Supporting Information

Synthesis of novel chiral DA-TD covalent organic framework for open-tubular capillary electrochromatography enantioseparation

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1. Chemicals and materials

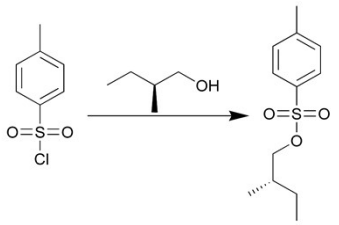
1,4-dimethoxybenzene，dimethyl sulfoxide，dioxane, hexamethylenetetramine, N,N-dimethylformamide (DMF), tetrahydrofuran (THF), *(S)*-(-)-2-methyl-1-butanol and 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline were purchased from Energy Chemical (Shanghai, China). Tetrakis(triphenylphosphine)palladium, K_2CO_3, *p*-toluenesulfonyl chloride, formaldehyde solution (37 wt. % in water) and 2,4,6-tribromophenol were purchased from Aladdin (Shanghai, China). Paraformaldehyde, dimethyl sulfoxide (DMSO), ethyl acetate (EtOAc), dichloromethane (DCM), N,N-dimethylacetamide (DMA), ether, pyridine and sodium bicarbonate ($NaHCO_3$) were obtained from Chron Chemicals Co., Ltd. (Sichuan, China). Isoprenaline and synephrine were bought from J&K Scientific Ltd. (Beijing, China). Terbutaline and epinephrine were purchased from National Institutes for Food and Drug Control (Beijing, China). (±)-Verapamil hydrochloride, carvedilol and norepinephrine were commercially available from Adamas-Beta Co., Ltd. (Shanghai, China). Fused silica capillary (375 μm o.d. × 75 μm i.d.) was purchased from Yongnian Photoconductive Fiber Factory (Hebei, China). Ultrapure water was used throughout the whole experimental procedure.

2. Apparatus and Characterization

Scanning electron microscopy (SEM) images of the capillary were recorded on a JSM-5600LV emission scanning electron microscope (JEOL, Japan). Powder X-ray diffraction (XRD) patterns were recorded on a D/max 82400 X-ray powder diffractometer (Rigaku, Japan) with Cu Kα radiation. Fourier-transform infrared

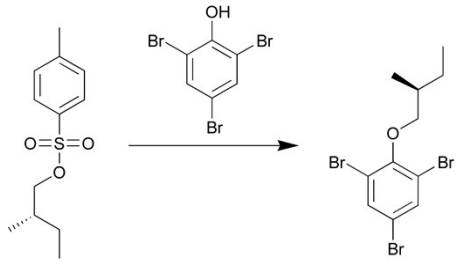
spectra were collected on a Nicolet Nexus 670 Fourier transform infrared spectrometer (FT-IR, America) with KBr pellets. CD spectra were recorded on a J-800 spectropolarimeter (Jasco, Japan). Thermogravimetric analysis (TGA) was carried out in an N_2 atmosphere with a heating rate of 10 ℃/min performed on a STA449C integration thermal analyzer. The N_2 adsorption and desorption isotherms were obtained at 77 K with a micromeritics ASAP 2020M system. Surface areas were calculated using Langmuir and Brunauer-Emmett-Teller (BET) methods. The pore-size-distribution curves were calculated from nitrogen adsorption isotherms using non-local density functional theory (NLDFT).

3. Experimental procedures

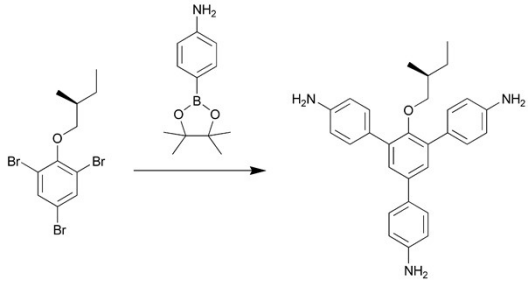


(*S*)-(-)-2-methylbutyl-4-methylbenzenesulfonate was prepared according to the literature with minor modifications.[1] *p*-toluenesulfonyl chloride (10.8 g, 56.7 mmol), pyridine (20 mL) and *(S)*-(-)-2-methyl-1-butanol (5.00 g, 56.7 mmol) were added into a 50 mL flask at 0 ℃. The reaction mixture was stirred overnight at room temperature. The mixture was poured into saturated $NaHCO_3$ (30 mL). Then, the organic phase was separated and aqueous phase was extracted with dichloromethane (10 mL × 3). The combined organic layers were dried over Na_2SO_4, filtered, concentrated by rotary evaporation. The crude was purified by column chromatography with hexanes/ether (10 : 1) as eluent to afford 11.2 g (82 %) of (*S*)-(-)-2-methylbutyl-4-

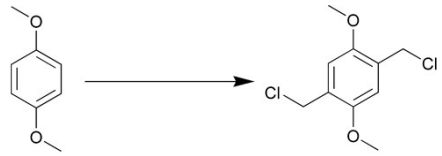
methylbenzenesulfonate. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.79 (m, 2H), 7.34 (m, 2H), 3.88(dd, 1H), 3.82 (dd, 1H), 2.45 (s, 3H), 1.57 (m, 1H), 1.38 (m, 1H), 1.16 (m, 1H), 0.88 (d, 3H), 0.83 (t, 3H). ESI-MS: Calcd for $[M+Na]^+$ 265.0869, found 265.0867.



(S)-1,3,5-tribromo-2-(2-methyl-butoxy)benzene was prepared according to the previous literature.[2] To a 50 mL flask, 2,4,6-tribromophenol (3.31 g, 10.0 mmol), K_2CO_3 (3.32 g, 24.0 mmol), THF (10 mL), DMF (10 mL) and (*S*)-(-)-2-methylbutyl-4-methylbenzenesulfonate (4.85 g, 20.0 mmol) were added under N_2 protection. Then, the resulting mixture was stirred at 70 ℃ for 24 h. The mixture was extracted with chloroform and the combined organic layers were washed with water. The combined organic layer was dried over Na_2SO_4 and concentrated by rotary evaporation. The crude purified by column chromatography with hexanes/ether (10 : 1) as eluent to afford 3.10 g (62%) of the (S)-1,3,5-tribromo-2-(2-methyl-butoxy)benzene. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.62 (s, 2H), 3.83 (m, 1H), 3.75 (m, 1H), 1.94 (m, 1H), 1.64 (m, 1H), 1.30 (m, 1H), 1.08 (d, 3H), 0.96 (t, 3H). ESI-MS: Calcd for $[M+Na]^+$ 400.8569, found 400.8575

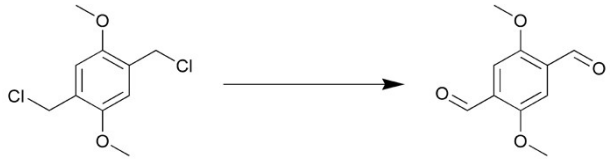


(S)-1,3,5-tribromo-2-(2-methyl-butoxy)benzene (0.802 g, 2.00 mmol) and 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline (1.31 g, 5.50 mmol) were dissolved in 15 mL DMF. Aqueous solution of K_2CO_3 (5 mL, 6 M) was added into the mixture under nitrogen atmosphere. After the addition of tetrakis(triphenylphosphine) palladium (50.0 mg), the mixture was refluxed for 48 h at 80 ℃. Upon cooling down, the mixture was extracted with 3 × 100 mL EtOAc. The obtained organic layer was collected and dried over Na_2SO_4. After that, the solvent was removed at reduced pressure. The crude purified by column chromatography with ether/EtOAc (1:1) as eluent to give (S)-1,3,5-tri(4-aminophenyl)-2-(2-methyl-butoxy)benzene (i.e. TD) as a yellow solid in 59% yield. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (m, 8H), 6.73 (m, 6H), 3.11 (dd, 1H), 3.01 (dd, 1H), 1.25 (m, 1H), 1.07 (m, 1H), 0.83 (m, 1H), 0.58 (d, 3H), 0.54 (t, 3H). ESI-MS: Calcd for $[M+Na]^+$ 438.2540, found 438.2535.



1,4-bis(chloromethyl)-2,5-dimethoxybenzene was prepared according to the previous literature.[3] 1,4-dimethoxybenzene (10.0 g, 72.3 mmol) and paraformaldehyde (3.00 g, 99.0 mmol) were dispersed in a mixture of 1,4-dioxane (30.0 mL) and formaldehyde solution (38.0% in water, 5 mL) in a glask. The resulting mixture was stirred at 90 ℃ and concentrated HCl (2 × 5 mL) was added during 30 min intervals. Heating was continued for 1 h and a further 30 mL of concentrated HCl was added. The resulting mixture was cooled to room temperature to afford a white

precipitate, which was collected by filtration and dried under vacuum. The crude product was recrystallized from hot acetone to give product 1,4-bis(chloromethyl)-2,5-dimethoxybenzene (5.10 g, 29.5%) as a white precipitate. ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.93 (s, 2H), 4.64 (s, 4H), 3.86 (s, 6H).



2,5-dimethoxyterephthalaldehyde was prepared according to the previous literature.[3] 1,4-bis(chloromethyl)-2,5-dimethoxybenzene (1.17 g, 5.00 mmol) and $NaHCO_3$ (4.20 g, 50.0 mmol) in DMSO (50.0 mL) were stirred at reflux for 3 h. After cooling to room temperature, the pale-yellow precipitate was collected by filtration and redissolved in water (30 mL). The mixture was extracted with DCM (50 mL× 3). The organic phase was washed thrice with water (100 mL×2) and dried over Na_2SO_4. After solvent evaporation, the residue was recrystallized from ethanol to yield compound 2,5-dimethoxyterephthalaldehyde (i.e. DA) as a bright yellow solid. ^{1}H NMR (300 MHz, $CDCl_3$) δ 10.50 (s, 2H), 7.26 (s, 2H), 3.95 (s, 6H). ESI-MS: Calcd for $[M+Na]^+$ 217.0471, found 217.0469.

4. **Synthesis of chiral DA-TD COF**

10 mL glass tube (the outer diameter is 10 mm and the inner diameter is 8 mm) was charged with TD (26.3 mg, 0.06 mmol), DA (17.5 mg, 0.09 mmol) in the presence of 9 M acetic acid (0.15 mL) using DMA (0.5 mL) and n-BuOH (1.5 mL) as solvent. The resulting mixture was sonicated for a few minutes until the solid was completely dissolved. Then, this glass tube was flash frozen at 77 K using the liquid nitrogen bath,

evacuated and flame sealed. Upon warming to room temperature, the glass tube was placed in an oven and heated at 100 ℃ for three days. After the reaction, the powder was filtered out, washed with DMA, water, ethanol and acetone, then further purification of the resulted chiral was carried out by Soxhlet extraction in THF for 24 h and dried under vacuum at 80 ℃ for 12 h to give yellow chiral DA-TD COF.

5. Synthesis of amorphous DA-TD

10 mL glass tube (the outer diameter is 10 mm and the inner diameter is 8 mm) was charged with TD (26.3 mg, 0.06 mmol), DA (17.5 mg, 0.09 mmol) in the presence of 9 M acetic acid (0.15 mL) using DMA (0.5 mL) and n-BuOH (1.5 mL) as solvent anhydrous. The resulting mixture was sonicated for a few minutes until the solid was completely dissolved, and then allowed to stand at room temperature for 5 h. The obtained yellow precipitate was collected by centrifugation at 10000 rpm and washed with acetonitrile and acetone for three times, respectively. Then, the powder was dried under high vacuum at 100 ℃ for 8 h to give amorphous DA-TD.

6. Preparation of chiral DA-TD COF coated capillary and amorphous DA-TD coated capillary

The coated capillary used in this study was fabricated by etching and chemically modifying the bare capillary. First, the bare capillary (75 μm i.d., 40.0 cm effective length and 50.2 cm total length) was sequentially rinsed with methanol for 10 min, ultrapure water for 1 h，1 M NaOH for 2 h. Then, two ends of the capillary were sealed by rubber stopper. The capillary was heated in an oven at 100 ℃ for 2 h. Afterwards, the capillary, which was washed with 0.5 M HCl for 30 min, deionized water for 10 min and acetone

for 10 min, was purged with nitrogen for about 1 h at 120 ℃ to remove residual water and acetone. Then, the pretreated capillary was filled with GLYMO solution (5% in toluene) and then treated in an oven at 100 ℃ for 6 h with both ends sealed. After that, the capillary coated with GLYMO, denoted as epoxy capillary, was rinsed extensively with toluene, acetone and blown dry with nitrogen subsequently. Then, 0.5 mg/mL, 1.0 mg/mL and 2 mg/mL solution of TD-DA COF in ethanol was filled into the epoxy capillary, respectively. With both ends sealed, the capillary was placed in an oven at 70 ℃ for 4 h to graft DA-TD COF onto the inner wall of the capillary. Finally, the DA-TD COF treated capillary was washed with acetone and then blown dry with nitrogen. The DA-TD COF coated capillary, named as DA-TD COF capillary, was filled with deionized water, and stored until use. The pressure used for whole process of preparation the capillary was 0.07 MPa.

The amorphous DA-TD coated capillary was prepared by replaced chiral DA-TD COF with amorphous DA-TD.

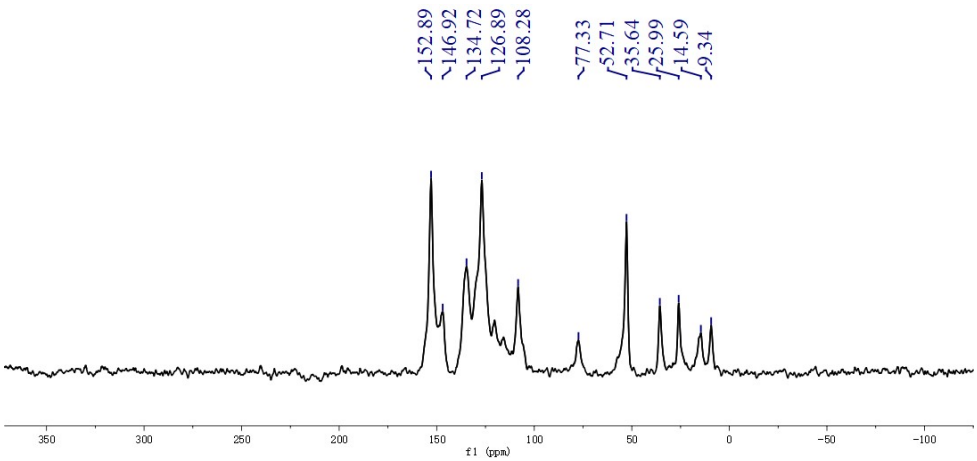


Figure S1. ^{13}C NMR of chiral DA-TD COF.

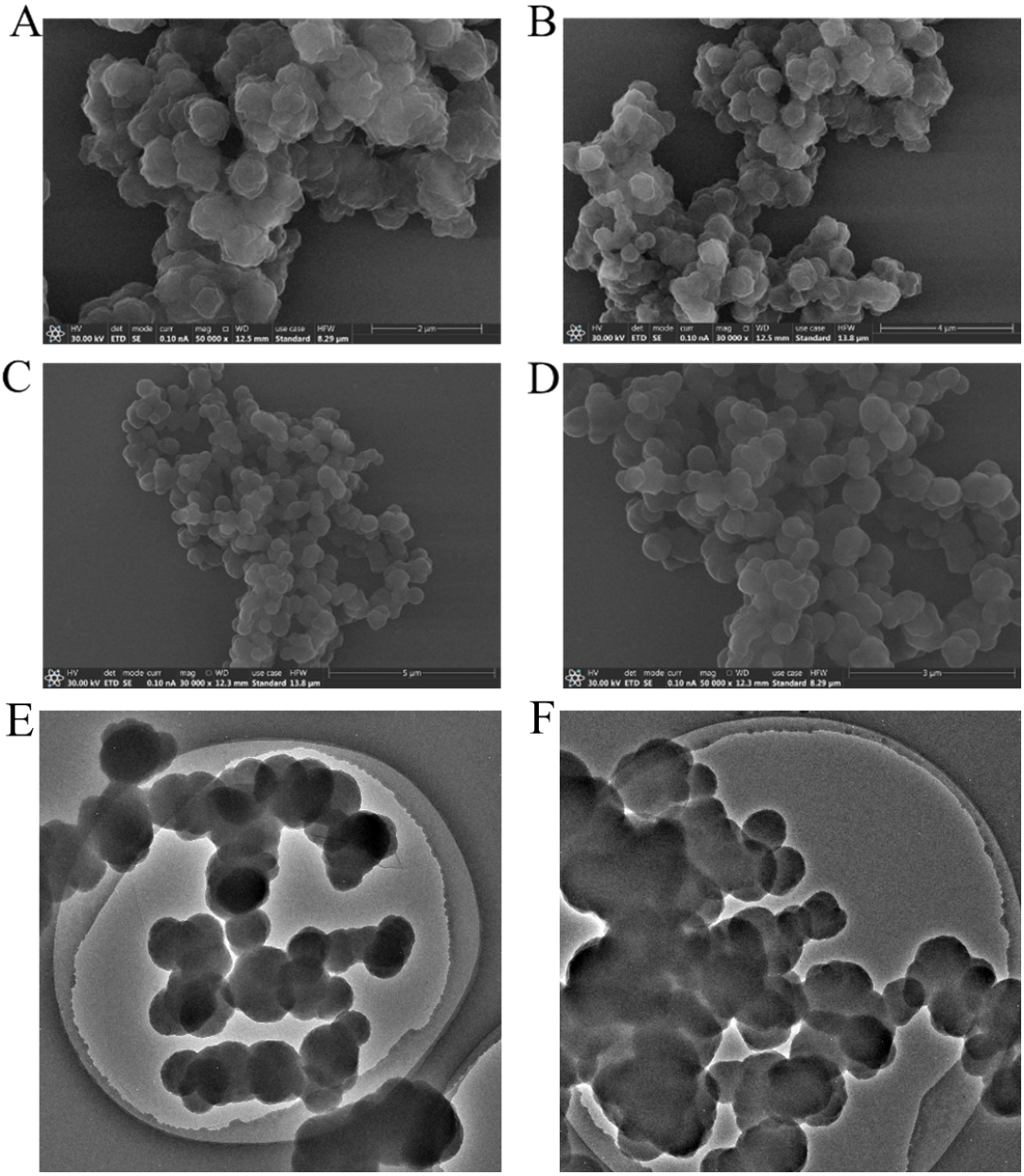


Figure S2. SEM images of DA-TD COF of 10, 000 (A) and 30, 000 magnification (B) and amorphous DA-TD of 10, 000 (C) and 30, 000 magnification (D) and TEM images of DA-TD COF (E) and amorphous DA-TD (F).

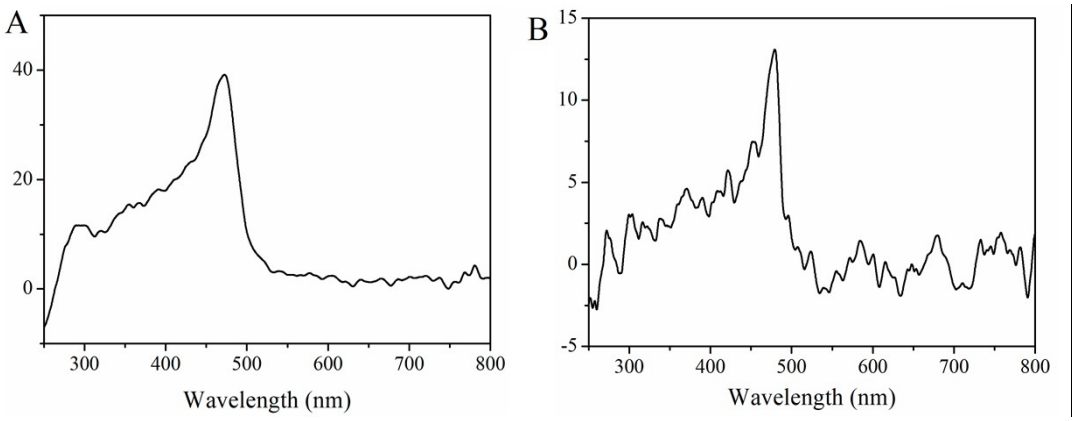


Figure S3. The solid-state CD spectrum of chiral DA-TD COF (A) and amorphous DA-TD (B).

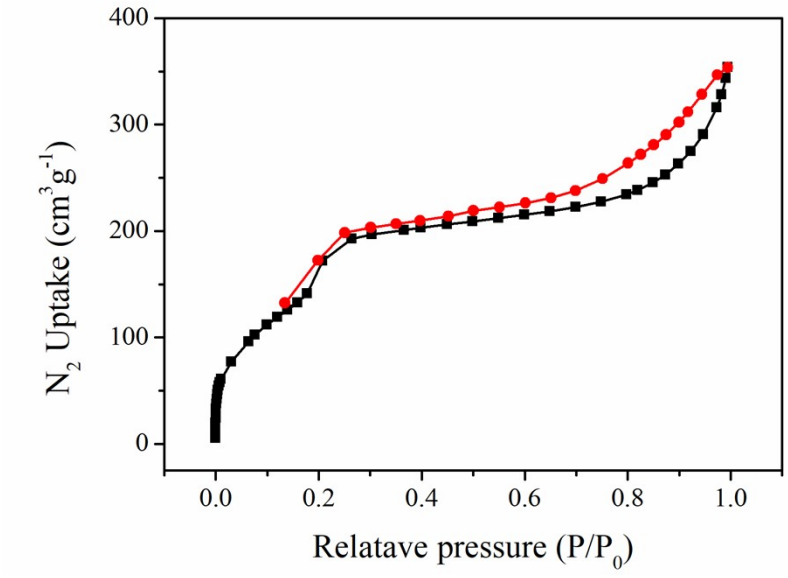


Figure S4. The N_2 adsorption-desorption isotherm of chiral DA-TD COF.

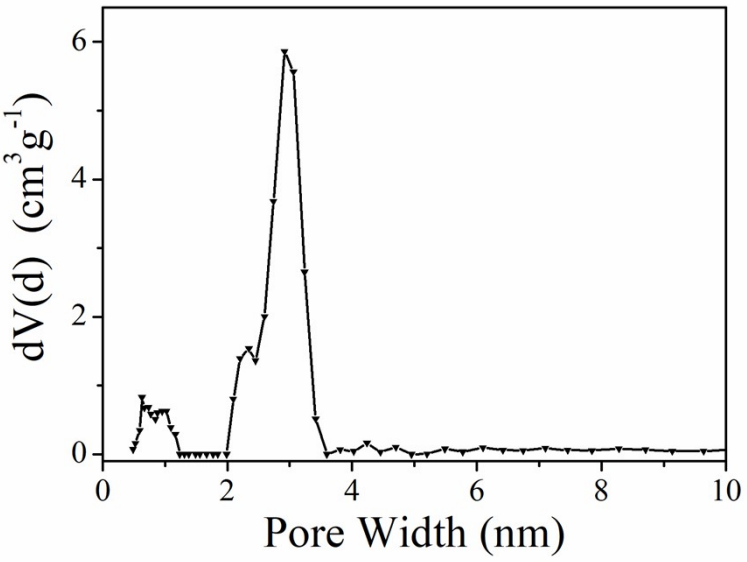


Figure S5. The pore-size distribution of chiral DA-TD COF.

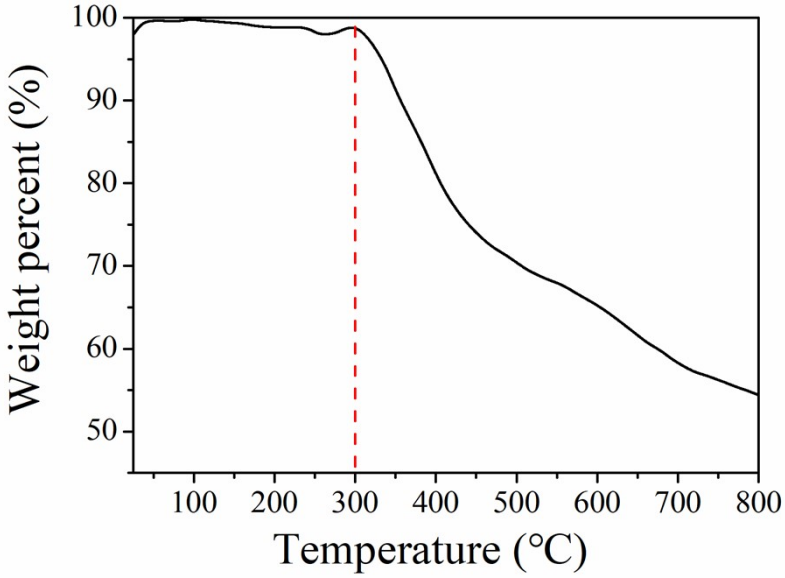


Figure S6. The TGA curve of chiral DA-TD COF.

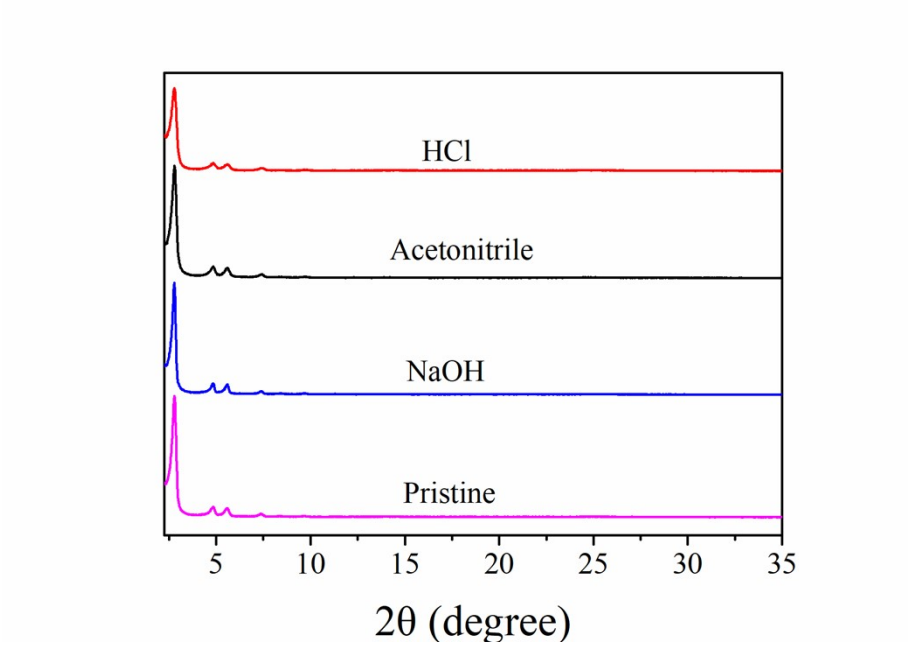


Figure S7. The PXRD patterns of chiral DA -TD COF after treatment in different solvents for three days.

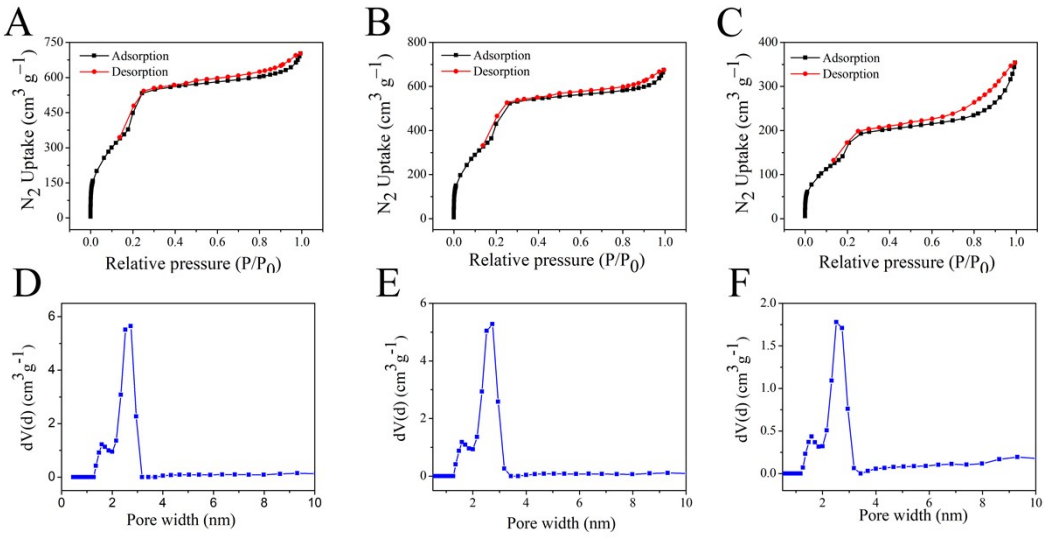


Figure S8. The N_2 adsorption-desorption isotherms and pore-size distribution of chiral DA-TD COF upon treatment in acetonitrile (A and D), 1 M NaOH (B and E) and 1 M HCl (C and F) for three days.

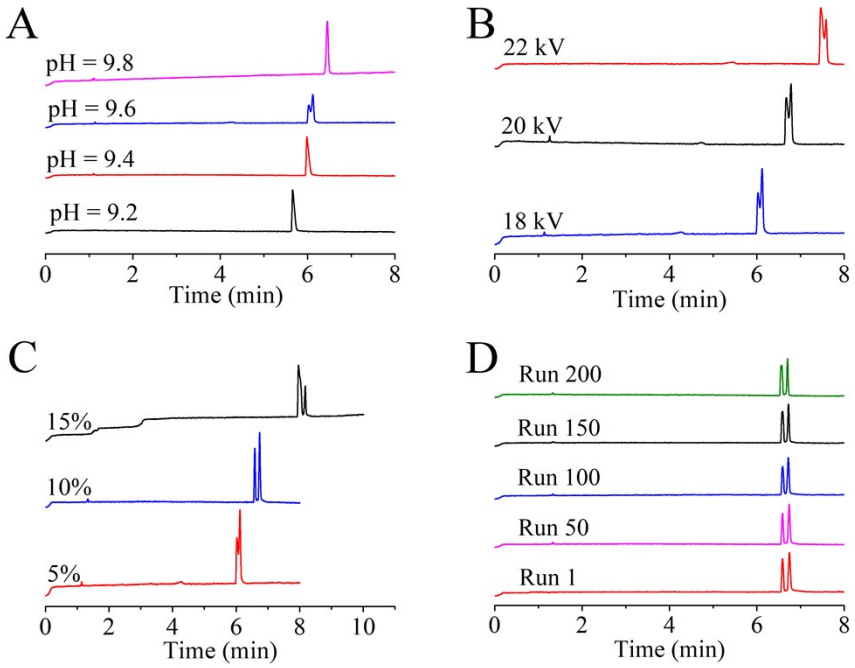


Figure S9. Effects of (A) pH, (B) voltage, (C) acetonitrile concentration on enantioseparation of terbutaline and (D) the reproducibility of 1 mg/mLchiral DA-TD COF coated capillary. Separation conditions: (A) 10 mM borate with different pH, (B) 10 mM borate (pH 9.6) with different voltage, (C) 10 mM borate (pH 9.6) with different acetonitrile concentration, (D) 10 mM borate (pH 9.6), 10% acetonitrile concentration, applied voltage: +20 kV. Detection wavelength: 214 nm; capillary: 75 μm i.d., 40.2 cm total length (30 cm effective length); capillary temperature: 20 ℃.

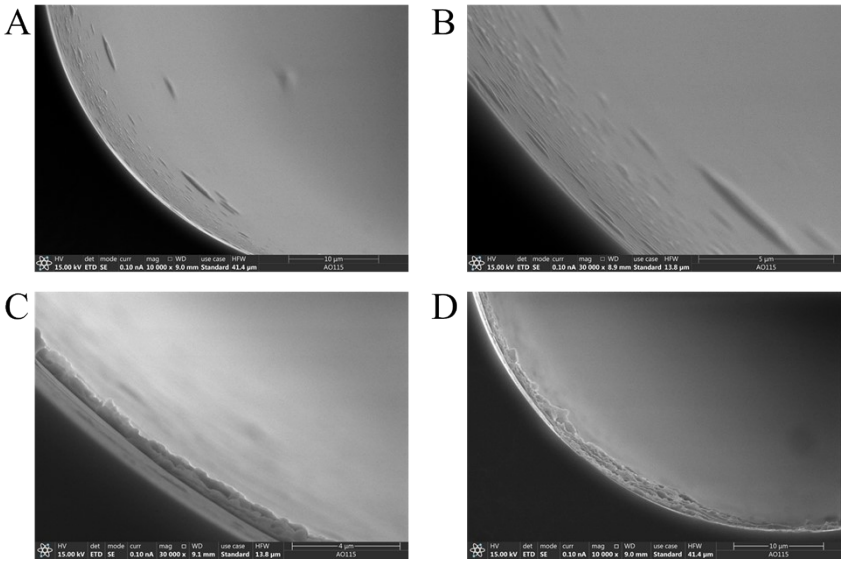


Figure S10. SEM images of the inner wall of 0.5 mg/mL chiral DA-TD COF coated capillary of 10, 000 (A), 30, 000 magnification (B) and 2 mg/mL chiral DA-TD COF coated capillary of 10, 000 (C), 30, 000 magnification (D).

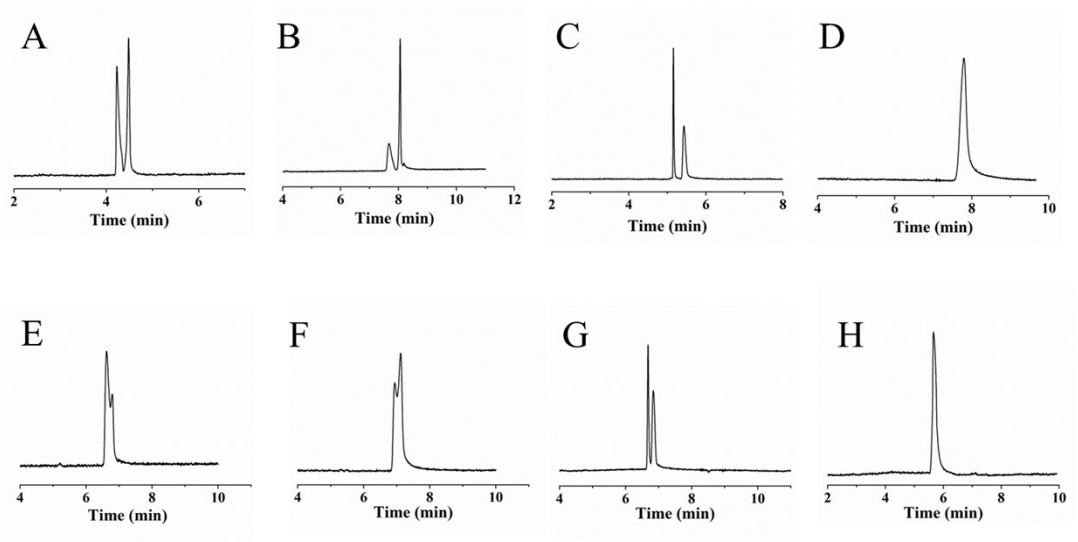


Figure S11. The electropherograms for enantioseparation of analytes under optimum conditions by 0.5 mg/mL chiral DA-TD COF coated capillary. A: terbutaline, B: verapamil, C: phenylephrine, D: norepinephrine, E: isoprenaline, F: epinephrine, G: propranolol, H: carvedilol. The separation conditions were same as Figure 3.

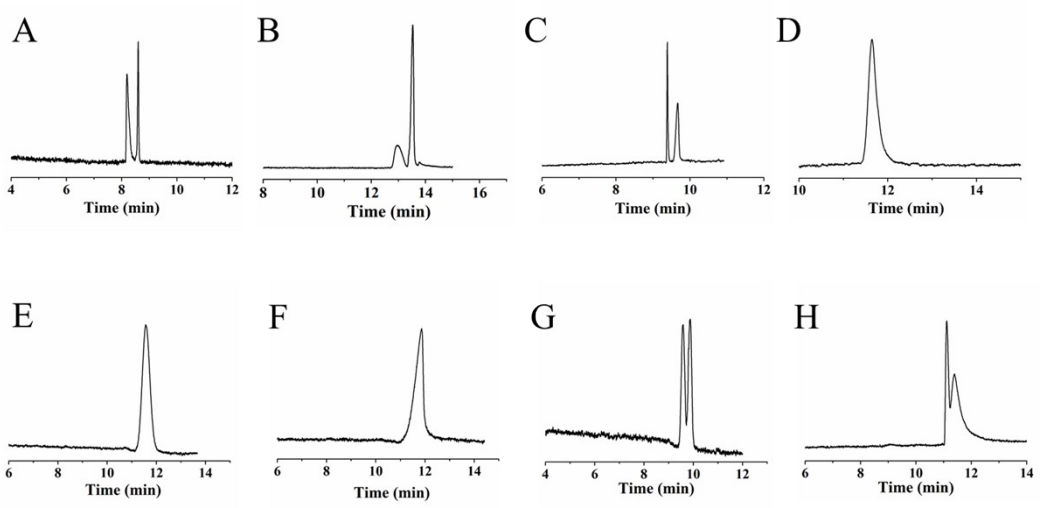


Figure S12. The electropherograms for enantioseparation of analytes under optimum conditions by 2 mg/mL chiral DA-TD COF coated capillary. A: terbutaline, B: verapamil, C: phenylephrine, D: norepinephrine, E: isoprenaline, F: epinephrine, G: propranolol, H: carvedilol. The separation conditions were same as Figure 3.

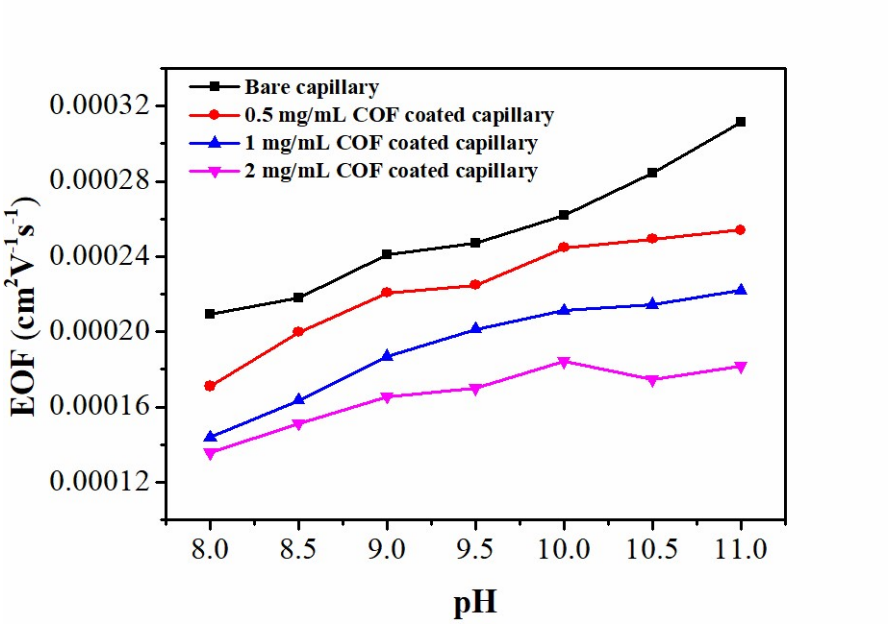


Figure S13. Effect of pH on the EOF in acetonitrile-sodium borate (10 mM sodium borate, 10% acetonitrile) for bare, 0.5 mg/mL chiral DA-TD COF, 1 mg/mL chiral DA-TD COF and 2 mg/mL chiral DA-TD COF coated capillary. The separation conditions were same as Figure 3.

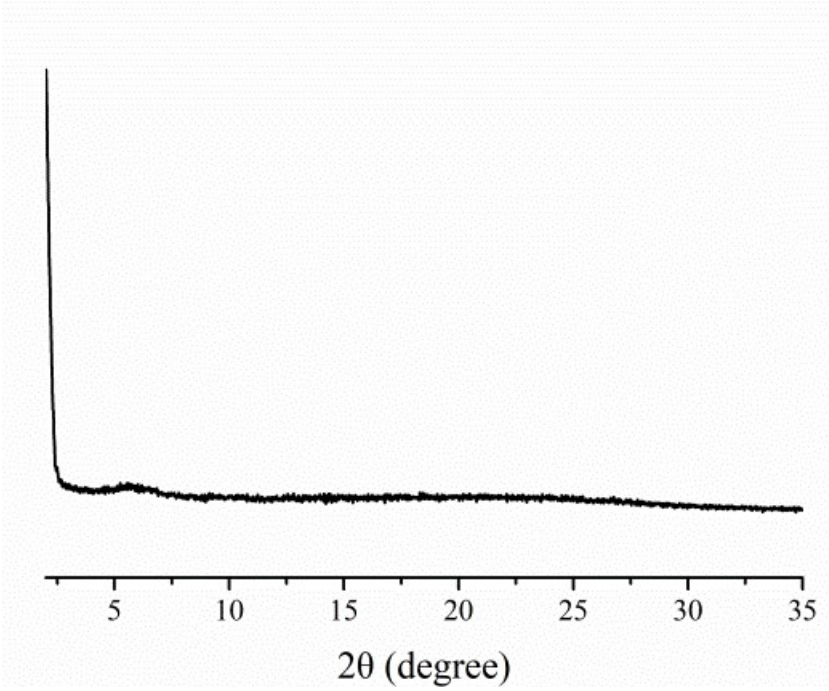


Figure S14. The PXRD pattern of amorphous DA-TD.

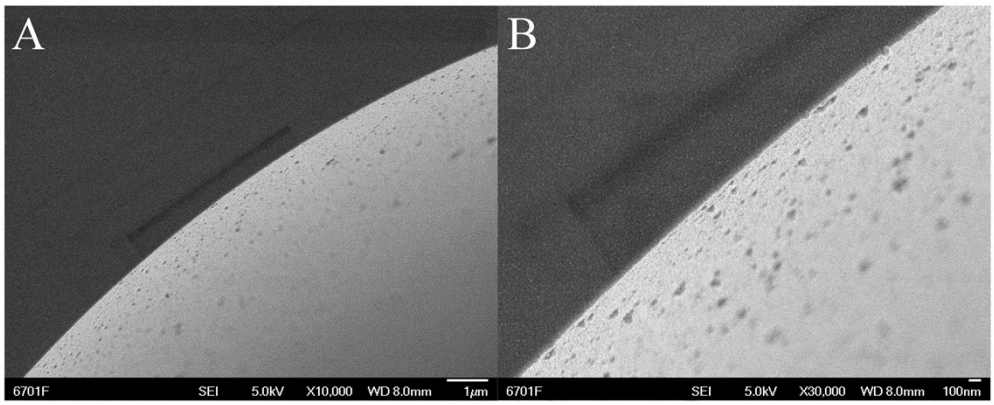


Figure S15. SEM images of the inner wall of amorphous DA-TD coated capillary of 10, 000 (A) and 30, 000 magnification (B).

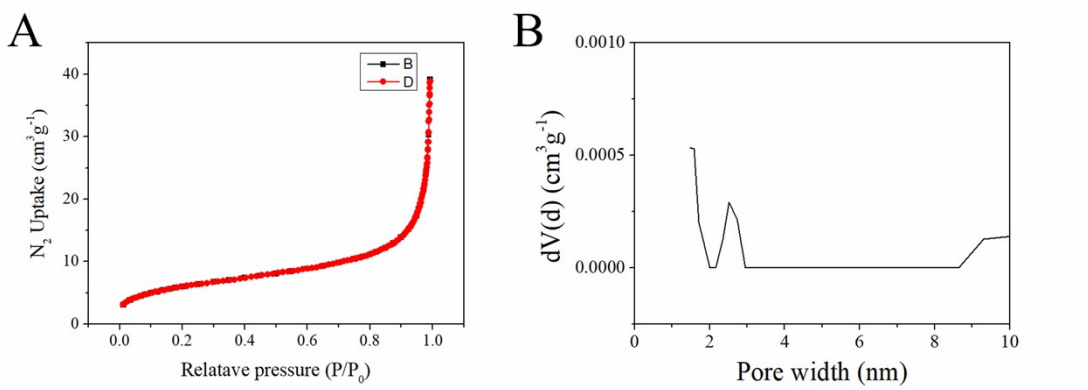


Figure S16. The N_2 adsorption-desorption isotherms and pore-size distribution of amorphous DA-TD.

The Experimental Details of Stimulation Method and Unit Cell Parameters

Crystallize structure of chiral DA-TD COF was generated using the Accelrys Materials Studio 7.0 software package. The model was constructed in the initial lattice with the space group of P1. The proposed model was geometry optimized using the MS Forcite molecular dynamics module (Universal force fields, Ewald summations) to obtain the optimized lattice parameters. Pawley refinement was applied to define the lattice parameters by Reflex module, producing the refined PXRD profiles. The simulated PXRD pattern of AA stacking was the best agreement with the experimental pattern of chiral DA-TD COF.

Table S1. Fractional atomic coordinates and parameter for the unit cell of chiral DA-TD COF with AA stacking mode.

Space group: P1			
A=36.44, b=35.81, c=4.38			
α=88.78, β=93.99, γ=117.85			
Rwp=5.23%, Rp=3.96%			
O1	0.06062	0.47659	-0.17646
O2	0.95507	0.53832	0.04771
C3	0.24933	0.62334	0.05951
C4	0.38045	0.76165	0.10459
C5	0.63256	0.2509	-0.10516
C6	0.76452	0.38861	-0.07109
C7	0.41352	0.78297	-0.07212
C8	0.43487	0.82591	-0.06966
C9	0.42305	0.8486	0.1064
C10	0.39063	0.82749	0.28536
C11	0.37008	0.78463	0.28832
C12	0.22561	0.63167	0.24373
C13	0.18319	0.60847	0.21743
C14	0.16358	0.57527	0.01223
C15	0.18717	0.56542	-0.15961
C16	0.22949	0.58941	-0.13962
C17	0.78686	0.37956	-0.26389
C18	0.82927	0.40245	-0.25098
C19	0.85025	0.43618	-0.05148
C20	0.82798	0.44676	0.12884
C21	0.78569	0.42306	0.12226
C22	0.59934	0.22934	0.06987
C23	0.57772	0.18641	0.06244

C24	0.58944	0.16391	-0.1166
C25	0.62192	0.18525	-0.29468
C26	0.64267	0.22813	-0.29333
N27	0.12014	0.55017	-0.02399
N28	0.44251	0.89272	0.11046
N29	0.56984	0.11977	-0.12417
N30	0.89377	0.46099	-0.02831
C31	0.0934	0.55911	0.06689
C32	0.47167	0.91779	-0.04819
C33	0.91968	0.45213	-0.13578
C34	0.5407	0.09459	0.03423
C35	0.48863	0.96297	-0.0212
C36	0.04912	0.53068	0.01172
C37	0.5236	0.04942	0.00519
C38	0.96405	0.48021	-0.08715
C39	0.02247	0.54531	0.07463
C40	0.03321	0.49041	-0.10812
C41	0.52323	0.98799	-0.17292
C42	0.47089	0.98116	0.14507
C43	0.99055	0.46555	-0.15339
C44	0.98027	0.52071	0.02482
C45	0.48897	0.02439	0.15656
C46	0.5413	0.03124	-0.16146
H47	0.42233	0.76646	-0.21936
H48	0.4598	0.84064	-0.21074
H49	0.38145	0.84441	0.42569
H50	0.34606	0.76952	0.43415
H51	0.2398	0.65531	0.41526
H52	0.16629	0.61589	0.36554
H53	0.17257	0.5397	-0.31653
H54	0.24659	0.58192	-0.28605
H55	0.77157	0.35558	-0.43194
H56	0.84502	0.39434	-0.40495
H57	0.84364	0.47287	0.28186
H58	0.76969	0.43118	0.27477
H59	0.59066	0.24562	0.22024
H60	0.55271	0.17154	0.20269
H61	0.631	0.16851	-0.43763
H62	0.66668	0.24343	-0.43923
H63	0.10298	0.58851	0.17427
H64	0.4844	0.90629	-0.20416
H65	0.90945	0.42298	-0.24882
H66	0.52815	0.106	0.19228

H67	0.03462	0.57674	0.15307
H68	0.5359	0.97318	-0.30022
O69	0.43559	0.95531	0.29162
H70	0.9774	0.43446	-0.24024
H71	0.4763	0.0392	0.28391
O72	0.57659	0.05709	-0.3081
C73	0.29455	0.64906	0.07545
C74	0.31806	0.62936	0.05919
C75	0.36045	0.65175	0.06266
C76	0.37968	0.69465	0.08025
C77	0.3574	0.71572	0.09415
C78	0.31422	0.6926	0.0954
C79	0.3848	0.63033	0.04809
C80	0.37478	0.59438	0.20904
C81	0.39785	0.57436	0.19676
C82	0.43163	0.5901	0.02287
C83	0.44143	0.6258	-0.13827
C84	0.41833	0.64575	-0.12657
O85	0.29109	0.71172	0.15036
C86	0.284	0.73349	-0.09024
C87	0.26248	0.75606	0.02413
C88	0.26513	0.79009	-0.18957
C89	0.21808	0.72526	0.07789
C90	0.25915	0.8228	-0.03478
N91	0.45666	0.57108	0.00008
C92	0.45378	0.53905	0.14024
C93	0.48207	0.52309	0.08941
C94	0.47655	0.48642	0.2231
C95	0.50407	0.47206	0.17258
C96	0.53632	0.49334	-0.0106
C97	0.54191	0.53009	-0.14327
C98	0.5144	0.54442	-0.09292
O99	0.44357	0.46572	0.40357
C100	0.43372	0.42555	0.50312
C101	0.71933	0.36317	-0.07385
C102	0.69629	0.3832	-0.04793
C103	0.65396	0.36116	-0.04377
C104	0.63429	0.31827	-0.06525
C105	0.65609	0.29682	-0.08826
C106	0.69925	0.31959	-0.09376
C107	0.63015	0.38299	-0.01881
C108	0.6402	0.41932	-0.1748
C109	0.61772	0.43979	-0.1525

C110	0.58453	0.42421	0.02718
C111	0.57458	0.38804	0.18245
C112	0.5971	0.36761	0.16072
O113	0.72196	0.30011	-0.15206
C114	0.72868	0.27768	0.08554
C115	0.75023	0.25531	-0.03155
C116	0.74773	0.22119	0.18052
C117	0.7946	0.28626	-0.08512
C118	0.75405	0.18879	0.02437
N119	0.56005	0.44367	0.05937
C120	0.56437	0.4772	-0.06497
O121	0.57486	0.55081	-0.32411
C122	0.58473	0.59099	-0.42329
H123	0.30319	0.59614	0.04476
H124	0.4126	0.71182	0.09252
H125	0.34951	0.58211	0.34938
H126	0.38896	0.54694	0.32505
H127	0.46702	0.63806	-0.27566
H128	0.42634	0.6729	-0.25813
H129	0.26538	0.71207	-0.27712
H130	0.31326	0.75642	-0.17104
H131	0.27889	0.77096	0.24003
H132	0.24191	0.77648	-0.38005
H133	0.29561	0.80613	-0.27948
H134	0.21697	0.70351	0.25285
H135	0.20146	0.70762	-0.13015
H136	0.20201	0.74114	0.15624
H137	0.2282	0.80946	0.04454
H138	0.26302	0.84723	-0.19509
H139	0.28209	0.83704	0.15706
H140	0.43081	0.52358	0.29583
H141	0.50056	0.44415	0.2742
H142	0.51795	0.57237	-0.19419
H143	0.45881	0.4265	0.65412
H144	0.42675	0.40439	0.30983
H145	0.40631	0.4136	0.63089
H146	0.71147	0.41642	-0.03265
H147	0.60139	0.30146	-0.07385
H148	0.665	0.43151	-0.31949
H149	0.62653	0.46734	-0.279
H150	0.54937	0.37578	0.32337
H151	0.58905	0.34013	0.28834
H152	0.69931	0.2546	0.16398

H153	0.74718	0.2986	0.27484
H154	0.7338	0.24057	-0.24784
H155	0.7172	0.2049	0.26961
H156	0.77083	0.23474	0.3717
H157	0.79564	0.30818	-0.2585
H158	0.81072	0.27055	-0.16548
H159	0.81123	0.30373	0.12352
H160	0.7313	0.1747	-0.16876
H161	0.75013	0.16421	0.18329
H162	0.78511	0.20238	-0.05326
H163	0.58834	0.49381	-0.21101
H164	0.55963	0.59007	-0.57408
H165	0.61213	0.60294	-0.55119
H166	0.59173	0.61213	-0.22983
C167	0.41404	0.97286	0.42291
C168	0.0452	0.438	-0.32887
C169	0.95191	0.54862	0.34401
C170	0.59818	0.03956	-0.43901
H171	0.38663	0.94785	0.51667
H172	0.404	0.98859	0.25199
H173	0.43305	0.99441	0.60842
H174	0.02883	0.43776	-0.54539
H175	0.02512	0.4125	-0.18726
H176	0.07115	0.4333	-0.37543
H177	0.93674	0.52022	0.47361
H178	0.93274	0.56372	0.33671
H179	0.9822	0.57016	0.45421
H180	0.62559	0.06457	-0.53269
H181	0.5792	0.01798	-0.62449
H182	0.60821	0.02385	-0.26782

Table S2. Fractional atomic coordinates and parameter for the unit cell of chiral DA-TD COF with AB stacking mode.

Space group: P1			
A=35.69, b=35.06, c=4.29			
α=88.73, β=94.05, γ=117.96			
Rwp=5.85%, Rp=4.64%			
O1	0.06195	0.48687	-0.09166
O2	0.97607	0.5518	0.02644
C3	0.25481	0.63714	0.02921
C4	0.38882	0.77868	0.0523

C5	0.64647	0.25757	-0.05201
C6	0.78133	0.3985	-0.03454
C7	0.42261	0.80052	-0.03796
C8	0.44443	0.84442	-0.03677
C9	0.43235	0.86757	0.05309
C10	0.39922	0.84594	0.14451
C11	0.37822	0.80212	0.14609
C12	0.23057	0.6456	0.12325
C13	0.18722	0.62182	0.10971
C14	0.16718	0.58787	0.00486
C15	0.19129	0.57786	-0.08284
C16	0.23454	0.60245	-0.07253
C17	0.80416	0.3893	-0.13297
C18	0.8475	0.41277	-0.12627
C19	0.86894	0.44726	-0.02433
C20	0.84619	0.45802	0.06771
C21	0.80297	0.43372	0.06425
C22	0.61252	0.23549	0.03739
C23	0.59042	0.1916	0.03366
C24	0.6024	0.16864	-0.05773
C25	0.63559	0.1905	-0.14869
C26	0.6568	0.23434	-0.14807
N27	0.12278	0.56214	-0.01374
N28	0.45224	0.91267	0.05509
N29	0.58237	0.12352	-0.06152
N30	0.91342	0.47269	-0.0124
C31	0.09545	0.57122	0.03256
C32	0.48204	0.93833	-0.02597
C33	0.9399	0.4637	-0.06719
C34	0.55259	0.09774	0.01942
C35	0.49937	0.98451	-0.01227
C36	0.0502	0.54209	0.00428
C37	0.53511	0.05157	0.00466
C38	0.98525	0.49247	-0.04225
C39	0.02296	0.55697	0.03627
C40	0.03394	0.50093	-0.05689
C41	0.53473	1.01014	-0.08976
C42	0.48124	1.00305	0.07258
C43	1.01233	0.47755	-0.07594
C44	1.00182	0.53386	0.01491
C45	0.49972	0.02594	0.08198
C46	0.5532	0.03304	-0.08038
H47	0.43162	0.78368	-0.11312

H48	0.46991	0.85951	-0.10883
H49	0.38984	0.8632	0.21614
H50	0.35367	0.78664	0.22059
H51	0.24507	0.66977	0.2109
H52	0.16995	0.62936	0.18532
H53	0.17636	0.55156	-0.16302
H54	0.25201	0.59484	-0.14728
H55	0.78853	0.36478	-0.21884
H56	0.8636	0.40452	-0.20488
H57	0.86219	0.48472	0.14589
H58	0.78661	0.44198	0.14211
H59	0.60365	0.25209	0.11416
H60	0.56486	0.17636	0.1053
H61	0.64487	0.17343	-0.22166
H62	0.68134	0.25002	-0.2226
H63	0.10524	0.60126	0.08739
H64	0.49505	0.92662	-0.1056
H65	0.92945	0.4339	-0.12491
H66	0.53976	0.10937	0.10011
H67	0.03538	0.5891	0.07631
H68	0.54768	0.99504	-0.15473
O69	0.44517	0.97658	0.14744
H70	0.99889	0.44577	-0.12028
H71	0.48677	0.04104	0.14697
O72	0.58927	0.05952	-0.15528
C73	0.30103	0.66351	0.03746
C74	0.32505	0.64344	0.02931
C75	0.36838	0.66639	0.03118
C76	0.38803	0.71025	0.0401
C77	0.36526	0.73172	0.04704
C78	0.32113	0.70802	0.04758
C79	0.39326	0.64457	0.02392
C80	0.38302	0.60783	0.10627
C81	0.4066	0.58743	0.10017
C82	0.44112	0.60358	0.01137
C83	0.45114	0.64006	-0.07109
C84	0.42753	0.66039	-0.06528
O85	0.29749	0.72749	0.07551
C86	0.29024	0.74971	-0.04758
C87	0.26825	0.77272	0.0107
C88	0.27096	0.80748	-0.09864
C89	0.22288	0.74117	0.03811
C90	0.26485	0.84087	-0.01966

N91	0.4667	0.58421	-0.00011
C92	0.46376	0.55149	0.07164
C93	0.49267	0.53525	0.04583
C94	0.48703	0.49778	0.11427
C95	0.51515	0.48318	0.08862
C96	0.54811	0.50498	-0.00496
C97	0.55383	0.54252	-0.07288
C98	0.52571	0.5571	-0.04731
O99	0.45332	0.47657	0.20646
C100	0.44326	0.43553	0.25745
C101	0.73515	0.37242	-0.03605
C102	0.7116	0.39283	-0.02297
C103	0.66834	0.37023	-0.02094
C104	0.64824	0.32638	-0.03185
C105	0.67052	0.30452	-0.04344
C106	0.71462	0.32787	-0.04615
C107	0.64401	0.39247	-0.00836
C108	0.65428	0.4296	-0.08818
C109	0.6313	0.45046	-0.07695
C110	0.59738	0.43448	0.01481
C111	0.58721	0.39751	0.09426
C112	0.61023	0.3767	0.08332
O113	0.73783	0.30802	-0.07579
C114	0.7447	0.28513	0.04577
C115	0.76673	0.26233	-0.01391
C116	0.76417	0.22747	0.0946
C117	0.81207	0.29403	-0.04122
C118	0.77063	0.1944	0.01493
N119	0.57236	0.4543	0.03109
C120	0.57678	0.48855	-0.03257
O121	0.5875	0.56375	-0.16525
C122	0.59759	0.60481	-0.21605
H123	0.30986	0.60948	0.022
H124	0.42167	0.72785	0.04645
H125	0.35719	0.59525	0.17795
H126	0.39751	0.55941	0.1658
H127	0.47729	0.65263	-0.14125
H128	0.43571	0.68813	-0.13259
H129	0.27122	0.7278	-0.14311
H130	0.32015	0.77319	-0.08884
H131	0.28502	0.78797	0.12108
H132	0.24723	0.79353	-0.19605
H133	0.30211	0.82392	-0.14453

H134	0.22174	0.71895	0.12761
H135	0.20589	0.72312	-0.06824
H136	0.20645	0.75735	0.07803
H137	0.23322	0.82718	0.0208
H138	0.2688	0.86583	-0.10168
H139	0.28829	0.85546	0.07844
H140	0.44028	0.53564	0.15113
H141	0.51157	0.45466	0.14065
H142	0.52934	0.58565	-0.09916
H143	0.4689	0.43655	0.33473
H144	0.43613	0.4139	0.15869
H145	0.41524	0.42327	0.32268
H146	0.72711	0.42679	-0.01522
H147	0.61461	0.30915	-0.03632
H148	0.67962	0.4421	-0.16208
H149	0.64031	0.47861	-0.14168
H150	0.56145	0.38494	0.16623
H151	0.602	0.34861	0.14862
H152	0.71469	0.26149	0.08582
H153	0.76361	0.30653	0.14253
H154	0.74993	0.24724	-0.12448
H155	0.73297	0.21077	0.14007
H156	0.78778	0.24136	0.19237
H157	0.81313	0.31642	-0.12992
H158	0.82855	0.27802	-0.08217
H159	0.82907	0.31191	0.06543
H160	0.74738	0.17996	-0.08383
H161	0.76662	0.16929	0.09623
H162	0.80237	0.20834	-0.02467
H163	0.60128	0.50557	-0.10718
H164	0.57193	0.60382	-0.29323
H165	0.62559	0.61707	-0.28135
H166	0.60474	0.62641	-0.11721
C167	0.42314	0.99446	0.21439
C168	0.04619	0.44743	-0.16949
C169	0.97284	0.56231	0.17784
C170	0.61133	0.04166	-0.22204
H171	0.39513	0.96885	0.26229
H172	0.41288	1.0105	0.12693
H173	0.44257	1.0165	0.30922
H174	0.02946	0.44715	-0.28023
H175	0.02567	0.42134	-0.0971
H176	0.07271	0.44268	-0.19316

H177	0.95734	0.53327	0.24412
H178	0.95325	0.57769	0.17397
H179	1.0038	0.58437	0.23422
H180	0.63935	0.06726	-0.2699
H181	0.59194	0.01958	-0.31685
H182	0.62158	0.02564	-0.13444
O183	-0.61374	1.16857	0.1592
O184	0.30038	1.2335	0.2773
C185	-0.42088	1.31884	0.28007
C186	-0.28688	1.46038	0.30316
C187	-0.02922	0.93928	0.19885
C188	0.10564	1.0802	0.21632
C189	-0.25308	1.48222	0.2129
C190	-0.23126	1.52612	0.21409
C191	-0.24334	1.54927	0.30395
C192	-0.27647	1.52764	0.39537
C193	-0.29747	1.48382	0.39695
C194	-0.44512	1.3273	0.3741
C195	-0.48847	1.30352	0.36057
C196	-0.50851	1.26957	0.25572
C197	-0.4844	1.25956	0.16802
C198	-0.44115	1.28415	0.17833
C199	0.12847	1.071	0.11789
C200	0.17181	1.09447	0.12459
C201	0.19325	1.12896	0.22653
C202	0.17049	1.13972	0.31856
C203	0.12728	1.11542	0.31511
C204	-0.06317	0.91719	0.28825
C205	-0.08527	0.8733	0.28452
C206	-0.07329	0.85034	0.19313
C207	-0.0401	0.8722	0.10217
C208	-0.01889	0.91604	0.10279
N209	-0.55291	1.24384	0.23711
N210	-0.22345	1.59437	0.30595
N211	-0.09332	0.80522	0.18934
N212	0.23773	1.15439	0.23846
C213	-0.58024	1.25292	0.28342
C214	-0.19365	1.62003	0.22489
C215	0.26421	1.1454	0.18367
C216	-0.1231	0.77944	0.27027
C217	-0.17632	1.66621	0.23859
C218	-0.62549	1.22379	0.25514
C219	-0.14058	0.73327	0.25552

C220	0.30956	1.17417	0.20861
C221	-0.65273	1.23867	0.28713
C222	-0.64175	1.18263	0.19396
C223	-0.14096	1.69184	0.16109
C224	-0.19445	1.68475	0.32344
C225	0.33664	1.15925	0.17492
C226	0.32613	1.21556	0.26576
C227	-0.17597	0.70764	0.33284
C228	-0.12249	0.71474	0.17048
H229	-0.24407	1.46538	0.13773
H230	-0.20578	1.54122	0.14203
H231	-0.28585	1.5449	0.467
H232	-0.32202	1.46834	0.47144
H233	-0.43062	1.35147	0.46176
H234	-0.50574	1.31106	0.43618
H235	-0.49933	1.23326	0.08784
H236	-0.42368	1.27654	0.10358
H237	0.11284	1.04648	0.03202
H238	0.18791	1.08622	0.04598
H239	0.1865	1.16642	0.39675
H240	0.11092	1.12368	0.39297
H241	-0.07204	0.93379	0.36502
H242	-0.11083	0.85806	0.35615
H243	-0.03082	0.85513	0.0292
H244	0.00565	0.93172	0.02826
H245	-0.57045	1.28296	0.33824
H246	-0.18064	1.60832	0.14526
H247	0.25376	1.1156	0.12595
H248	-0.13593	0.79107	0.35097
H249	-0.64031	1.2708	0.32716
H250	-0.12801	1.67674	0.09613
O251	-0.23052	1.65828	0.39829
H252	0.3232	1.12747	0.13058
H253	-0.18892	0.72274	0.39783
O254	-0.08642	0.74122	0.09558
C255	-0.37466	1.34521	0.28831
C256	-0.35064	1.32514	0.28017
C257	-0.30731	1.34809	0.28204
C258	-0.28766	1.39195	0.29096
C259	-0.31043	1.41342	0.2979
C260	-0.35456	1.38972	0.29844
C261	-0.28243	1.32627	0.27477
C262	-0.29267	1.28953	0.35713

C263	-0.26909	1.26913	0.35102
C264	-0.23457	1.28528	0.26222
C265	-0.22455	1.32176	0.17977
C266	-0.24816	1.34209	0.18558
O267	-0.3782	1.40919	0.32636
C268	-0.38545	1.43141	0.20327
C269	-0.40744	1.45442	0.26156
C270	-0.40473	1.48918	0.15222
C271	-0.45282	1.42287	0.28897
C272	-0.41084	1.52257	0.2312
N273	-0.20899	1.26591	0.25075
C274	-0.21193	1.23319	0.32249
C275	-0.18302	1.21695	0.29669
C276	-0.18866	1.17948	0.36513
C277	-0.16054	1.16488	0.33948
C278	-0.12758	1.18668	0.2459
C279	-0.12187	1.22422	0.17798
C280	-0.14998	1.2388	0.20355
O281	-0.22237	1.15827	0.45732
C282	-0.23243	1.11723	0.5083
C283	0.05946	1.05412	0.21481
C284	0.03591	1.07453	0.22789
C285	-0.00735	1.05193	0.22992
C286	-0.02745	1.00808	0.21901
C287	-0.00517	0.98622	0.20742
C288	0.03893	1.00957	0.2047
C289	-0.03168	1.07417	0.2425
C290	-0.02141	1.1113	0.16267
C291	-0.04439	1.13216	0.1739
C292	-0.07831	1.11618	0.26566
C293	-0.08848	1.07921	0.34512
C294	-0.06546	1.0584	0.33418
O295	0.06214	0.98972	0.17507
C296	0.06901	0.96683	0.29663
C297	0.09104	0.94403	0.23695
C298	0.08848	0.90917	0.34546
C299	0.13638	0.97573	0.20964
C300	0.09494	0.8761	0.26579
N301	-0.10333	1.136	0.28195
C302	-0.09891	1.17025	0.21829
O303	-0.08819	1.24545	0.08561
C304	-0.0781	1.28651	0.03481
H305	-0.36583	1.29118	0.27285

H306	-0.25402	1.40955	0.29731
H307	-0.3185	1.27695	0.4288
H308	-0.27818	1.24111	0.41666
H309	-0.1984	1.33433	0.10961
H310	-0.23998	1.36983	0.11827
H311	-0.40448	1.4095	0.10775
H312	-0.35554	1.45489	0.16201
H313	-0.39067	1.46967	0.37193
H314	-0.42846	1.47523	0.05481
H315	-0.37358	1.50562	0.10633
H316	-0.45395	1.40065	0.37847
H317	-0.4698	1.40482	0.18262
H318	-0.46924	1.43905	0.32889
H319	-0.44247	1.50888	0.27166
H320	-0.40689	1.54753	0.14918
H321	-0.3874	1.53716	0.3293
H322	-0.23541	1.21734	0.40198
H323	-0.16412	1.13636	0.3915
H324	-0.14635	1.26735	0.1517
H325	-0.20679	1.11825	0.58559
H326	-0.23956	1.0956	0.40955
H327	-0.26045	1.10497	0.57354
H328	0.05142	1.10849	0.23564
H329	-0.06108	0.99085	0.21454
H330	0.00393	1.1238	0.08878
H331	-0.03538	1.16031	0.10918
H332	-0.11424	1.06664	0.41709
H333	-0.07369	1.03031	0.39948
H334	0.039	0.94319	0.33668
H335	0.08792	0.98823	0.39339
H336	0.07424	0.92894	0.12638
H337	0.05728	0.89247	0.39093
H338	0.11209	0.92306	0.44323
H339	0.13744	0.99812	0.12094
H340	0.15286	0.95972	0.16869
H341	0.15338	0.99361	0.31629
H342	0.07169	0.86166	0.16702
H343	0.09093	0.85099	0.34709
H344	0.12668	0.89004	0.22619
H345	-0.07441	1.18727	0.14368
H346	-0.10376	1.28552	-0.04237
H347	-0.0501	1.29877	-0.0305
H348	-0.07095	1.30811	0.13365

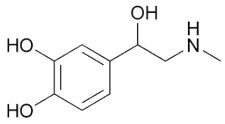
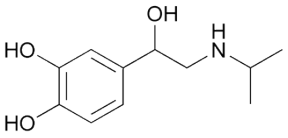
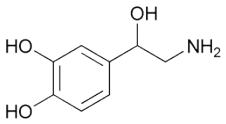
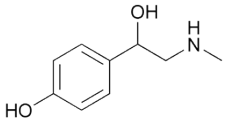
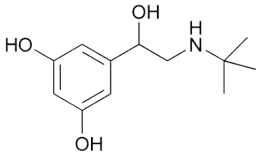
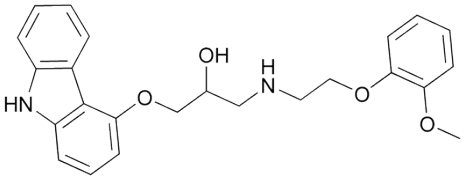
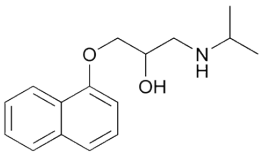
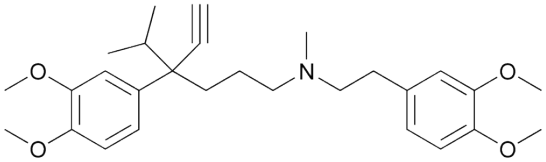
C349	-0.25255	1.67616	0.46525
C350	-0.6295	1.12913	0.08137
C351	0.29715	1.24401	0.4287
C352	-0.06436	0.72336	0.02882
H353	-0.28056	1.65056	0.51315
H354	-0.26281	1.6922	0.37779
H355	-0.23312	1.6982	0.56007
H356	-0.64623	1.12885	-0.02937
H357	-0.65002	1.10304	0.15376
H358	-0.60298	1.12438	0.05769
H359	0.28165	1.21497	0.49498
H360	0.27756	1.25939	0.42483
H361	0.32811	1.26607	0.48508
H362	-0.03635	0.74896	-0.01904
H363	-0.08376	0.70128	-0.06599
H364	-0.05411	0.70734	0.11642

Table S3. The optimum separation pH, acetonitrile concentration, resolution and theoretical plate numbers for the model chiral analytes.

Analyte	pH	Acetonitrile concentration (%)	*R*s	TN (n/m)[a]	
				N_1	N_2
Terbutaline	9.60	10	2.53	169726	147403
Verapamil	9.10	0	4.13	58927	19796
Phenylephrine	9.85	15	2.35	10202	11531
Norepinephrine	9.52	0	1.02	20526	18160
Isoprenaline	9.55	0	1.63	87624	74885
Epinephrine	9.33	0	1.66	42184	139526
Propranolol	10.95	20	1.27	87302	35709
Carvedilol	9.50	20	1.27	82516	38454

a: the theoretical plate numbers.

Table S4. The diameter of the model analytes calculated by Materials Studio.

Analyte	Structure	d (Å)
Epinephrine		9.91×5.08×4.11
Isoproterenol		8.852×5.593×7.62
Norepinephrine		8.67×4.05×2.68
Synephrine		8.70×4.17×5.32
Terbutaline		9.30×6.65×7.47
Carvedilol		14.98×11.04×7.61
Propranolol		6.752×12.38×7.42
Verapamil		16.297×13.19×9.17

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