

Supporting Information

Helix-Sense-Selective Co-precipitation for Preparing Optically Active Helical Polymer Nanoparticles/Graphene Oxide Hybrid Nanocomposites

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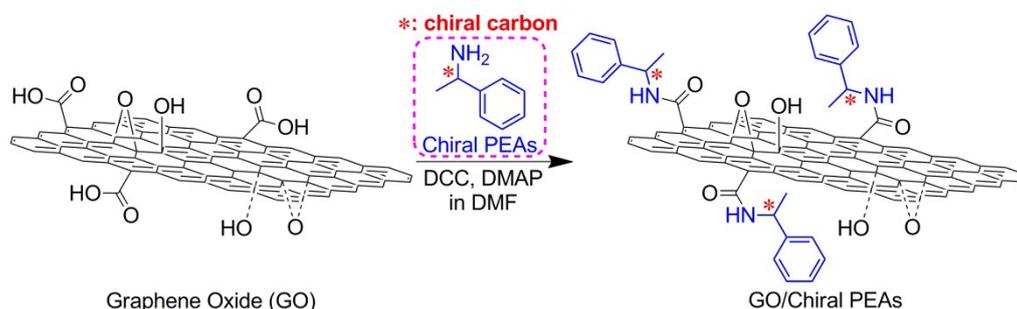


Figure S1. Schematic illustration for the preparation of chirally modified GO (i.e., GO/Chiral PEAs, including GO/R-PEA and GO/S-PEA).

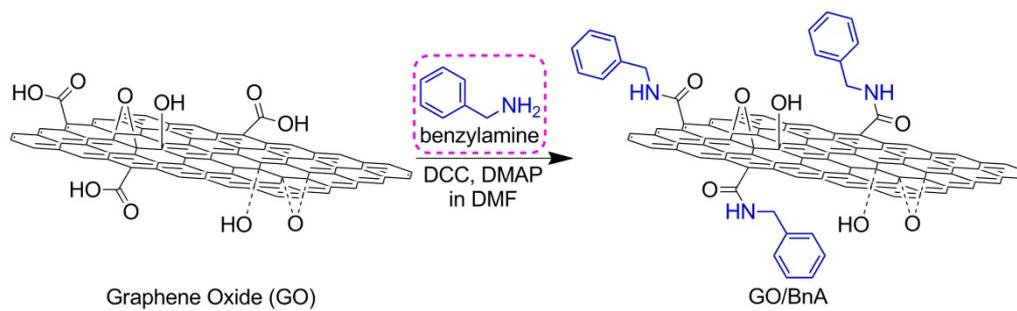


Figure S2. Schematic illustration for the preparation of achirally modified GO (i.e., GO/BnA).

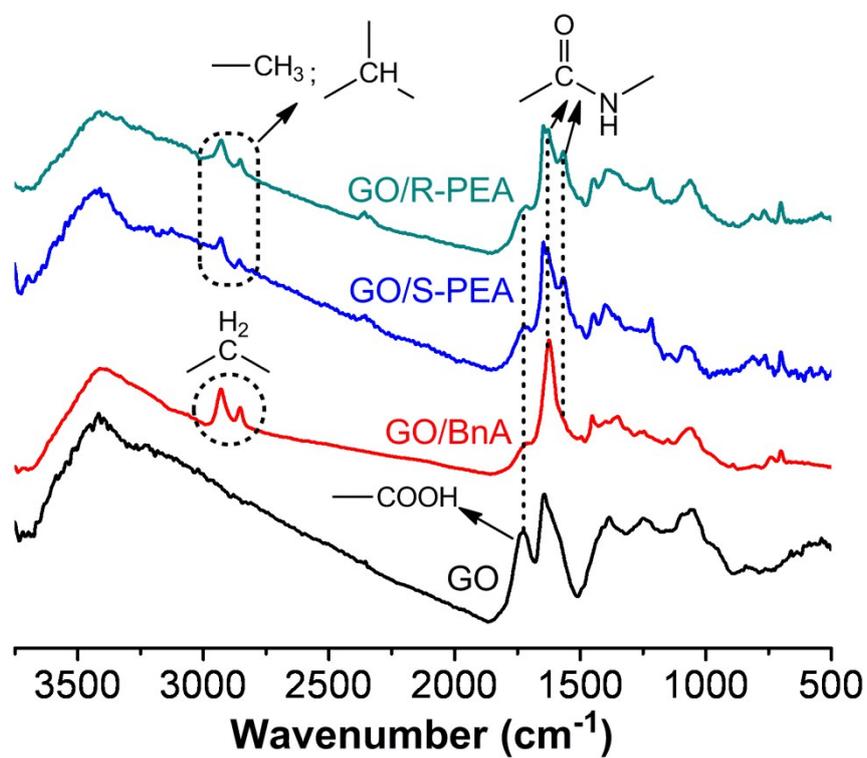


Figure S3. FT-IR spectra of GO, GO/BnA, GO/S-PEA, and GO/R-PEA.

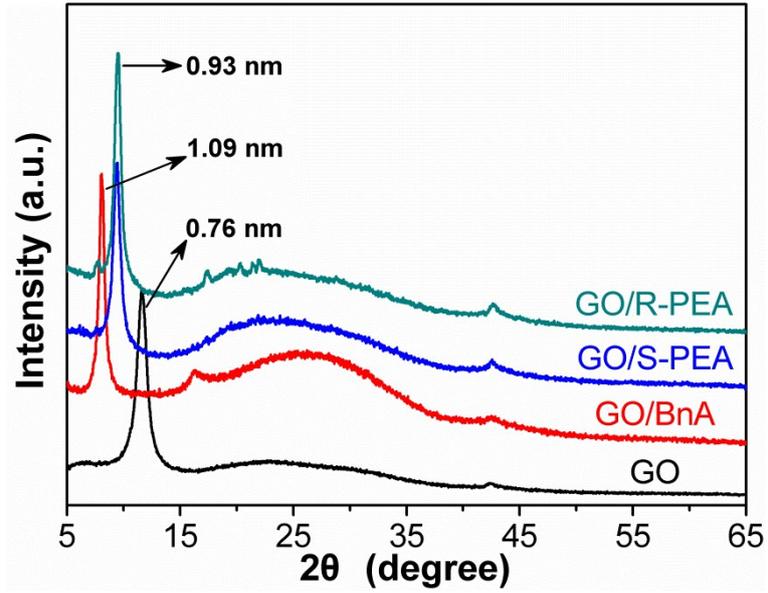


Figure S4. X-ray diffraction (XRD) patterns of GO, GO/BnA, GO/S-PEA, and GO/R-PEA.

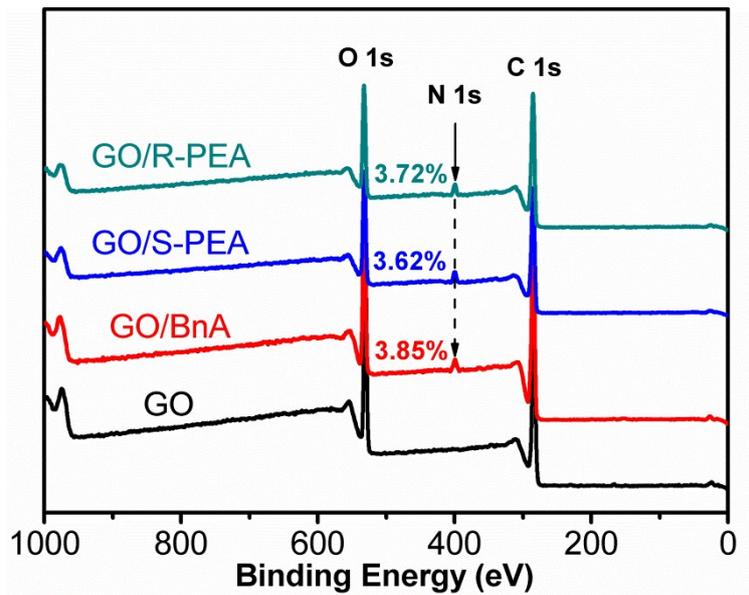


Figure S5. X-ray photoelectron spectra of GO, GO/BnA, GO/S-PEA, and GO/R-PEA.

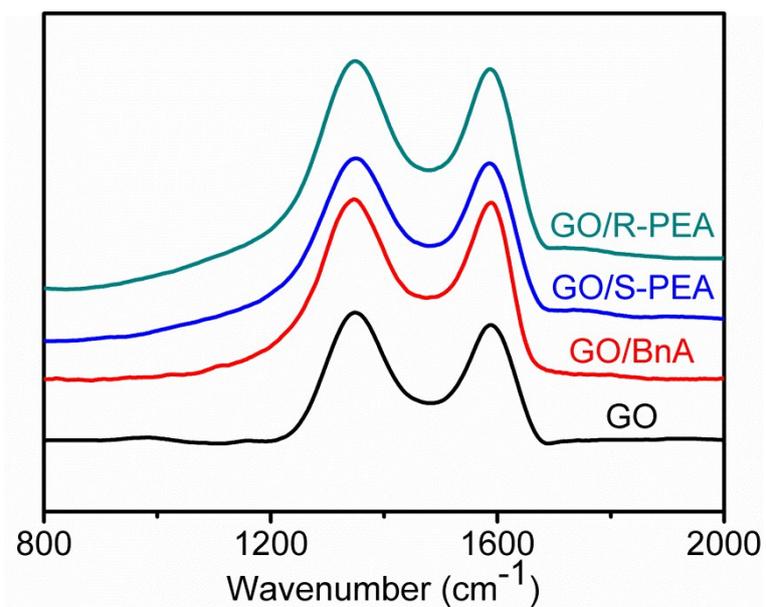


Figure S6. Raman spectra of GO, GO/BnA, GO/S-PEA, and GO/R-PEA.

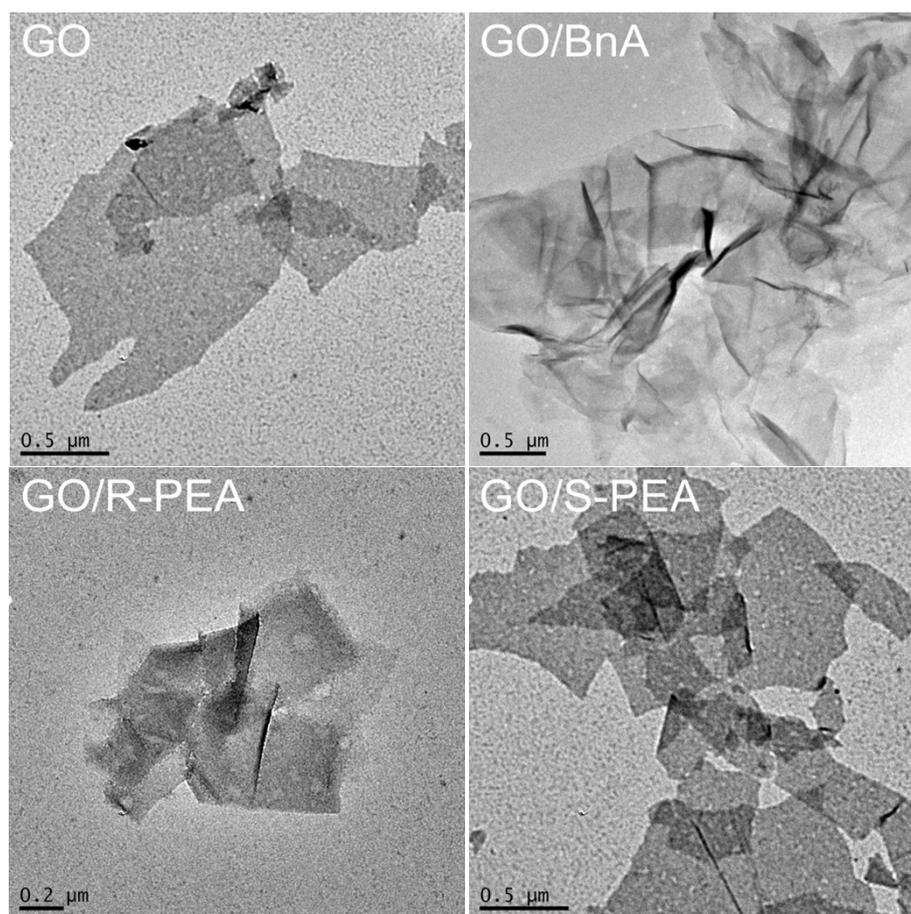


Figure S7. TEM images of GO, GO/BnA, GO/R-PEA, and GO/S-PEA.

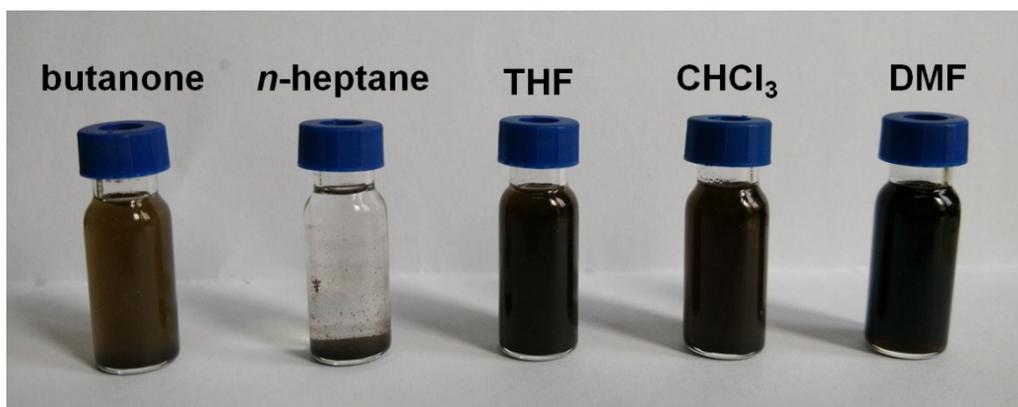


Figure S8. Dispersibility of GO/S-PEA in organic solvents. GO/S-PEA was dispersed in the solvents (1 mg/mL) by sonication for 1 h, and then stored motionlessly for 24 h.

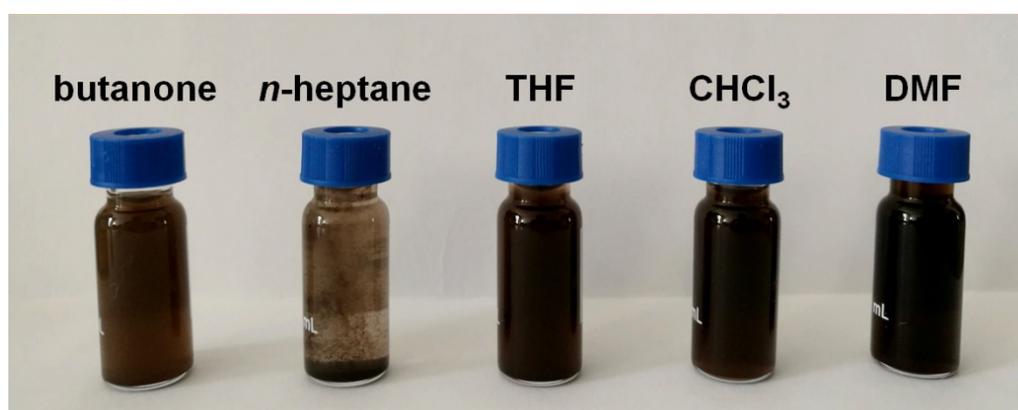


Figure S9. Dispersibility of GO/BnA in organic solvents. GO/BnA was dispersed in the solvents (1 mg/mL) by sonication for 1 h, and then stored motionlessly for 24 h.

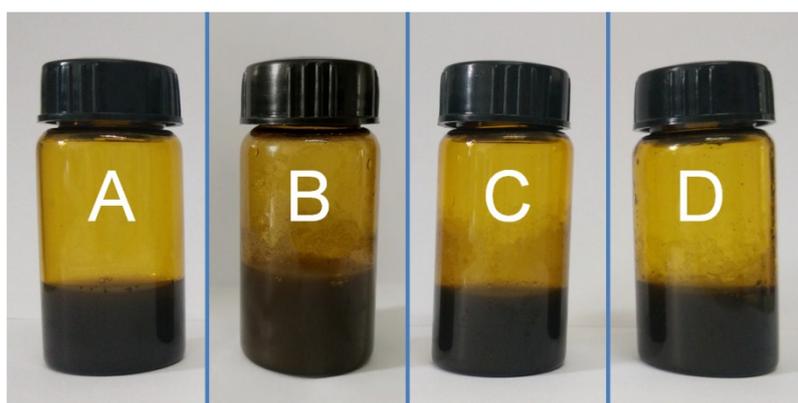


Figure S10. Dispersibility of (A) GO, (B) GO/BnA, (C) GO/R-PEA, and (D) GO/S-PEA in H₂O. The samples were dispersed in H₂O (1 mg/mL) by sonication for 1 h, and then stored motionlessly for 24 h.

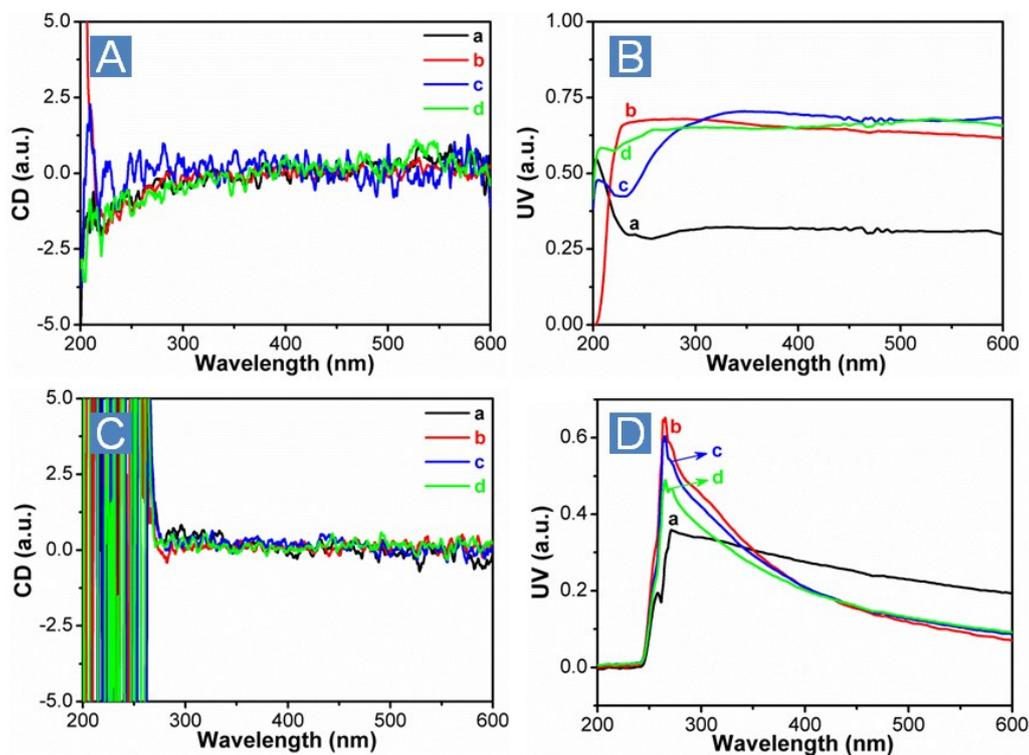


Figure S11. CD (A, C) and UV-vis (B, D) spectra of (a) GO, (b) GO/BnA, (c) GO/R-PEA, and (d) GO/S-PEA. For A and B, the samples were mixed with a very small amount of CHCl_3 (obtaining thick dispersions) and pressed between two pieces of quartz glass for measurement. The CD and UV-vis spectra of CHCl_3 between two pieces of quartz glass were measured beforehand and used as the baseline. For C and D, the samples were dispersed in DMF.

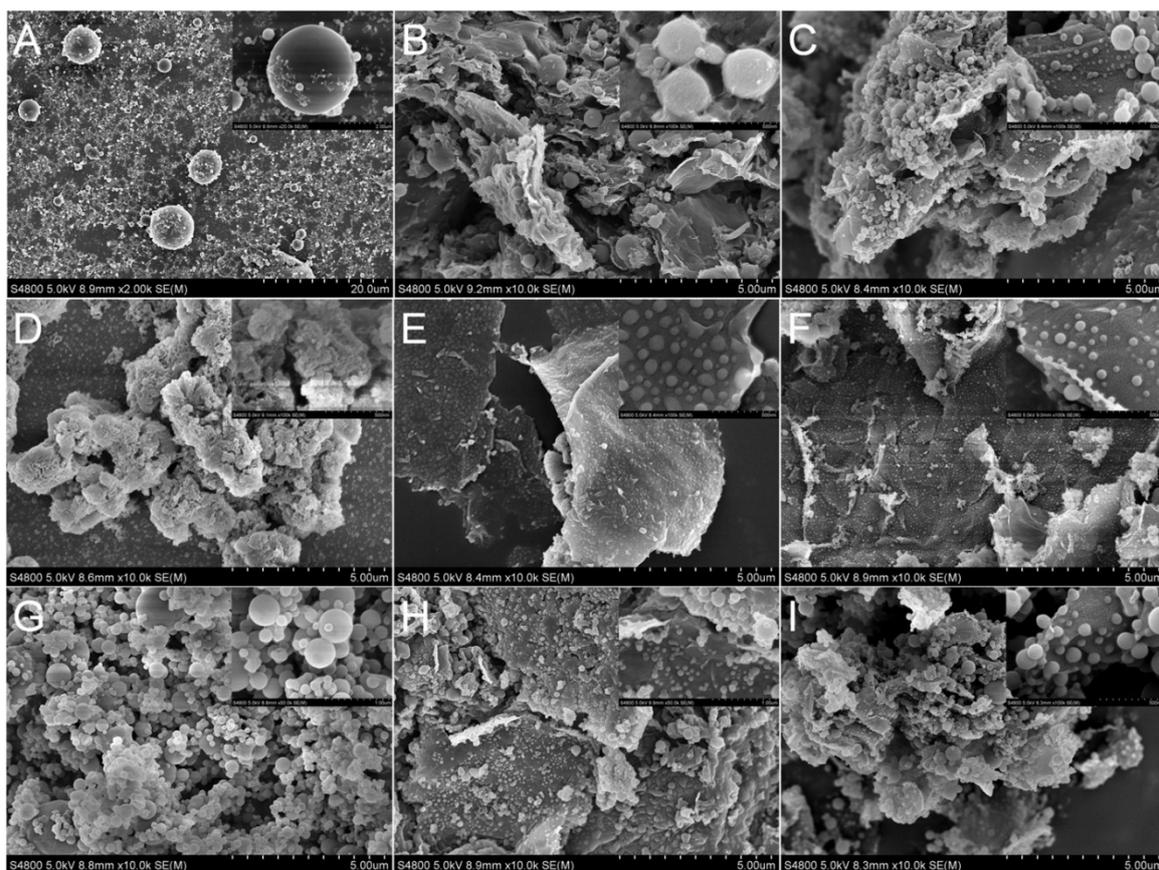


Figure S12. SEM images (the dry solid products) of (A) **OIP1**; (B) **OIP1/GO** nanocomposite; (C) **OIP1/GO/BnA** nanocomposite; (D) **OIP2**; (E) **OIP2/GO** nanocomposite; (F) **OIP2/GO/BnA** nanocomposite; (G) **OIP3**; (H) **OIP3/GO** nanocomposite; (I) **OIP3/GO/BnA** nanocomposite.

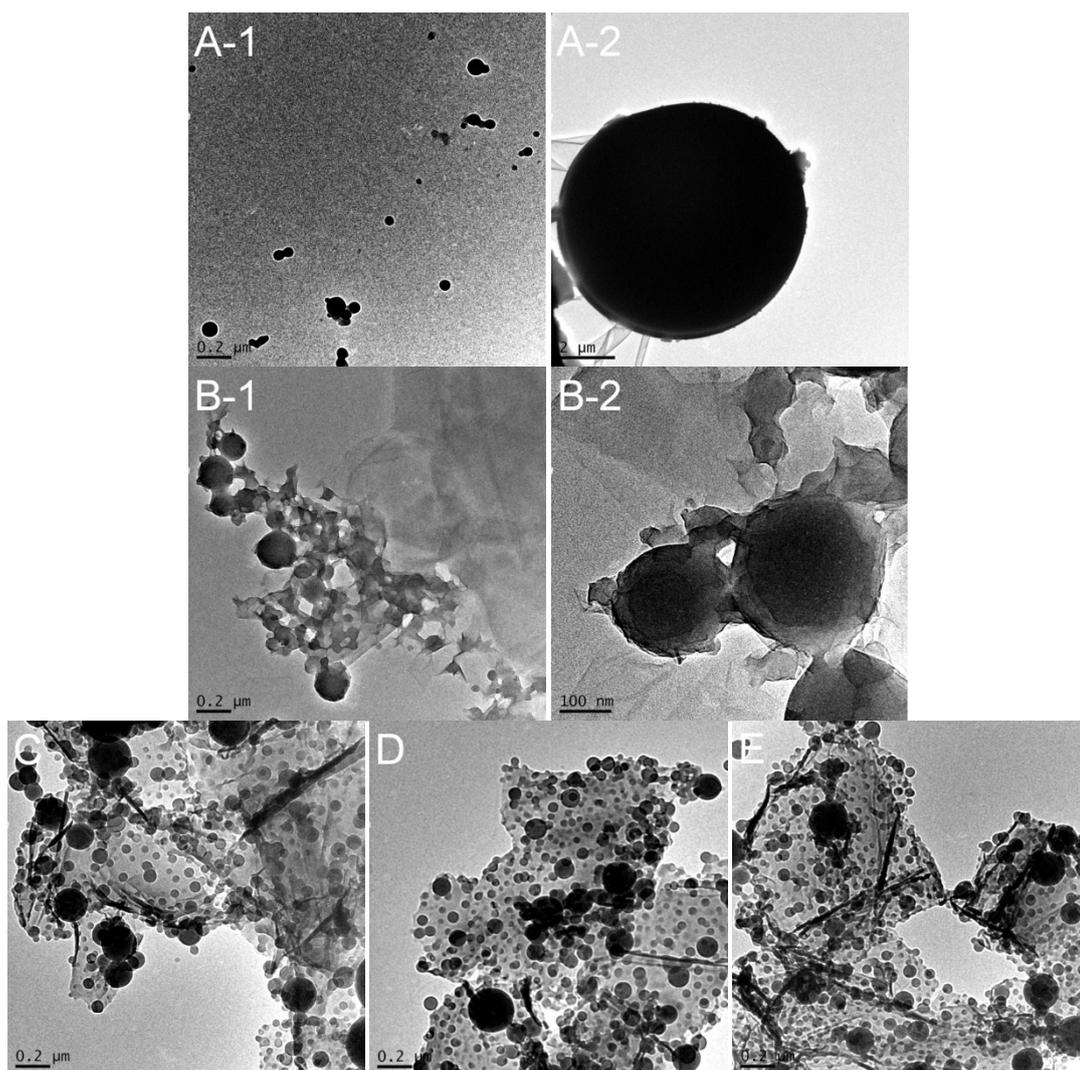


Figure S13. TEM images of the dry solid products (on carbon support films): (A-1 & A-2) P1 precipitated in THF/H₂O, obtaining **OIP1**; (B-1 & B-2) P1 co-precipitated with GO in THF/H₂O, obtaining **OIP1/GO** nanocomposite; (C) P1 co-precipitated with GO/BnA in THF/H₂O, obtaining **OAP1/GO/BnA** nanocomposite; (D) P1 co-precipitated with GO/R-PEA in THF/H₂O, obtaining **OAP1/GO/R-PEA** nanocomposite; and (E) P1 co-precipitated with GO/S-PEA in THF/H₂O, obtaining **OAP1/GO/S-PEA** nanocomposite.

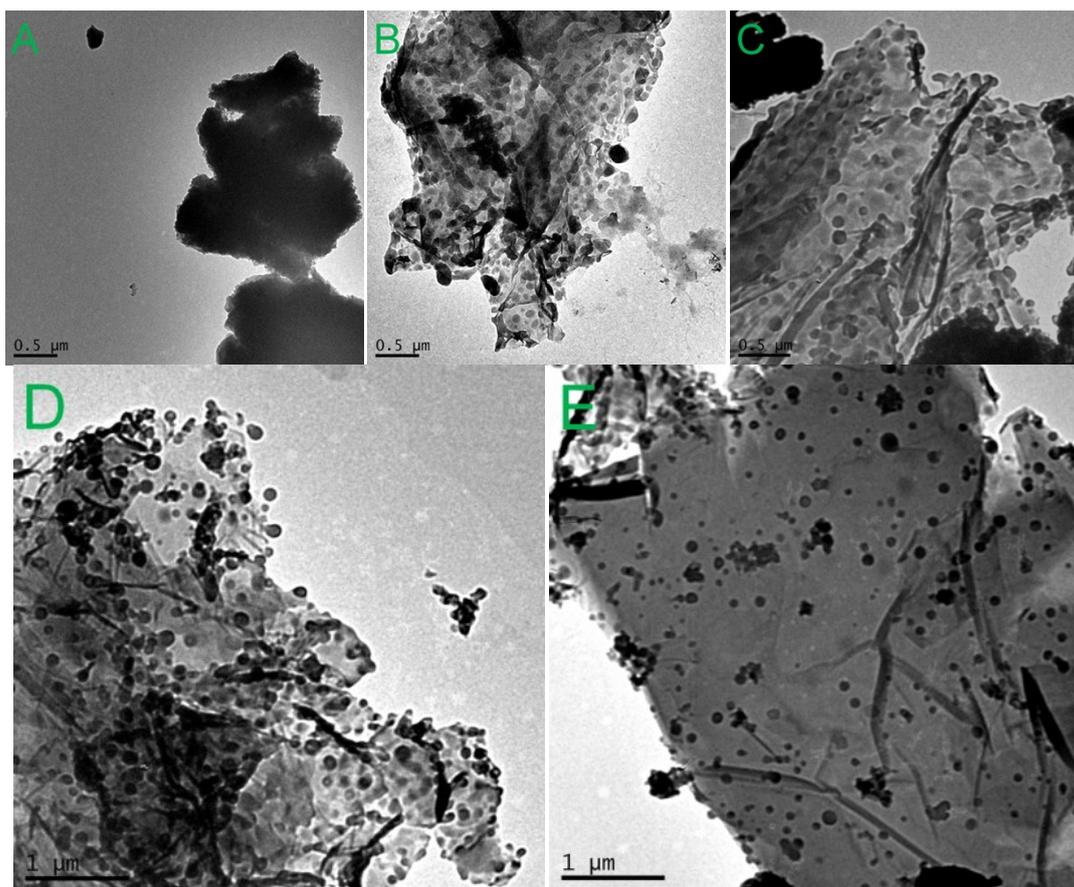


Figure S14. TEM images of the dry solid products (on carbon support films): (A) P2 precipitated in THF/H₂O, obtaining **OIP2**; (B) P2 co-precipitated with GO in THF/H₂O, obtaining **OIP2/GO** nanocomposite; (C) P2 co-precipitated with GO/BnA in THF/H₂O, obtaining **OAP2/GO/BnA** nanocomposite; (D) P2 co-precipitated with GO/R-PEA in THF/H₂O, obtaining **OAP2/GO/R-PEA** nanocomposite; and (E) P2 co-precipitated with GO/S-PEA in THF/H₂O, obtaining **OAP2/GO/S-PEA** nanocomposite.

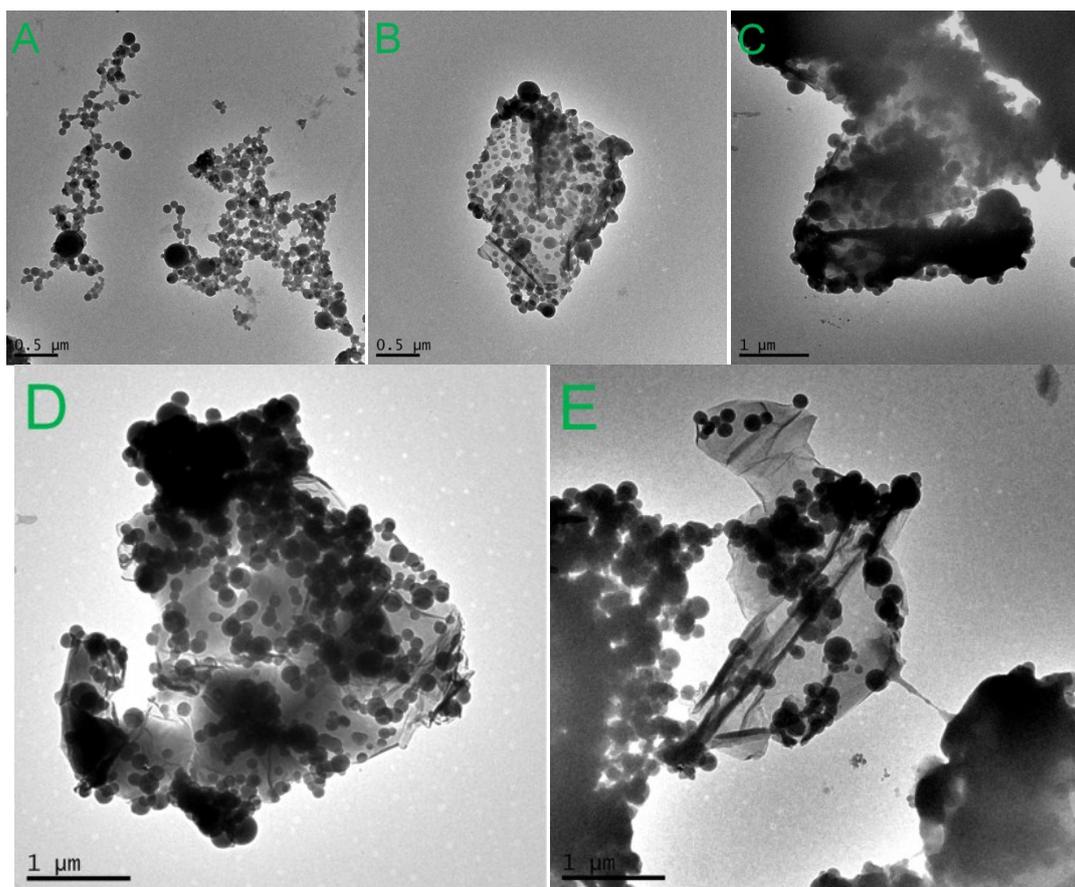


Figure S15. TEM images of the dry solid products (on carbon support films): (A) P3 precipitated in THF/H₂O, obtaining **OIP3**; (B) P3 co-precipitated with GO in THF/H₂O, obtaining **OIP3/GO** nanocomposite; (C) P3 co-precipitated with GO/BnA in THF/H₂O, obtaining **OAP3/GO/BnA** nanocomposite; (D) P3 co-precipitated with GO/R-PEA in THF/H₂O, obtaining **OAP3/GO/R-PEA** nanocomposite; and (E) P3 co-precipitated with GO/S-PEA in THF/H₂O, obtaining **OAP3/GO/S-PEA** nanocomposite.

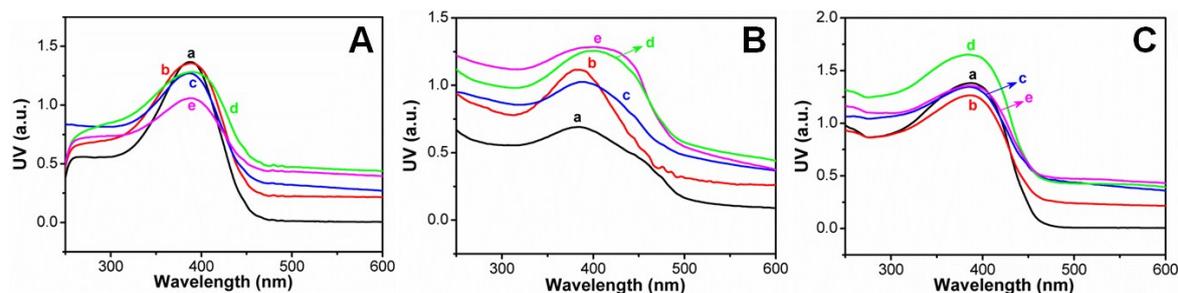


Figure S16. (A) UV-vis spectra of (a) **OIP1**, (b) **OIP1/GO** nanocomposite, (c) **OIP1/GO/BnA** nanocomposite, (d) **OAP1/GO/R-PEA** nanocomposite, and (e) **OAP1/GO/S-PEA** nanocomposite; (B) UV-vis spectra of (a) **OIP2**, (b) **OIP2/GO** nanocomposite, (c) **OIP2/GO/BnA** nanocomposite, (d) **OAP2/GO/R-PEA** nanocomposite, and (e) **OAP2/GO/S-PEA** nanocomposite; and (C) UV-vis spectra of (a) **OIP3**, (b) **OIP3/GO** nanocomposite, (c) **OIP3/GO/BnA** nanocomposite, (d) **OAP3/GO/R-PEA** nanocomposite, and (e) **OAP3/GO/S-PEA** nanocomposite. The samples were swollen with very small amount of CHCl_3 and pressed between two pieces of quartz glass for measurement. The UV-vis spectrum of CHCl_3 between two pieces of quartz glass was measured beforehand and used as the baseline.

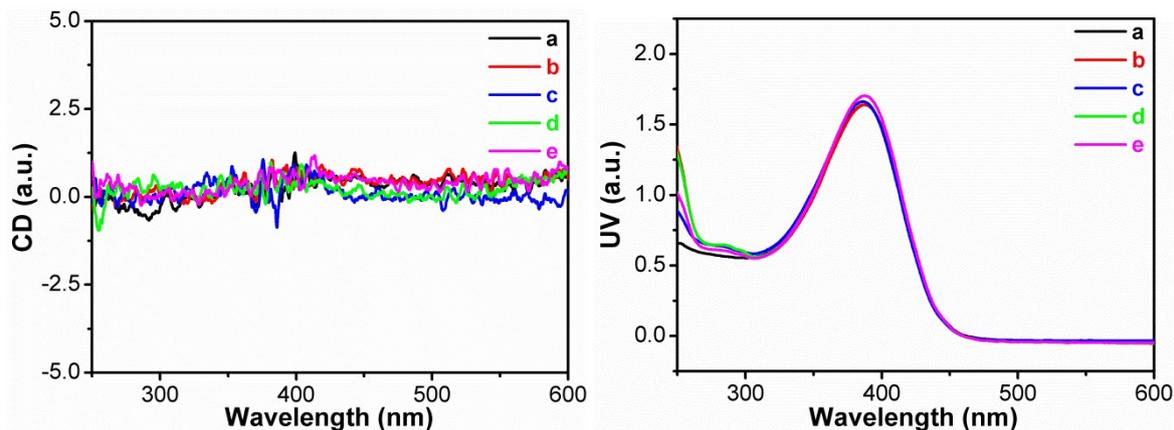


Figure S17. CD and UV-vis spectra of (a) **OIP1**, (b) **OIP1/GO** nanocomposite, (c) **OIP1/GO/BnA** nanocomposite, (d) **OAP1/GO/R-PEA** nanocomposite, and (e) **OAP1/GO/S-PEA** nanocomposite. The polymers in the samples were dissolved by a large amount of CHCl_3 (0.2 mg/mL). After filtration of the insoluble part (GO or modified GO), the filtrates (pure polymer solutions) were subjected to the measurements.

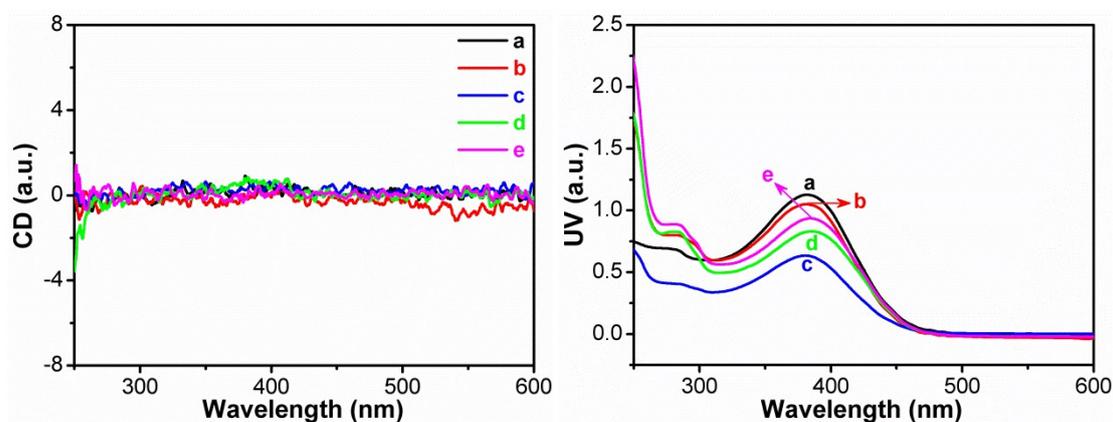


Figure S18. CD and UV-vis spectra of (a) **OIP2**, (b) **OIP2/GO** nanocomposite, (c) **OIP2/GO/BnA** nanocomposite, (d) **OAP2/GO/R-PEA** nanocomposite, and (e) **OAP2/GO/S-PEA** nanocomposite. The polymers in the samples were dissolved by a large amount of CHCl_3 (0.2 mg/mL). After filtration of the insoluble part (GO or modified GO), the filtrates (pure polymer solutions) were subjected to the measurements.

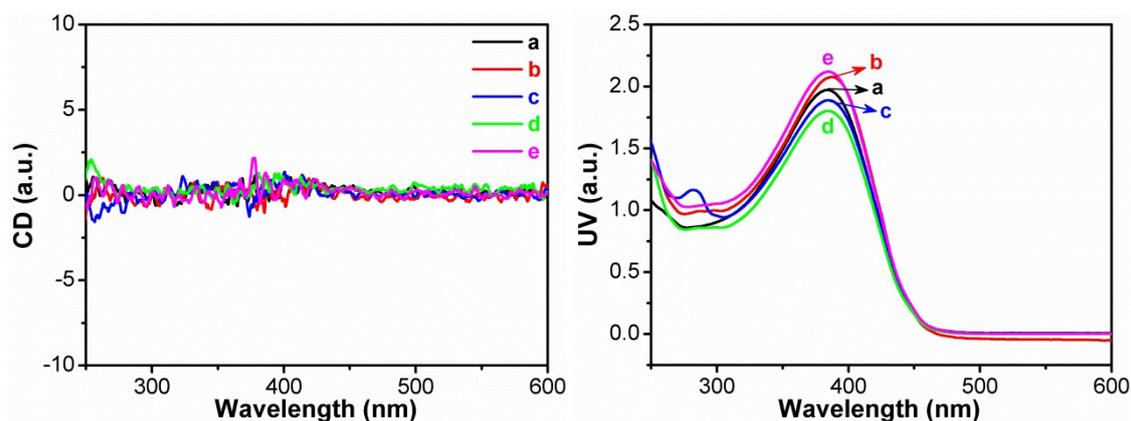


Figure S19. CD and UV-vis spectra of (a) **OIP3**, (b) **OIP3/GO** nanocomposite, (c) **OIP3/GO/BnA** nanocomposite, (d) **OAP3/GO/R-PEA** nanocomposite, and (e) **OAP3/GO/S-PEA** nanocomposite. The polymers in the samples were dissolved by a large amount of CHCl_3 (0.2 mg/mL). After filtration of the insoluble part (GO or modified GO), the filtrates (pure polymer solutions) were subjected to the measurements.



Figure S20. **OIP1** (10 mg) was co-dispersed respectively with 5 mg of (A) GO, (B) GO/BnA, (C) GO/R-PEA, and (D) GO/S-PEA in THF/ H_2O (0.5 mL/5 mL) by sonication for 1 h, and then stored motionlessly for 0.5 h.

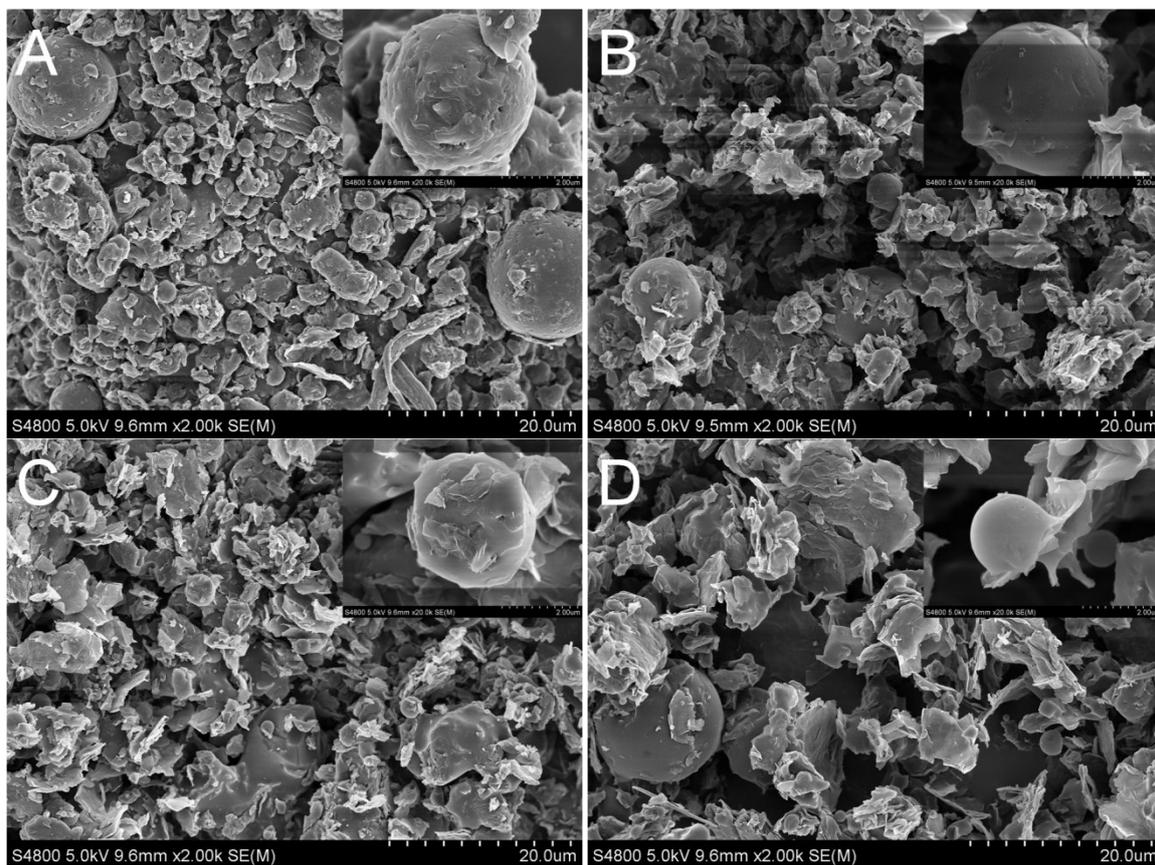


Figure S21. SEM images of the solid precipitates obtained after co-dispersing of **OIP1** respectively with (A) GO, (B) GO/BnA, (C) GO/R-PEA, and (D) GO/S-PEA in THF/H₂O.

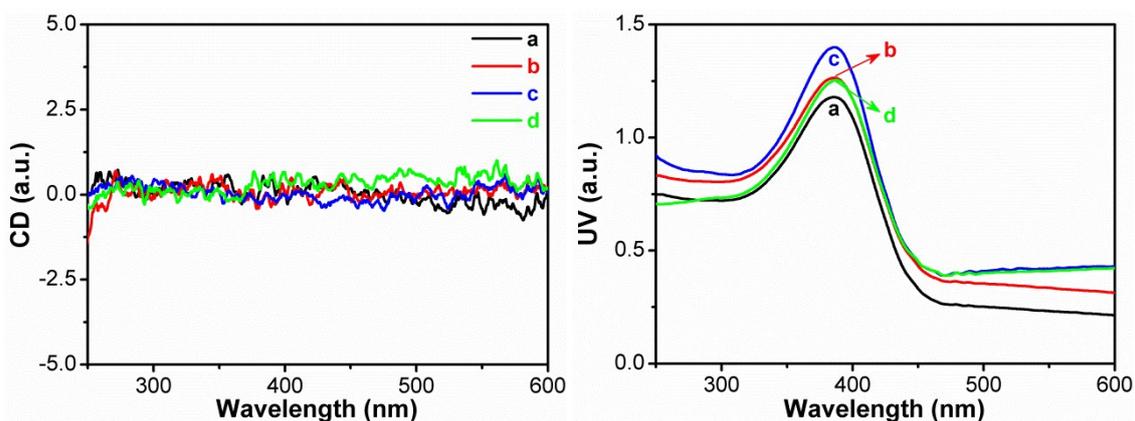


Figure S22. CD and UV-vis spectra of the solid precipitates obtained after co-dispersing of **OIP1** respectively with (A) GO, (B) GO/BnA, (C) GO/R-PEA, and (D) GO/S-PEA in THF/H₂O. The samples were swollen with very small amount of CHCl₃ and pressed between two pieces of quartz glass for measurement. The CD and UV-vis spectra of CHCl₃ between two pieces of quartz glass were measured beforehand and used as the baseline.

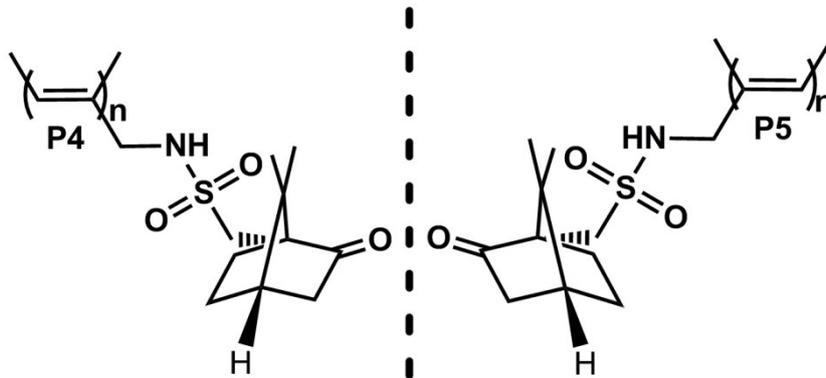


Figure S23. Chemical structures of the chirally helical polymers (P4 and P5)

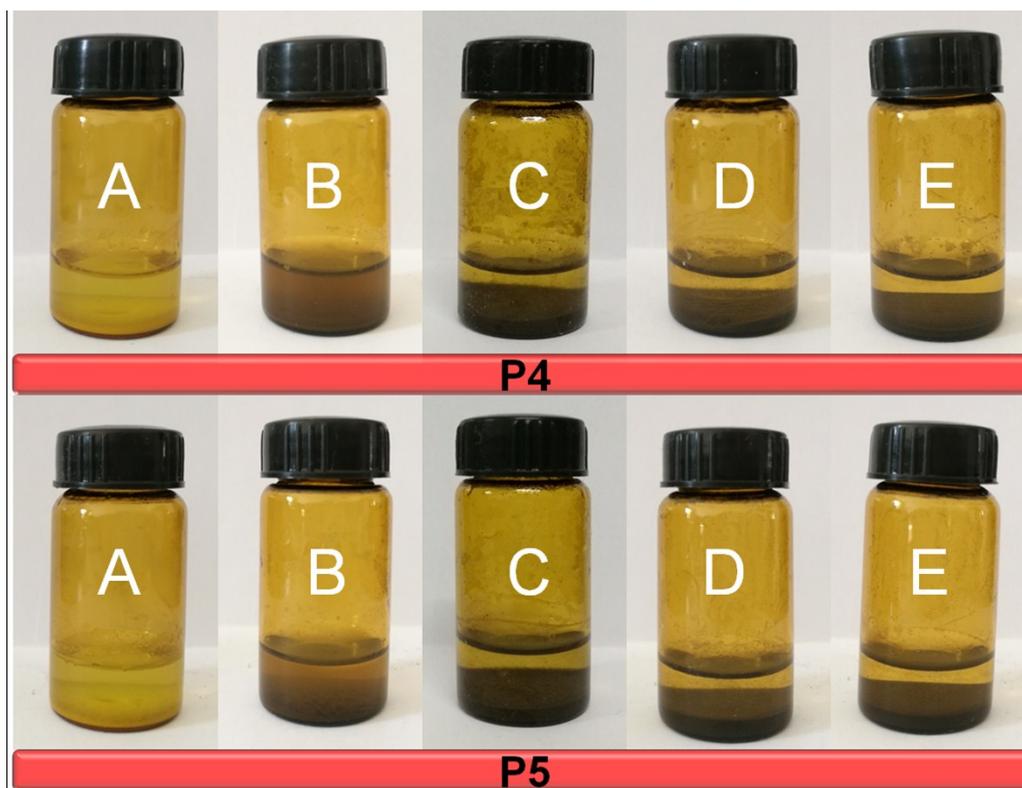


Figure S24. Photographs of the final precipitation systems in vessels: (A) P4 and P5 separately precipitated in THF/H₂O; (B) P4 and P5 separately co-precipitated with GO in THF/H₂O; (C) P4 and P5 separately co-precipitated with GO/BnA in THF/H₂O; (D) P4 and P5 separately co-precipitated with GO/R-PEA in THF/H₂O; and (E) P4 and P5 separately co-precipitated with GO/S-PEA in THF/H₂O.

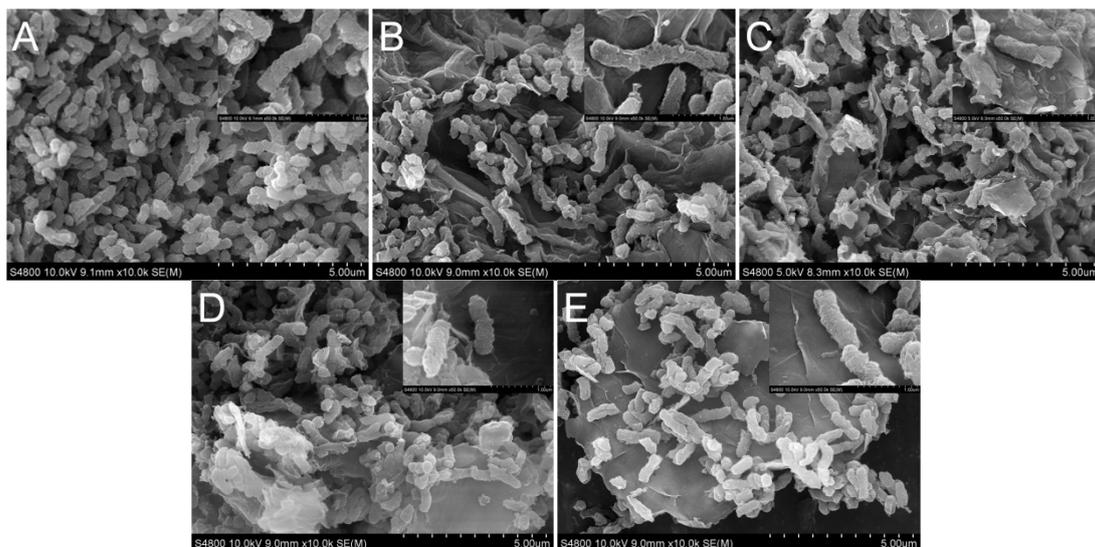


Figure S25. SEM images of the dry solid products obtained from the following experiments: (A) P4 precipitated in THF/H₂O; (B) P4 co-precipitated with GO in THF/H₂O; (C) P4 co-precipitated with GO/BnA in THF/H₂O; (D) P4 co-precipitated with GO/R-PEA in THF/H₂O; and (E) P4 co-precipitated with GO/S-PEA in THF/H₂O.

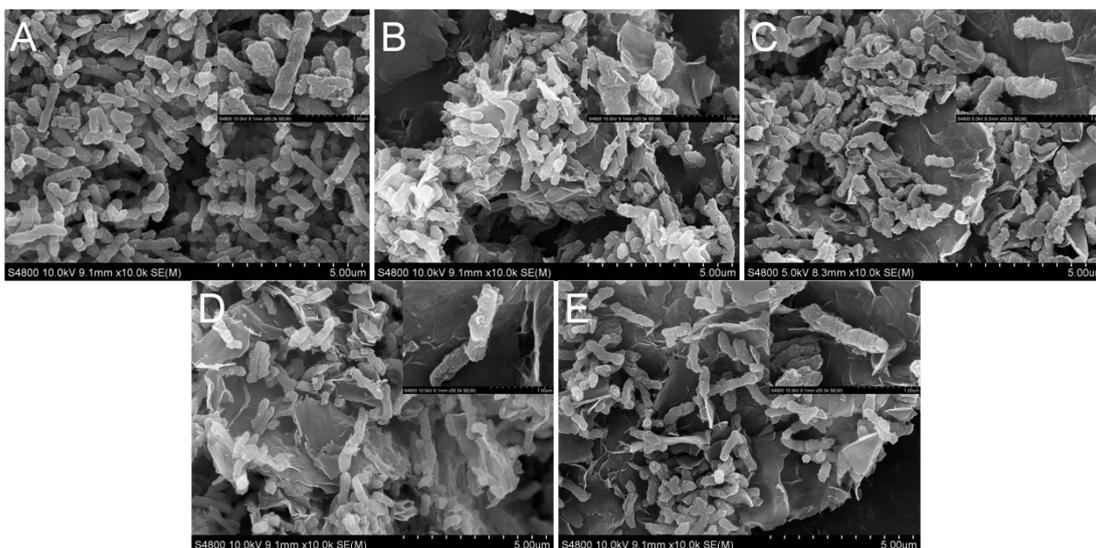


Figure S26. SEM images of the dry solid products obtained from the following experiments: (A) P5 precipitated in THF/H₂O; (B) P5 co-precipitated with GO in THF/H₂O; (C) P5 co-precipitated with GO/BnA in THF/H₂O; (D) P5 co-precipitated with GO/R-PEA in THF/H₂O; and (E) P5 co-precipitated with GO/S-PEA in THF/H₂O.

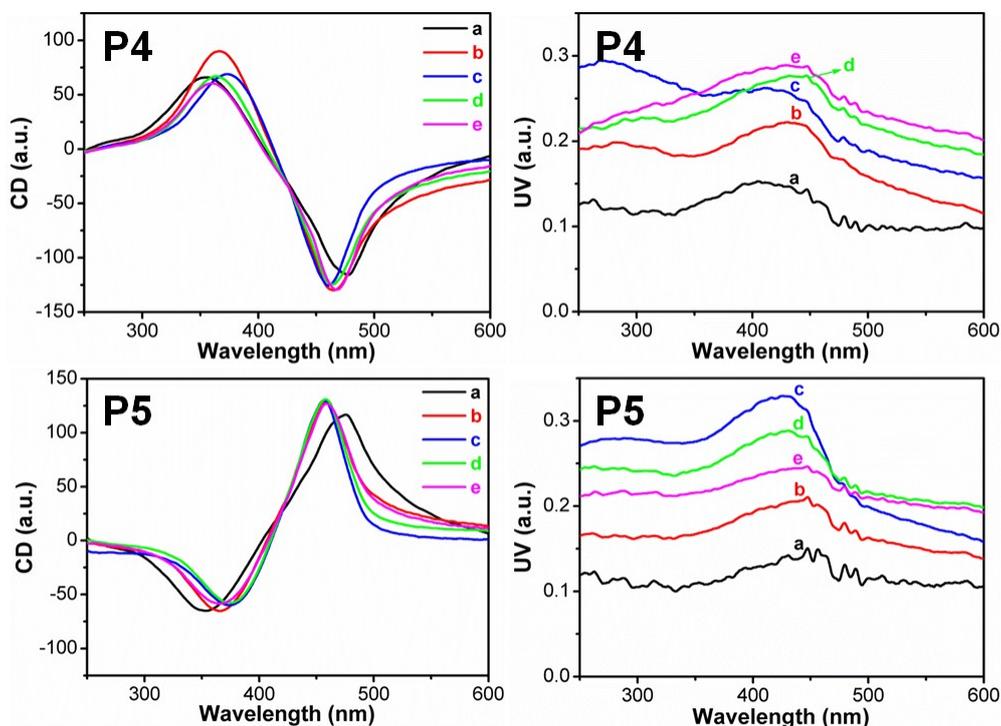


Figure S27. CD and UV-vis spectra of the dry solid products obtained from the following experiments: (a) P4 and P5 separately precipitated in THF/H₂O; (b) P4 and P5 separately co-precipitated with GO in THF/H₂O; (c) P4 and P5 separately co-precipitated with GO/BnA in THF/H₂O; (d) P4 and P5 separately co-precipitated with GO/R-PEA in THF/H₂O; and (e) P4 and P5 separately co-precipitated with GO/S-PEA in THF/H₂O. The samples were swollen with very small amount of CHCl₃ and pressed between two pieces of quartz glass for measurement. The CD and UV-vis spectra of CHCl₃ between two pieces of quartz glass were measured beforehand and used as the baseline.