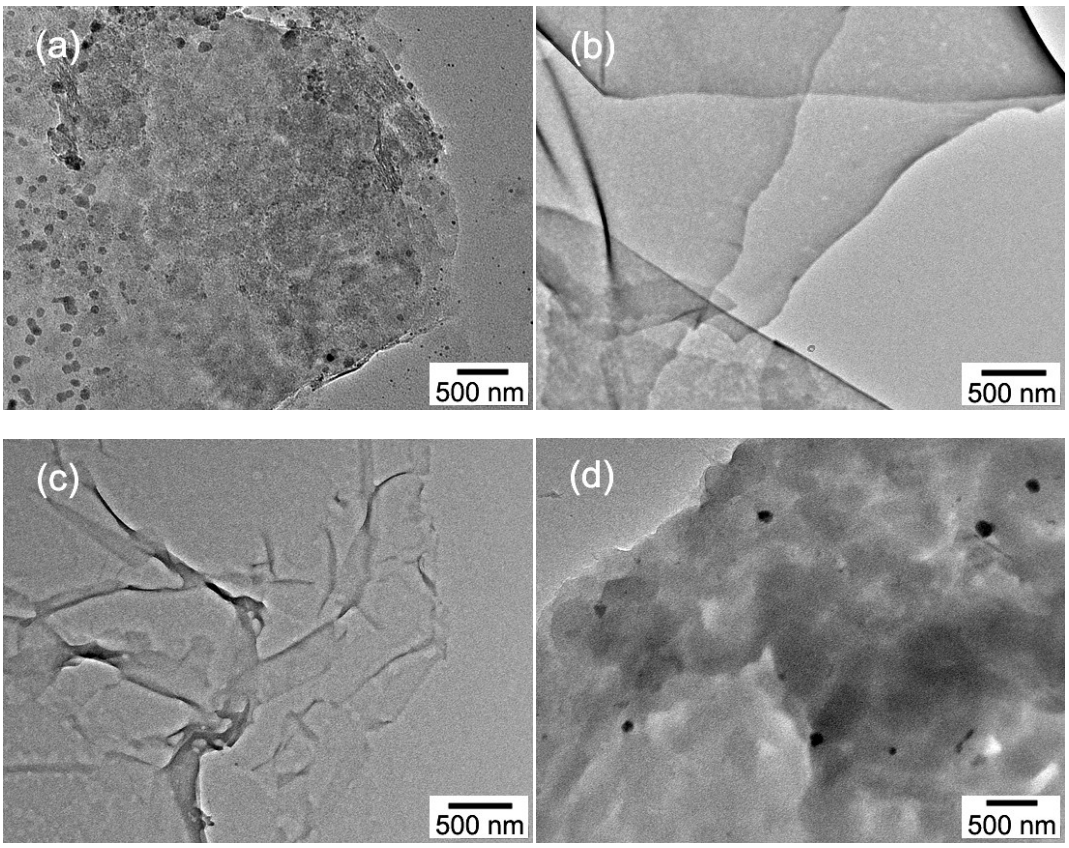


Fig. S5 TEM images of samples obtained by dissolving PPs in water with polymer concentration of 1 mg mL^{-1}, where PPs were prepared with CA/LCy molar ratio being 2:1 at 160 °C for: (a) 0.5 h; (b) 2 h; (c) 4 h; (d) 6 h.

S6. Influence of solvent

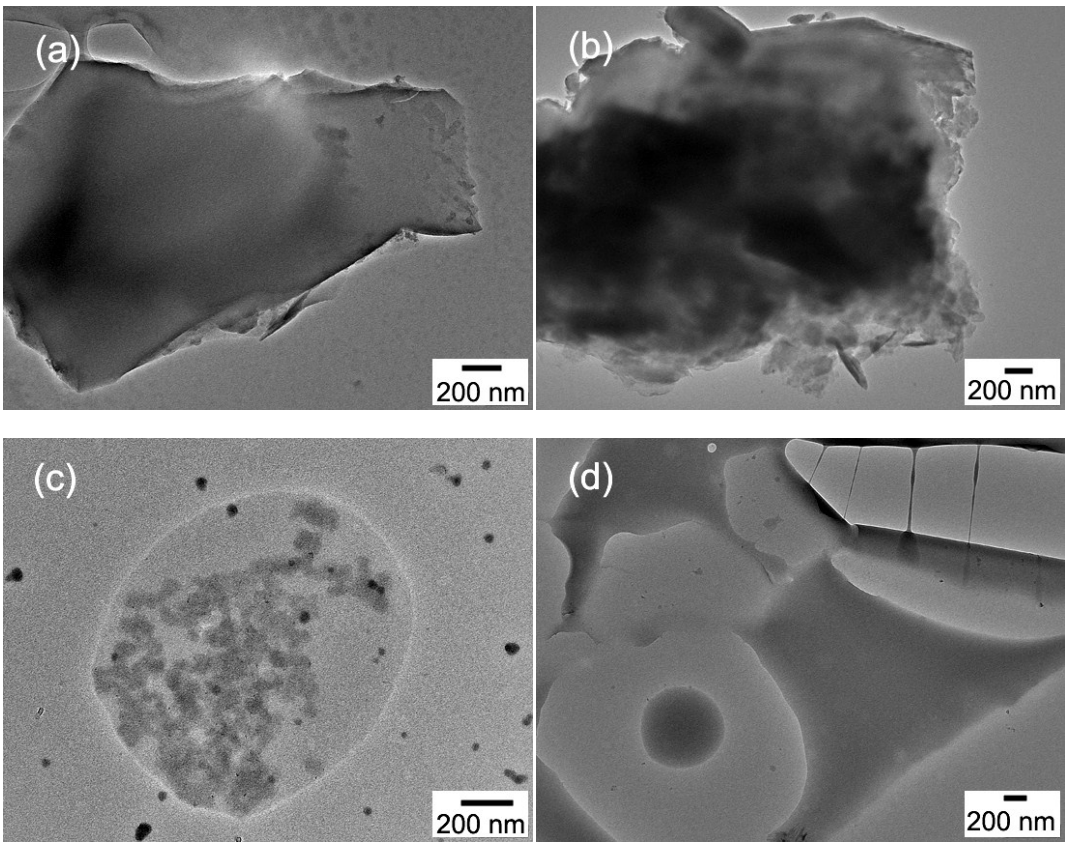


Fig. S6 TEM images of samples obtained by dissolving PPs in different solvents with polymer concentration of 1 mg mL^{-1}, where PPs were prepared with CA/LCy molar ratio of 2:1 at 160 °C for 1 h: (a) absolute ethanol; (b) acetone; (c) tetrahydrofuran; (d) ethyl acetate.

S7. Dissolution of PPs in water without ultrasonication

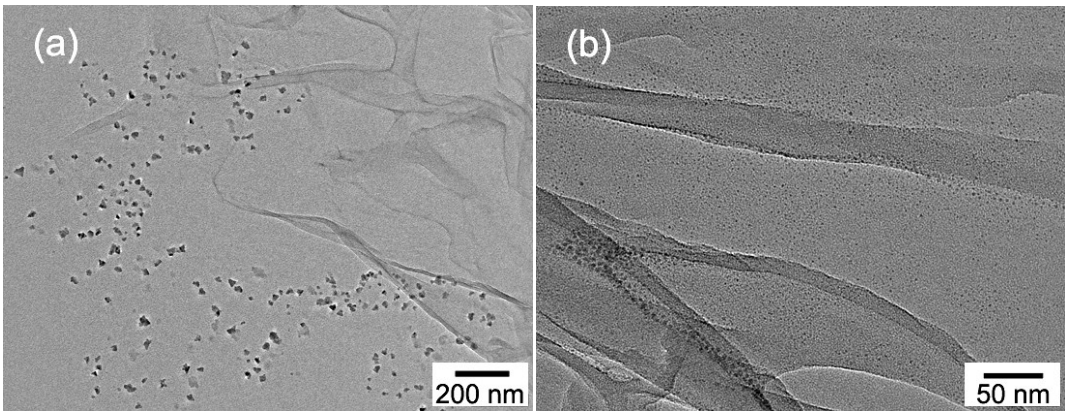


Fig. S7 TEM images of samples obtained by dissolving PPs in water with polymer concentration of 1 mg mL^{-1} but without ultrasonication, where PPs were prepared with CA/LCy molar ratio of 2:1 at 160 °C for 1 h: (a) polymer nanoplates coexist with PNs; (b) CDs residing on PNs.

S8. Separation of oligomers through column chromatography

To separate the oligomers through column chromatography, 40 g of silica-gel powders were added into 60 mL of mixed solvent with volume ratio of 50:1 for CH_2Cl_2/CH_3OH, followed by agitation to form uniform slurry. The slurry was transferred into a chromatographic column. The solvent level was higher by 1 cm than that of the silica gel. The column was sealed and kept at room temperature for 2 h.

100 mg of PPs were dissolved into 4 mL of the aforementioned CH_2Cl_2/CH_3OH mixed solvent, and then slowly added into the chromatographic column with bottom valve slightly open. The aforementioned CH_2Cl_2/CH_3OH mixed solvent was used as the eluent. After complete collection of type-I oligomers (Fig. S8), mixed solvent with volume ratio of 4:1 for CH_2Cl_2/CH_3OH was used

instead to collect type-II oligomers. Finally, type-III oligomers were collected by using absolute CH_3OH as the eluent.

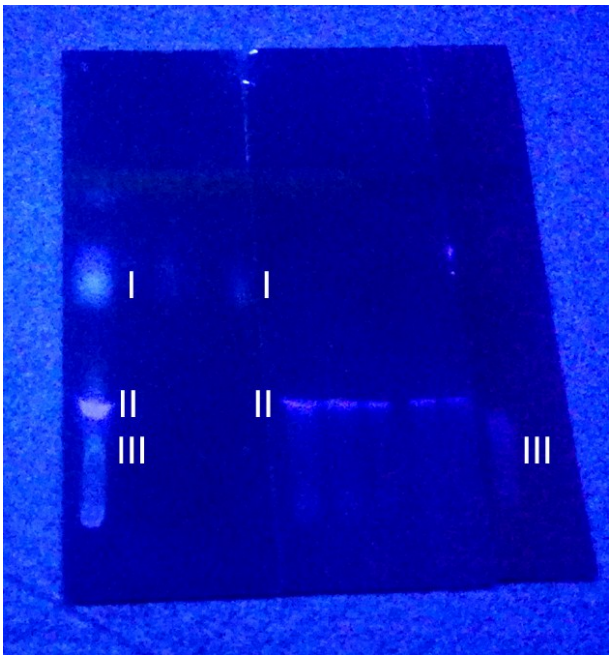
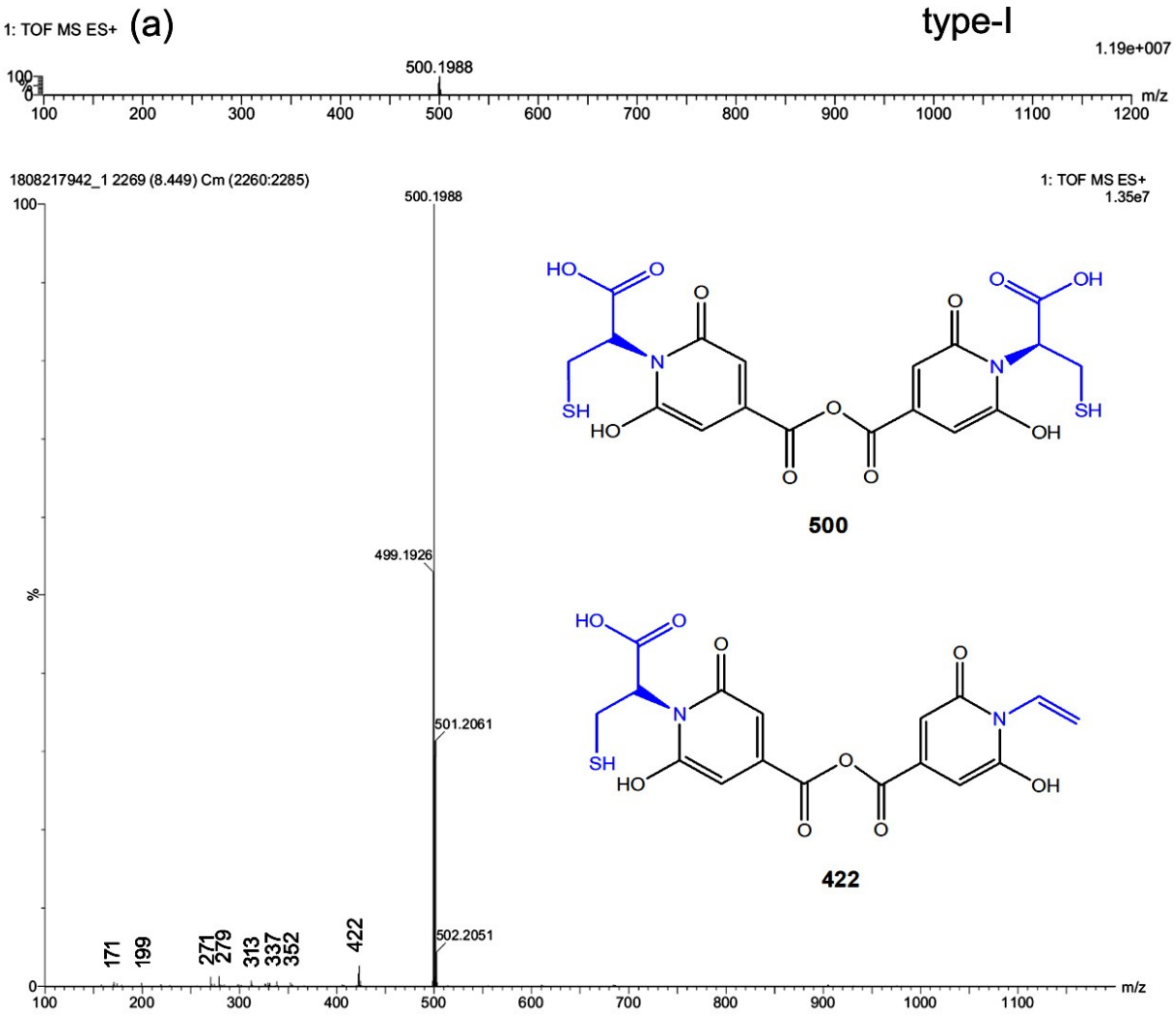
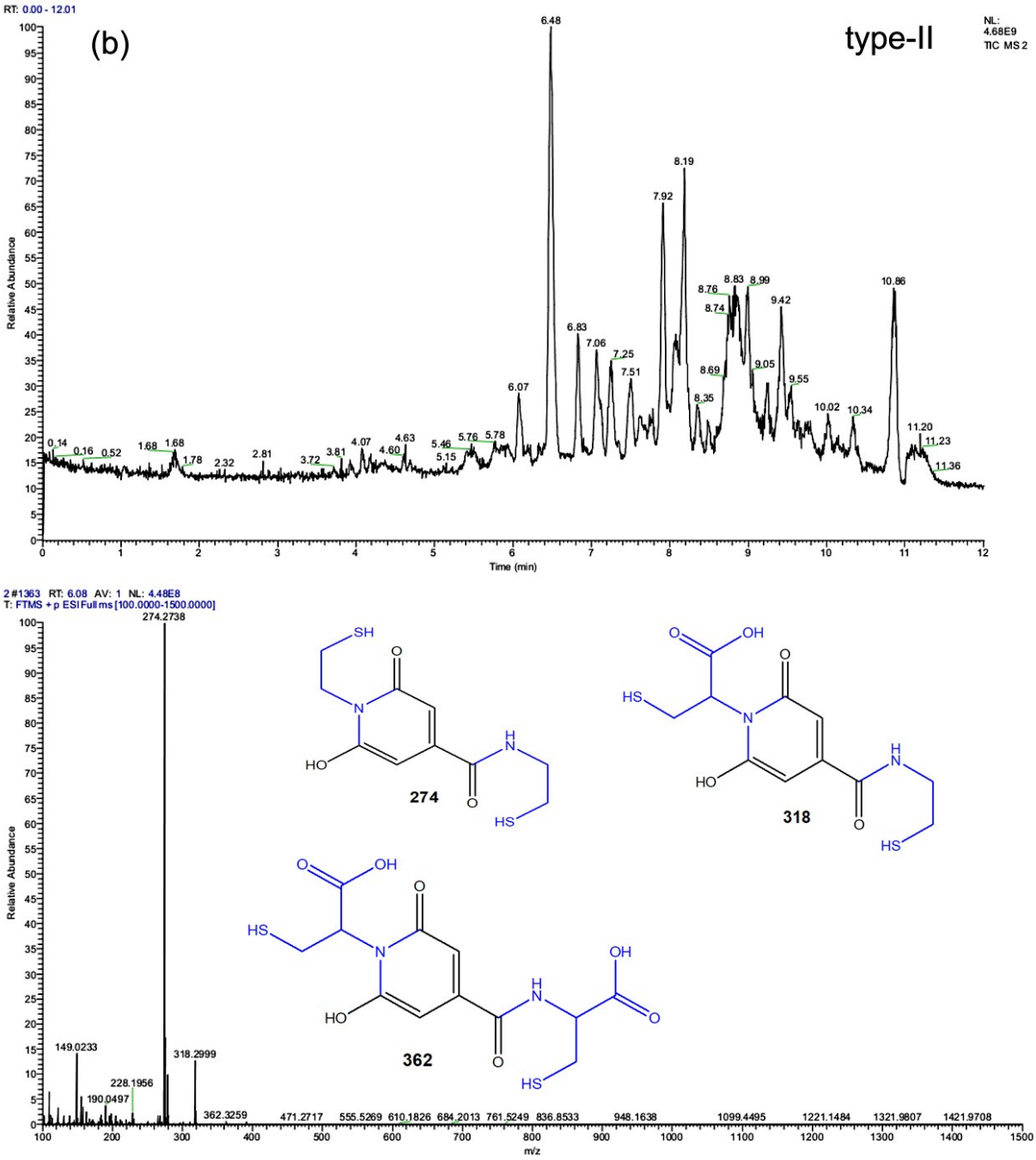


Fig. S8 Photograph of the chromatoplate; I, II, and III marked in the figure denote three types of oligomers, respectively; where PPs used for column chromatography were prepared with CA/LCy molar ratio of 2:1 at 160 °C for 1 h.

S9. TOF LC/MS analysis of the oligomers

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NL:
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TIC MS 2
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7.06
7.25
7.51
6.07
8.76
8.83
8.99
8.74
9.42
8.69
9.05
9.55
8.35
10.02
10.34
10.86
11.20
11.23
11.36
0.14
0.16
0.52
1.68
1.68
1.78
2.32
2.81
3.72
3.81
4.07
4.60
4.63
5.46
5.15
5.76
5.78
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684.2013
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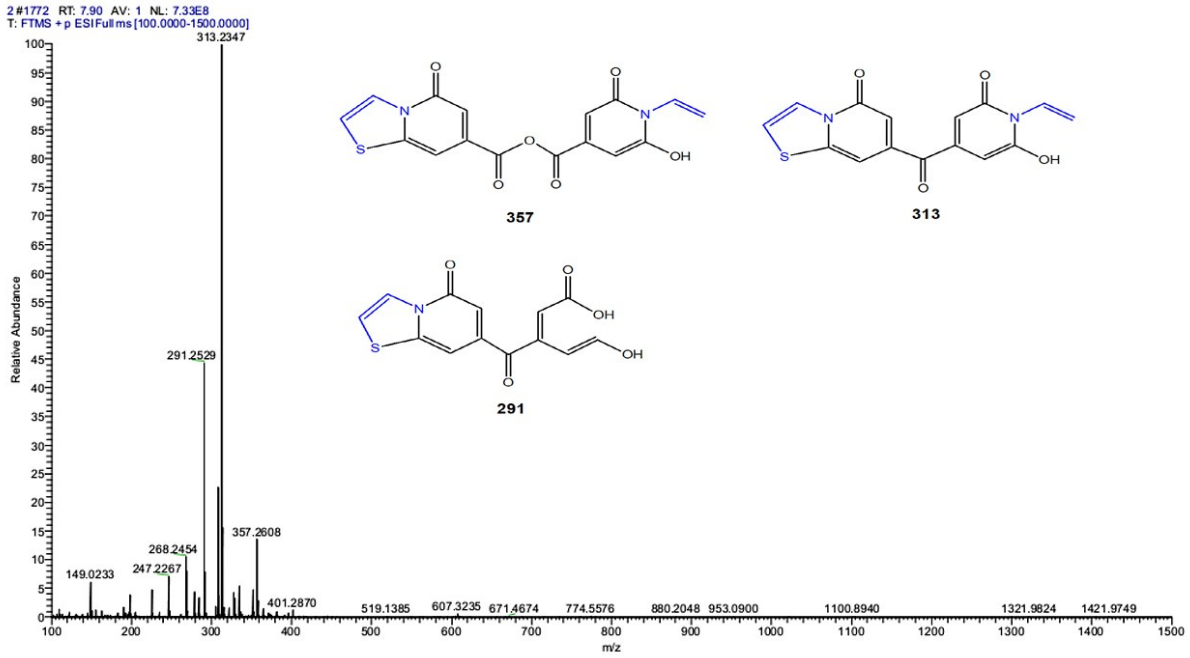
m/z
274
318
362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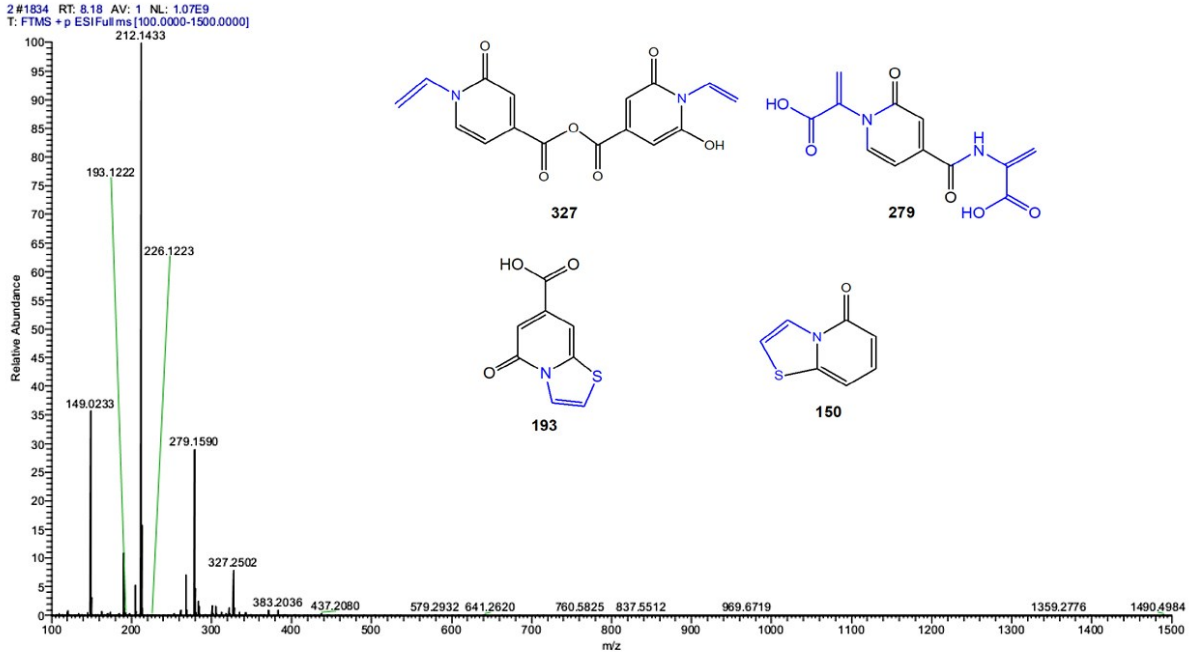
m/z
357
313
291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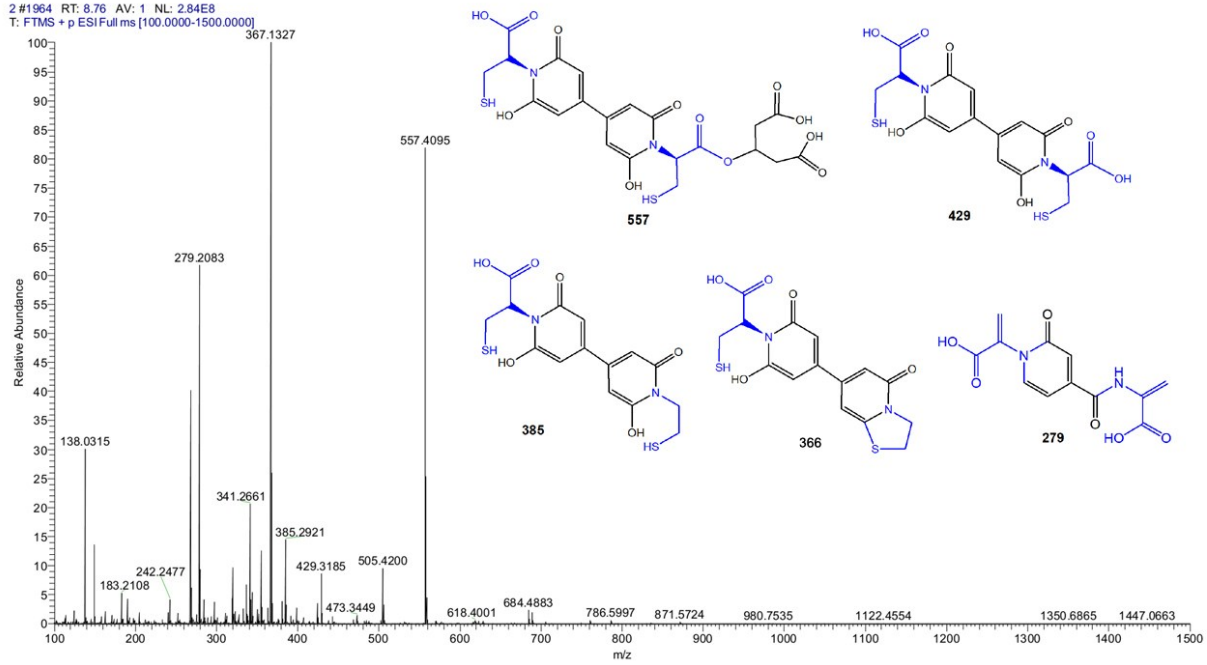
1490.4984
Relative Abundance
m/z
327
279
193
150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366
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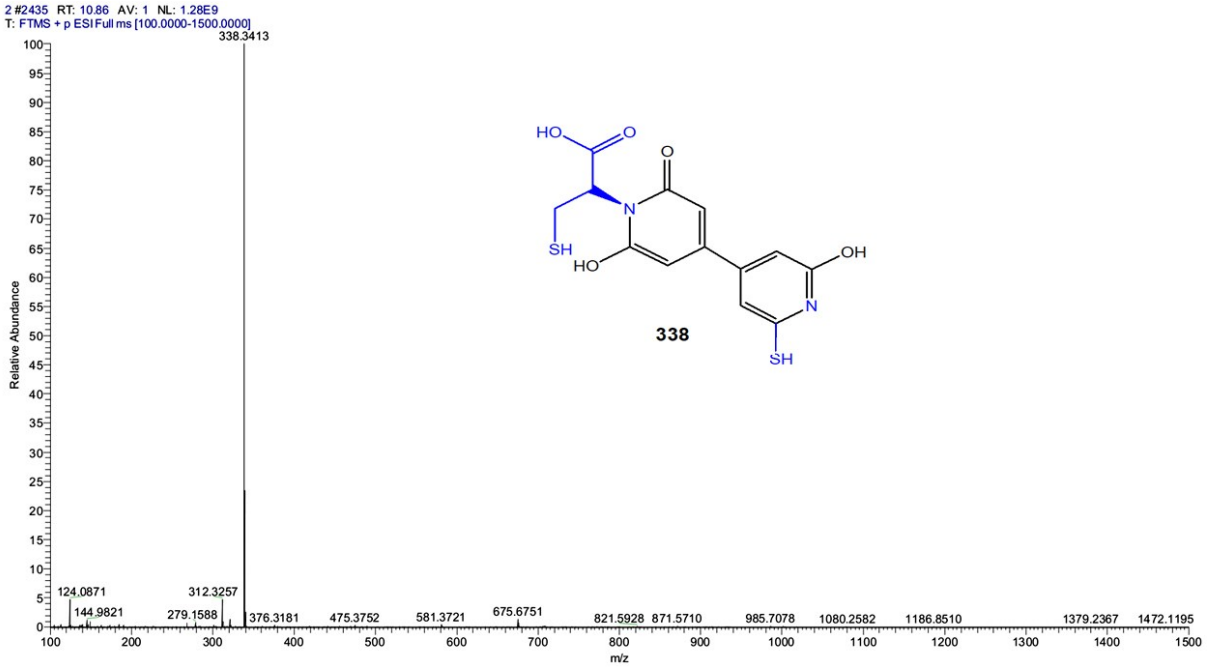
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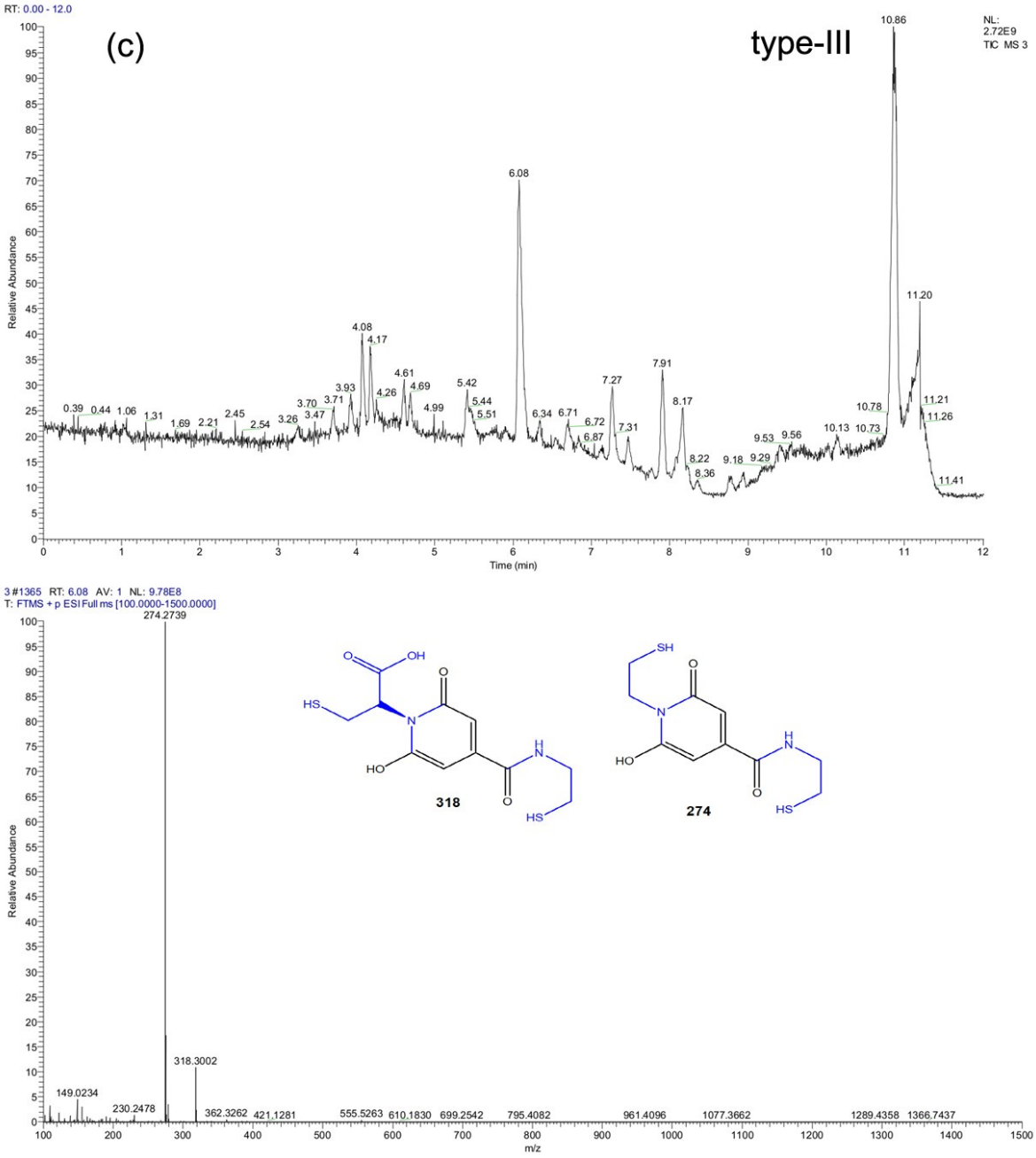
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(c)
type-III
NL:
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TIC MS 3
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4.08
4.17
7.91
7.27
4.61
4.69
3.93
3.71
5.42
8.17
11.21
11.26
10.78
11.41
0.39 0.44 1.06 1.31 1.69 2.21 2.45 2.54 3.26 3.47 3.70 4.26 4.99 5.44 5.51 6.34 6.71 6.72 6.87 7.31 8.22 8.36 9.18 9.29 9.53 9.56 10.13 10.73
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318.3002
149.0234
230.2478
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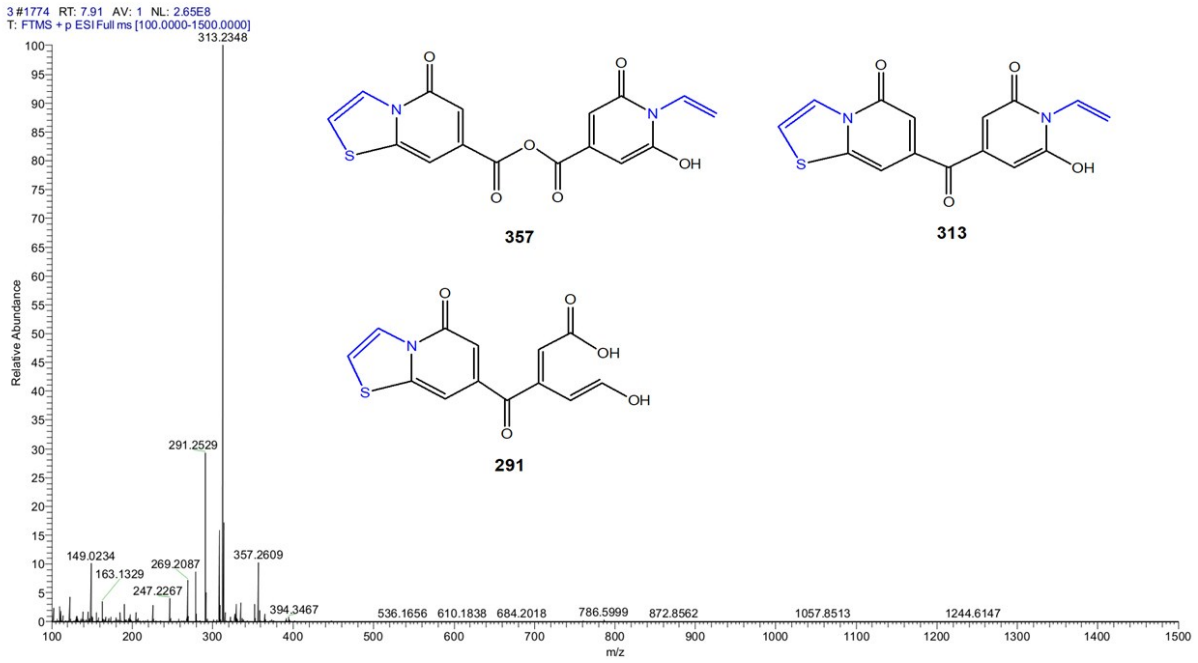
m/z
318
274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357.2609
394.3467
536.1656
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872.8562
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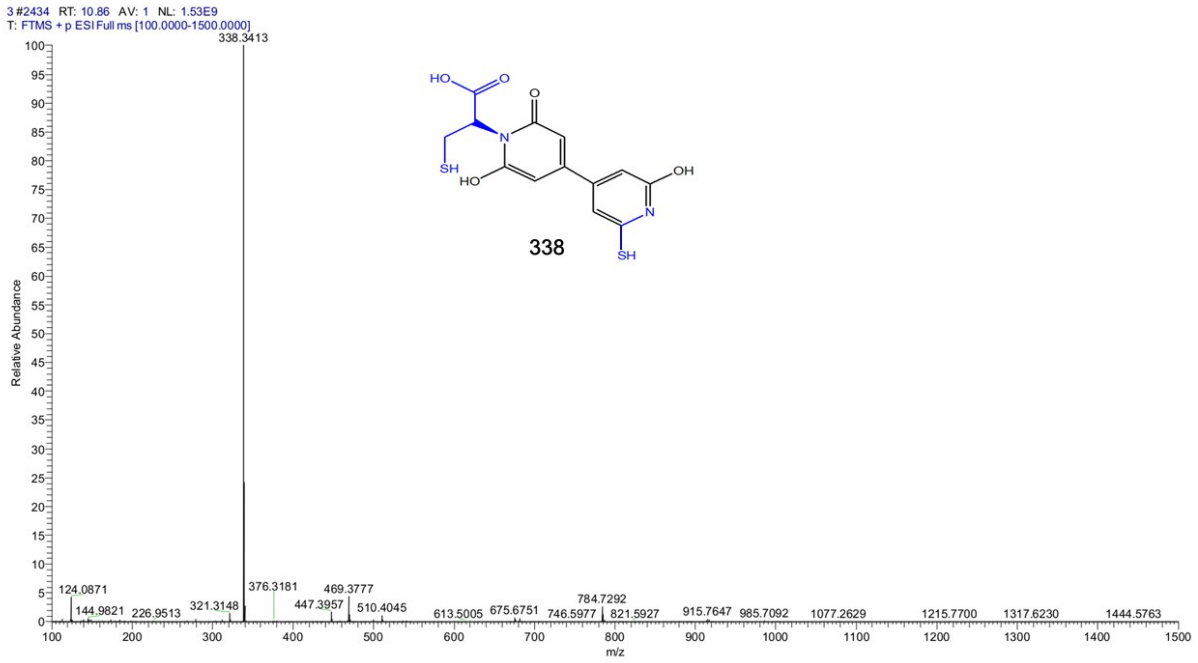
1244.6147
Relative Abundance
m/z
357
313
291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675.6751
746.5977
784.7292
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1077.2629
1215.7700
1317.6230
1444.5763
Relative Abundance
m/z
338

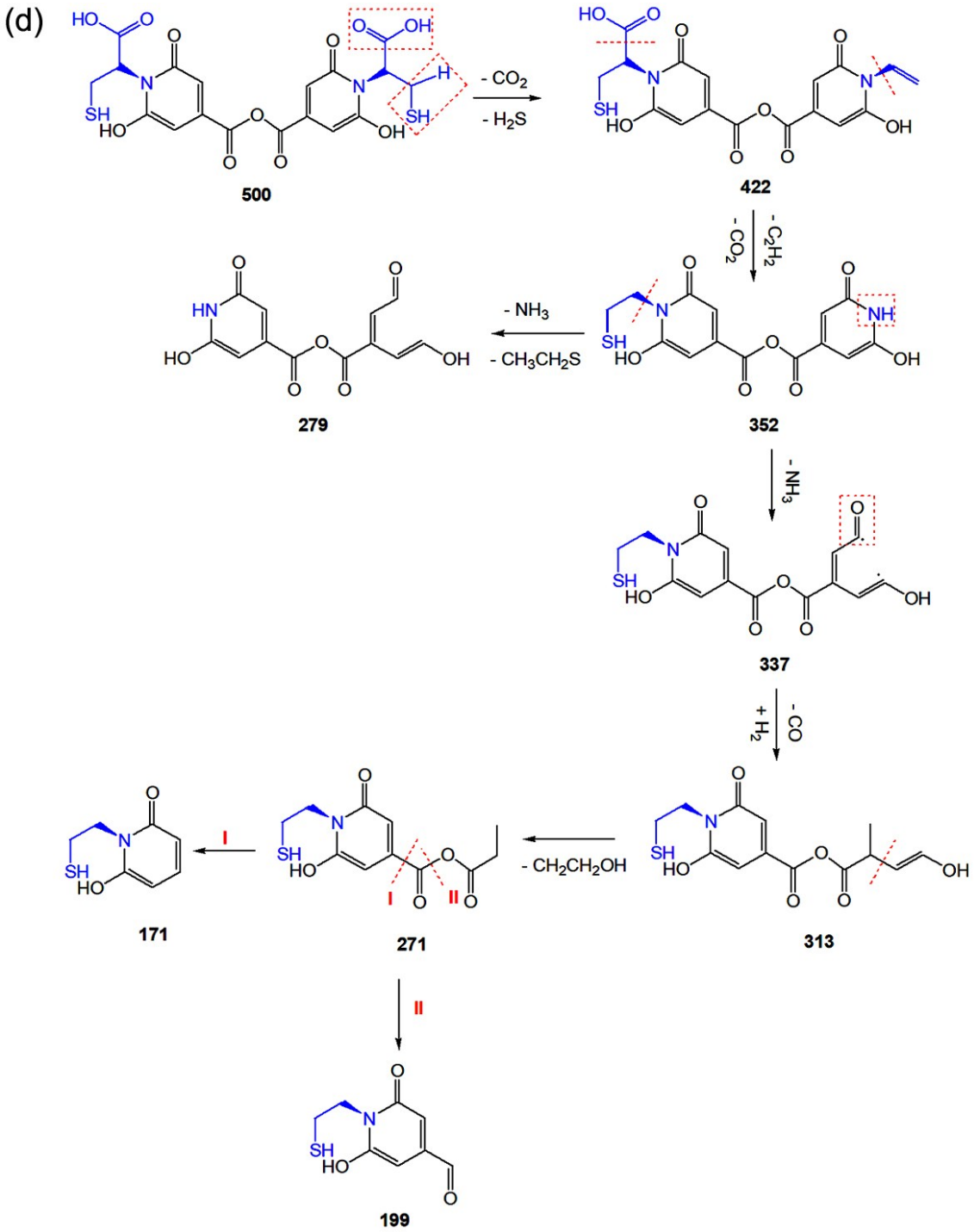

Fig. S9 TOF LC/MS analysis of: (a) type-I oligomer; (b) type-II oligomers; (c) type-III oligomers; the three types of components were separated by the column chromatography; (d) proposed formation mechanisms of the fragment structures corresponding to the molecular ion peaks appeared in a.

S10. Additional TEM measurements

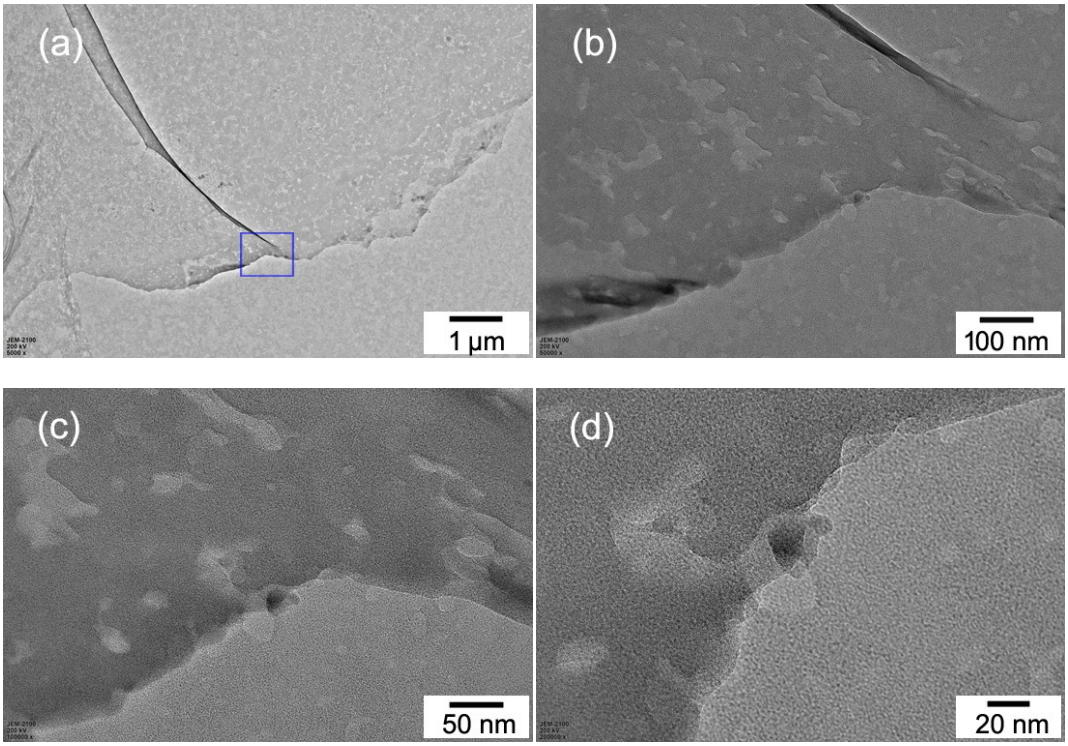

Fig. S10 TEM images of the sample prepared with CA/LCy molar ratio of 1:1 at 150 °C for 2 h; for TEM observations, the concentration of sample aqueous solution was 1 mg mL^{-1}.

S11. ζ-potential measurements

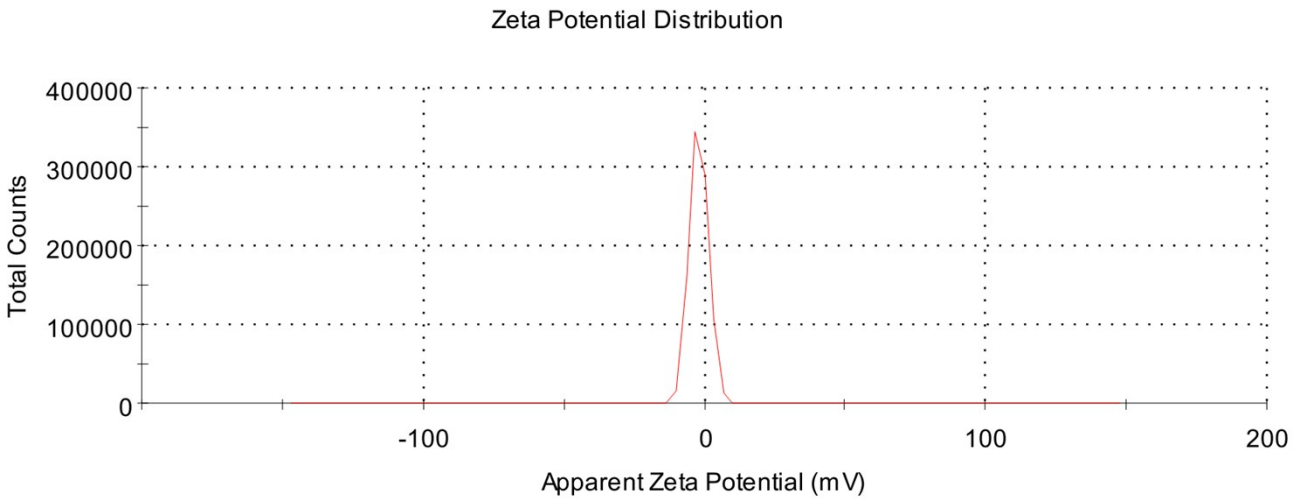

Fig. S11 ζ-Potential plot of PNF aqueous solution with PNF concentration of 1 mg mL^{-1}, where PPs were prepared with CA/LCy molar ratio of 2:1 at 160 °C for 1 h.

S12. Cultivation of mung bean sprouts without and with PNFs

S12.1 Cultivation process

50 mung beans were selected and transferred into 100 mL of distilled water and 100 mL of PNF aqueous solution (0.125 mg mL^{-1}) at room temperature for 7 h, respectively. Then, the beans was sandwiched with gauze and transferred into petri dishes (Fig. S13). The cultivation process was performed by placing petri dishes in a thermostat with temperature set at 25 °C. The gauze was kept wet by intermittently dropping distilled water and PNF aqueous solution (0.125 mg mL^{-1}), during the cultivation process, respectively.

The sprouts occurred after cultivation for 48 h. The length of the bean sprouts was measured at designated times by randomly selecting 20 sprouts without counting the length of roots. After length measurements every time, the sprouts were re-placed into the petri dishes. The cultivation process was terminated at the time of 172.5 h.

S12.2 Digital photographs for the growth of mung bean sprouts

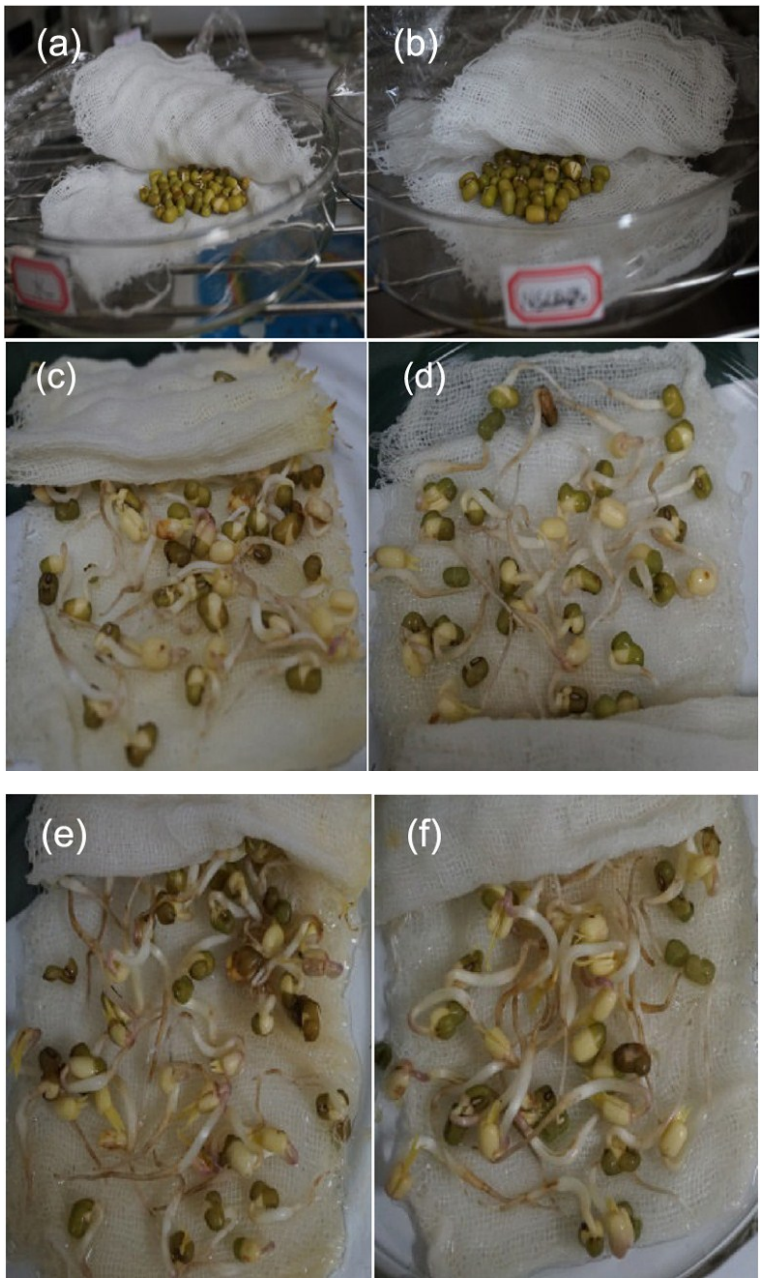

Fig. S12 Digital photographs for the growth of mung bean sprouts in water without (a,c,e) and with PNFs (b,d,f) at cultivation time of: (a,b) 17.5 h; (c,d) 125 h; (e,f) 172.5 h.