Electronic Supplementary Information (ESI)

Poly(methyl methacrylate) end-functionalized with hexabenzocoronene as an effective dispersant for multi-walled carbon nanotubes

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Materials

All starting chemicals and reagents were obtained from commercial sources and were used without further purification unless otherwise noted.

4-bromo-4'-hydroxybiphenyl (99%), 2-(2-chloroethoxy)tetrahydro-2H-pyran (96%), cesium carbonate (Cs_2CO_3, 99%), DMSO (99.7%), anhydrous sodium sulfate (Na_2SO_4), sodium bicarbonate ($NaHCO_3$), phenylacetylene (98%) was distilled under reduced pressure and stored in the refrigerator prior to use, 1-pyrenebutanol (99%), triethylamine (99%), bis(triphenyl phosphine) palladium(II) dichloride ($PdCl_2(PPh_3)_2$, 98%), copper(I) iodide (CuI, 98%), benzene (>99.5%), 2-bromo-2-methylpropionyl bromide (98%), methyl methacrylate (MMA, 99%), tris[2-(dimethylamino)ethyl]amine (Me_6TREN, 97%), copper wire (Exeter Analytical Inc.), methanol, dichloromethane (DCM), iron(III) chloride ($FeCl_3$), nitromethane ($MeNO_2$, 99%), poly(methyl methacrylate) (PMMA, Mw: 540K, CAS: 9011-14-7, Scientific Polymer Products), S-purified multiwall nanotube (MWCNTs, outer diameter 40 ~ 60 nm, Catalog # 900-1270, SES Research).

Characterization Methods

^{1}H NMR spectra were recorded on a 400 MHz Bruker Avance or 500 MHz Bruker Ascend NMR spectrometer, and ^{13}C NMR spectra were proton decoupled and recorded on a 500 MHz Bruker Ascend NMR spectrometer using the carbon signal of the deuterated solvent as the internal standard. Chemical shifts are reported in parts per million (ppm) using the following abbreviations for peak multiplicities: s, singlet; d, doublet; t, triplet; m, multiplet; br, broad peak. Gel permeation chromatography (GPC) analyses were performed on an Agilent 1260 tetrahydrofuran (THF) GPC with poly(methyl methacrylate) as a standard and toluene as the flow rate marker and RI detection mode. UV-Vis absorption spectra were measured using a Shimadzu UV 3600PC spectrometer, and stock solutions were prepared in chloroform. Thermogravimetric analysis (TGA) was performed on a TA instruments Q50. Infrared (IR) spectra were measured on a Bruker ALPHA spectrometer with OPUS 6.5 software. Dynamic light scattering (DLS) and zeta potential were determined by Nano-ZS (Malvern Inc.) Zetasizer. Field emission scanning electron microscopy (Magellan 400L XHR-SEM) was operated to examine the morphology of dispersed MWCNTs on Silicon substrate. Transmission electron microscopy images were taken from JEOL JEM-2000FX.

Experimental Procedure

Note: For simplicity, nuclei are labelled by observed chemical shifts. Nuclei that appear at the same chemical shift are given the same label. We do not intend to indicate these nuclei are homotopic.

S1. Synthesis of 2-[2-[(4'-bromo[1,1'-biphenyl]-4-yl)oxy]ethoxy]tetrahydro- 2*H*-pyran, compound 1.

4-Bromo-4'-hydroxybiphenyl (7.92 g, 31.79 mmol) and Cs_2CO_3 (12.50 g, 38.36 mmol) were mixed with 100 mL of DMSO in a 200 mL round-bottom flask with a Teflon-coated magnetic stirbar. 2-(2-

chloroethoxy)tetrahydro-2H-pyran (6.26 g, 38.02 mmol) was added slowly to this solution using a pipette and the mixture was stirred overnight at 60 °C. The reaction mixture was allowed to cool to room temperature, and was poured into 500 mL of distilled water, and stirred for 30 min. The organic components were extracted three times using DCM in a separatory funnel, and the combined DCM extracts were washed with distilled water, saturated $NaHCO_3$ solution, distilled water, dried over Na_2SO_4, and filtered. The filtrate was evaporated to dryness under reduced pressure to obtain crude **1**, which was purified by recrystallization in ethanol to obtain **1** as white crystals (8.26 g, 68.9 %).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.53 (dd, J = 6.5, 2.0 Hz, 2H; H_1), 7.47 (dd, J = 6.6, 2.1 Hz, 2H; H_2), 7.41 (dd, J = 6.5, 2.0 Hz, 2H; H_3), 7.00 (dd, J = 6.7, 2.0 Hz, 2H; H_4), 4.73 (t, J = 3.6 Hz, 1H; H_5), 4.20 (m, 2H; H_6), 4.08 (m, 1H; H_7 or H_8 or H_9), 3.92 (m, 1H; H_8 or H_7 or H_9), 3.85 (m, 1H; H_9 or H_7 or H_8), 3.54 (m, 1H; H_{10}), 1.72 (m, 6H; H_{11}).

^{13}C NMR (125 MHz, $CDCl_3$): δ 158.89 (C_1), 139.85 (C_2), 132.69 (C_3), 131.93 (C_4), 128.43 (C_5), 128.07 (C_6), 120.93 (C_7), 115.24 (C_8), 99.16 (C_9), 67.67 (C_{10}), 65.96 (C_{11}), 62.38 (C_{12}), 30.68 (C_{13}), 25.58 (C_{14}), 19.55 (C_{15}).

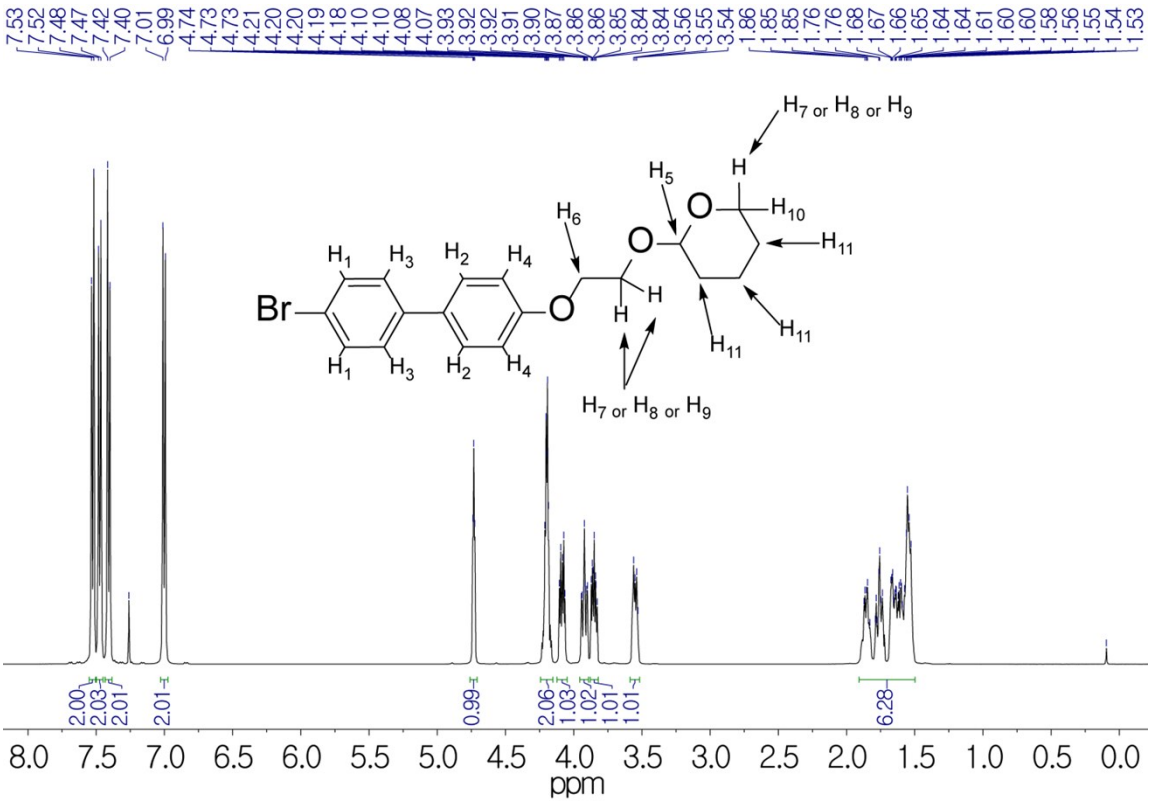


Fig. S1-1. ^{1}H NMR ($CDCl_3$) of 2-[2-[(4'-bromo[1,1'-biphenyl]-4-yl)oxy]ethoxy]tetrahydro- 2*H*-pyran, compound 1.

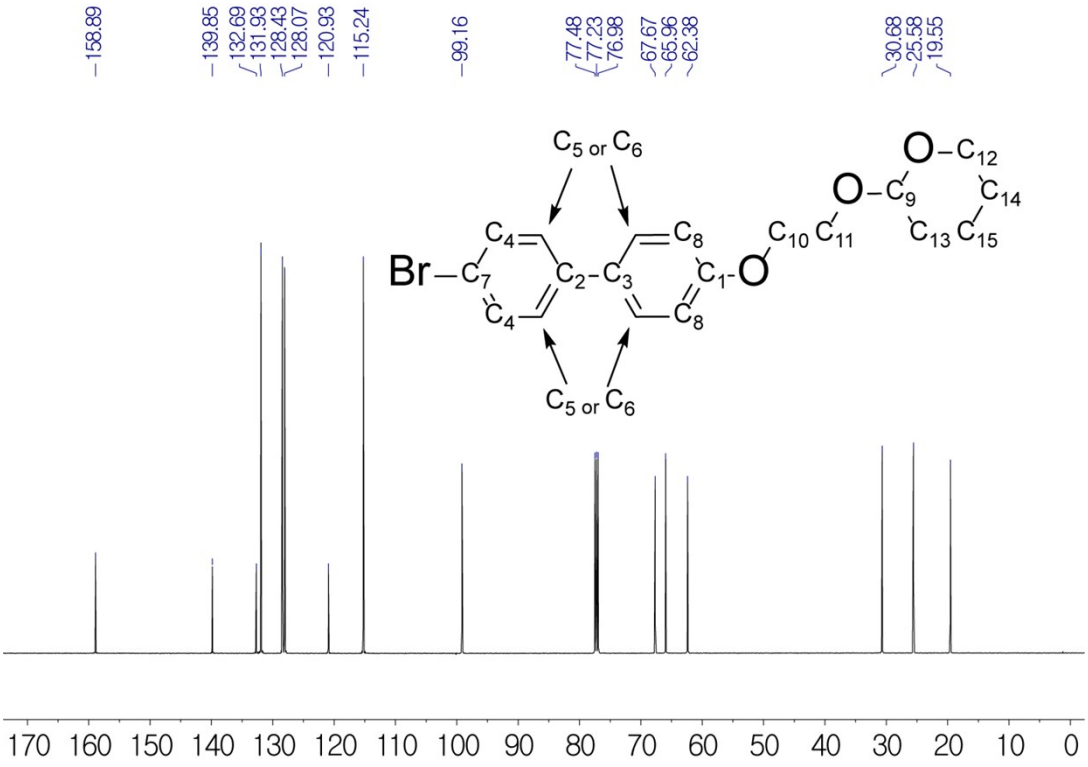


Fig. S1-2. ^{13}C NMR ($CDCl_3$) of 2-[2-[(4'-bromo[1,1'-biphenyl]-4-yl)oxy]ethoxy]tetrahydro- 2*H*-pyran, compound 1.

S2. Synthesis of 2-(2-(4'-(phenylethynyl)biphenyl-4-yloxy)ethoxy)-tetrahydro-2H-pyran, compound 2.

In an argon-filled glove box, compound **1** (4.0 g, 10.6 mmol), $PdCl_2(PPh_3)_2$ (0.12 g, 0.172 mmol), and CuI (0.068 g, 0.355 mmol) were added to a 200 mL Schlenk flask containing a Teflon-coated magnetic stirrer. The flask was then sealed with a rubber stopper and removed from the glove box. Under a continuous flow of argon, the rubber stopper was removed and replaced with a water condenser, and then triethylamine (degassed, 100 mL) and phenylacetylene (2.17 g, 21.25 mmol) were added to the flask through the top of water condenser using a glass syringe. The reaction mixture was then heated at reflux

for 7 days under an argon atmosphere, and the reaction mixture was allowed to cool to room temperature. The reaction mixture was then transferred to separation funnel and extracted with DCM, washed with ammonium chloride solution, distilled water, brine, and dried over Na_2SO_4. After filteration, the solvent was removed and the residue was purified by column chromatography on silica gel using hexane/ethylacetate (10:1) as the eluent. The crude product was purified by recrystallization in methanol to obtain **2** as a light brown colored powder (3.68 g, 87 %).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.57 (m, 8H; H_1), 7.35 (m, 3H; H_2), 7.02 (dd, J = 6.7, 2.0 Hz, 2H; H_3), 4.73 (t, J = 3.6 Hz, 1H; H_4), 4.21 (m, 2H; H_5), 4.08 (m, 1H; H_6 or H_7 or H_8), 3.92 (m, 1H; H_7 or H_6 or H_8), 3.85 (m, 1H; H_8 or H_6 or H_7), 3.55 (m, 1H; H_9), 1.71 (m, 6H; H_{10}).

^{13}C NMR (125 MHz, $CDCl_3$): δ 158.92 (C_1), 140.70 (C_2), 133.04 (C_3), 132.17 (C_4 or C_5), 131.75 (C_5 or C_4), 128.52 (C_6 or C_8 or C_9), 128.38 (C_7), 128.16 (C_6 or C_8 or C_9), 126.66 (C_6 or C_8 or C_9), 123.51 (C_{10}), 121.59 (C_{11}), 115.22 (C_{12}), 99.17 (C_{13}), 90.02 (C_{14}), 89.62 (C_{15}), 67.66 (C_{16}), 65.98 (C_{17}), 62.39 (C_{18}), 30.68 (C_{19}), 25.59 (C_{20}), 19.55 (C_{21}).

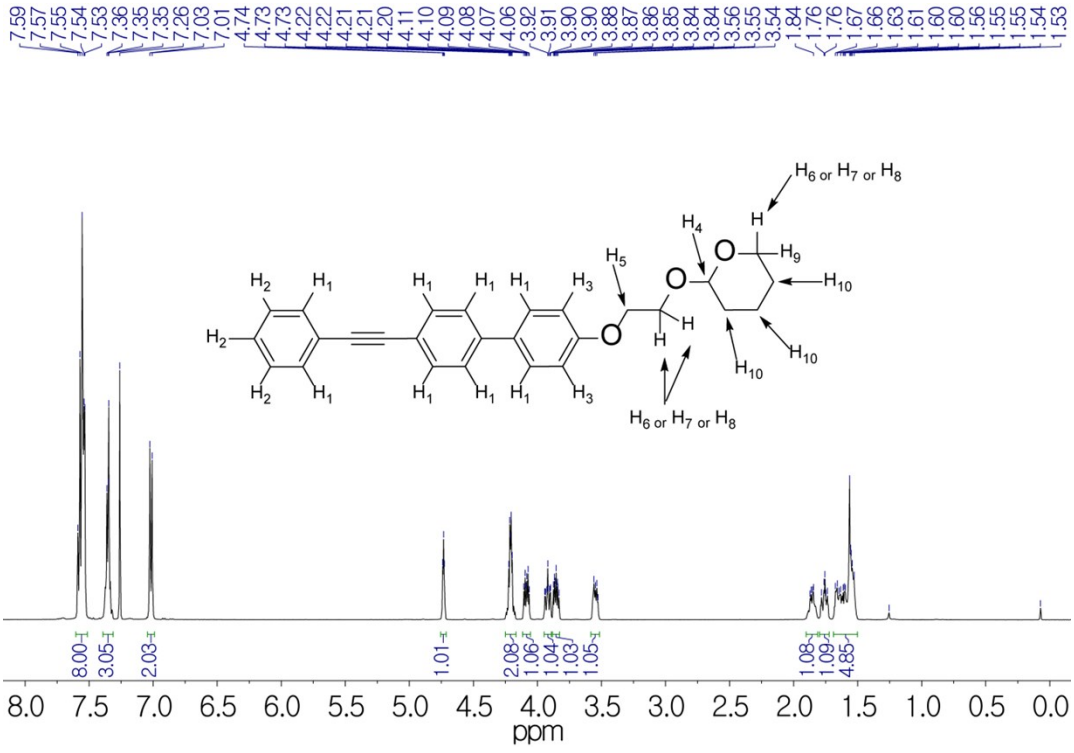


Fig. S2-1. ^{1}H NMR ($CDCl_3$) of 2-(2-(4'-(phenylethynyl)biphenyl-4-yloxy)ethoxy)-tetrahydro-2H-pyran, compound 2.

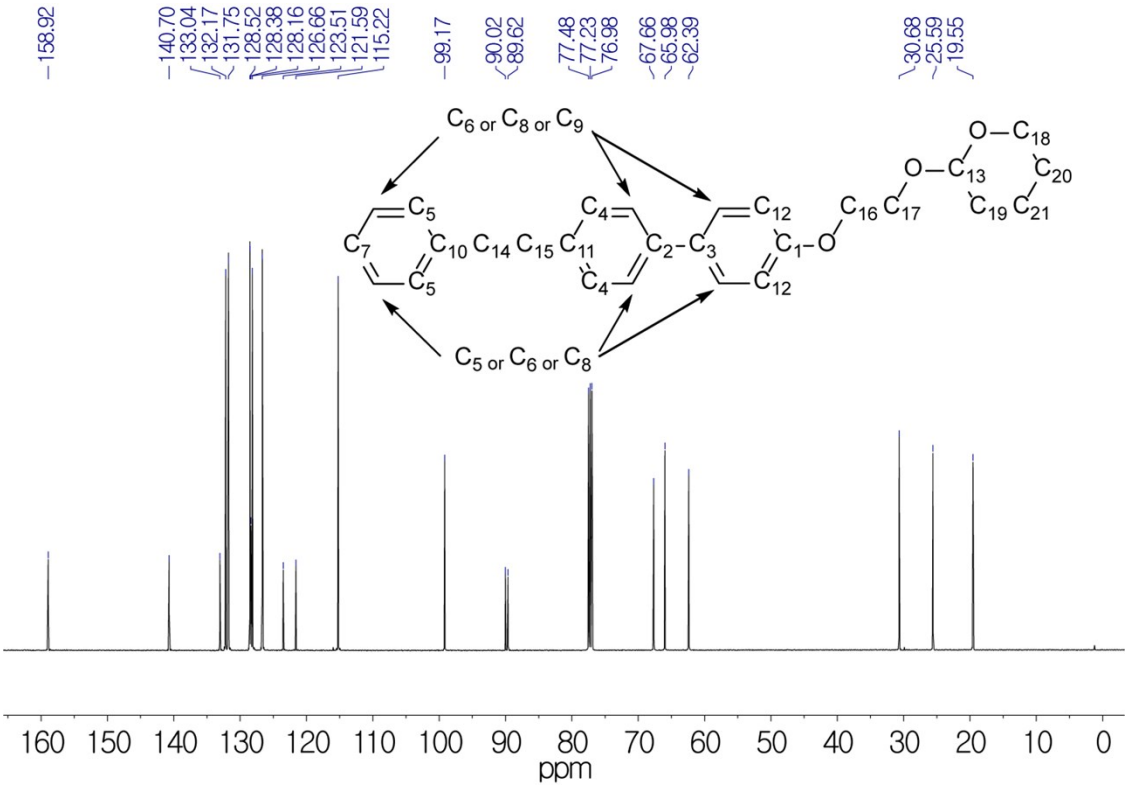


Fig. S2-2. ^{13}C NMR ($CDCl_3$) of 2-(2-(4'-(phenylethynyl)biphenyl-4-yloxy)ethoxy)-tetrahydro-2H-pyran, compound 2.

S3. Synthesis of 2,3,4,5-tetraphenyl-2,4-cyclopentadien-1-one, compound 3.

Compound **3** was prepared using the methods reported by Johnson and Grummitt.[i] 1,3-Diphenylacetone (21.0 g, 100 mmol), benzil (21.0 g, 100 mmol), and 150 mL of 95% ethanol, were added to a 500 mL round bottom flask with a Teflon-coated magnetic stir bar, and the flask was fitted with a reflux condenser. The mixture was then stirred and heated to a gentle reflux. Potassium hydroxide (3.0 g, 53 mmol) in 15 mL of 95% ethanol is then added to the mixture. The mixture is refluxed for an additional 10 minutes, then cooled to 0 °C. A purple solid was collected by suction filtration and washed with 30 mL

95% ethanol for 3 times. The resultant solid was recrystallized from ethanol to obtain the **3** as a purple solid (31.8 g, 83 %).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.28 (m, 12H; H_1), 7.21 (t, 4H; H_2, J = 7.6 Hz), 6.97 (m, 4H; H_3).

^{13}C NMR (125 MHz, $CDCl_3$): δ 200.51 (C_1), 154.64 (C_2), 133.22 (C_3), 130.91 (C_4), 130.32 (C_5), 129.51 (C_6), 128.69 (C_7), 128.22 (C_8), 128.17 (C_9), 127.64 (C_{10}), 125.47 (C_{11}).

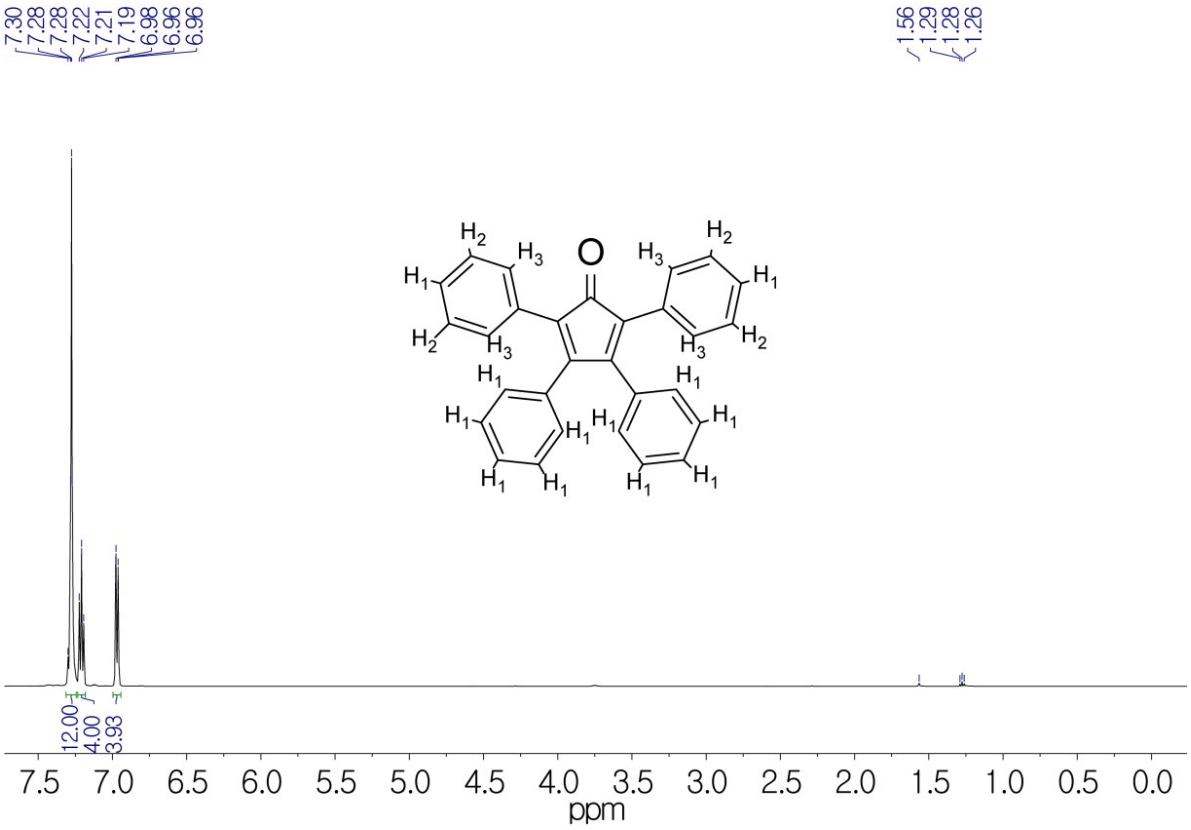


Fig. S3-1. ^{1}H NMR ($CDCl_3$) of 2,3,4,5-tetraphenyl-2,4-cyclopentadien-1-one, compound 3.

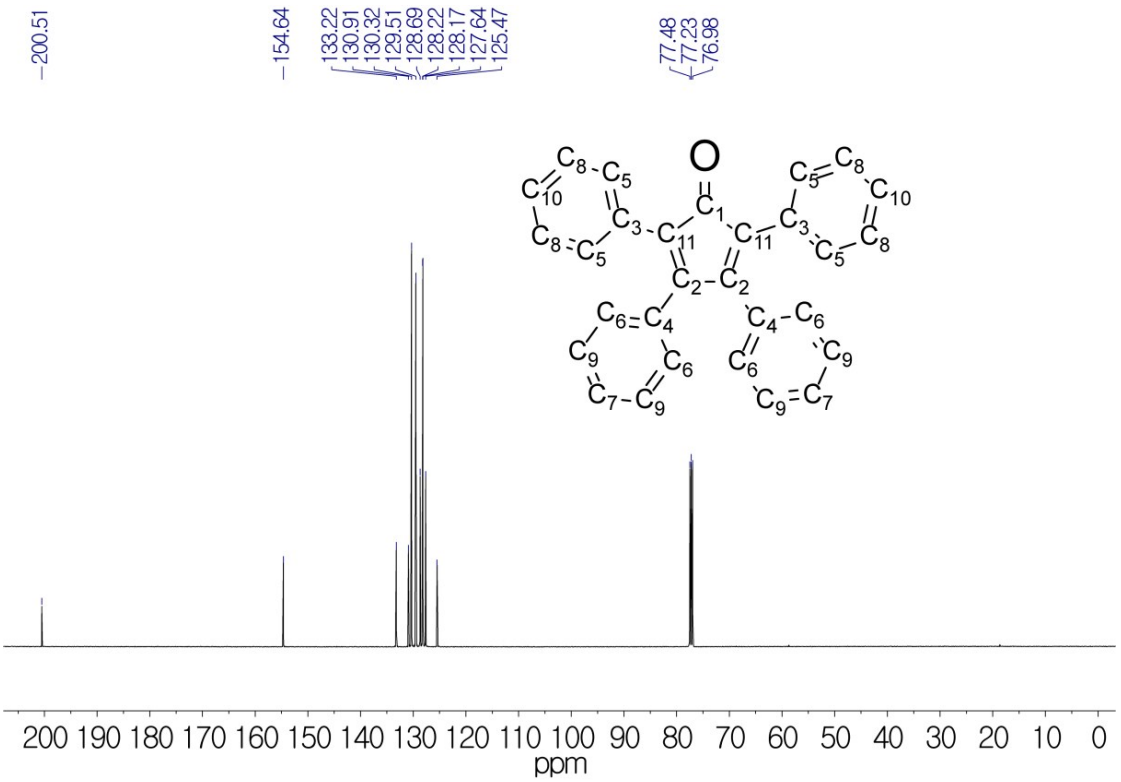


Fig. S3-2. ^{13}C NMR ($CDCl_3$) of 2,3,4,5-tetraphenyl-2,4-cyclopentadien-1-one, compound 3.

S4. Synthesis of 2-[(4'-{2,4,5,6-tetraphenyl-[1,1'-biphenyl]-3-yl}-[1,1'-biphenyl]-4-yl)oxy]-1-ethanol, compound 4.

Compound **4** was prepared using a procedure modified from that of Fieser.[ii] Compound **2** (0.1g, 0.25 mmol) and compound **3** (0.1 g, 0.26 mmol) were added to a 100 mL pyrex glass tube (OD: 3.4 cm, length: 24 cm). A Pasteur pipette connected to a source of argon was placed at the center of the reaction tube with the tip of the pipette placed around the middle of the tube. The 100 mL glass tube was set to place in an sand bath and the contents of the tube were heated for 1h at around 185~200 °C (note: all reagents were melted and starting bubbling, and the glass tube was left open during the entire reaction). The resulting mixture was allowed to cool to room temperature, and was purified by column chromatography on silica gel with hexane/ethyl acetate (5:5) to obtain **4** as a light yellow colored powder **4** (0.05 g, 33 %).

^{1}H NMR (500 MHz, $CDCl_3$): δ 7.39 (m, 2H; H_1), 7.11 (m, 2H; H_2), 6.87 (m, 29H; H_3), 4.08 (m, 2H; H_4,), 3.95 (s, br, 2H; H_5), 2.19 (s, 1H; H_6).

^{13}C NMR (125 MHz, $CDCl_3$): δ 158.00 (C_1), 140.77 (C_{2g}), 140.76 (C_{2g}), 140.55 (C_{2g}), 140.54 (C_{2g}), 140.12 (C_{2g}), 139.35 (C_{2g}), 136.96 (C_{2g}), 133.90 (C_9), 131.98 (C_{3g}), 131.59 (C_{3g}), 131.57 (C_{3g}), 127.91 (C_{3g}), 126.84 (C_{3g}), 126.76 (C_{3g}), 125.39 (C_{3g}), 125.36 (C_{3g}), 124.83 (C_{4g}), 114.80 (C_{19}), 69.40 (C_{20}), 61.60 (C_{21}).

^{13}C 135-DEPT NMR (100 MHz, $CDCl_3$): δ 131.87 (C_{3g}, -CH), 131.48 (C_{3g}, -CH), 131.46 (C_{3g}, -CH), 127.81 (C_{3g}, -CH), 126.72 (C_{3g}, -CH), 126.64 (C_{3g}, -CH), 125.27 (C_{3g}, -CH), 125.24 (C_{3g}, -CH), 124.71 (C_{3g}, -CH), 114.71 (C_{19}, -CH), -69.32 (C_{20}, $-CH_2$), -61.49 (C_{21}, $-CH_2$).

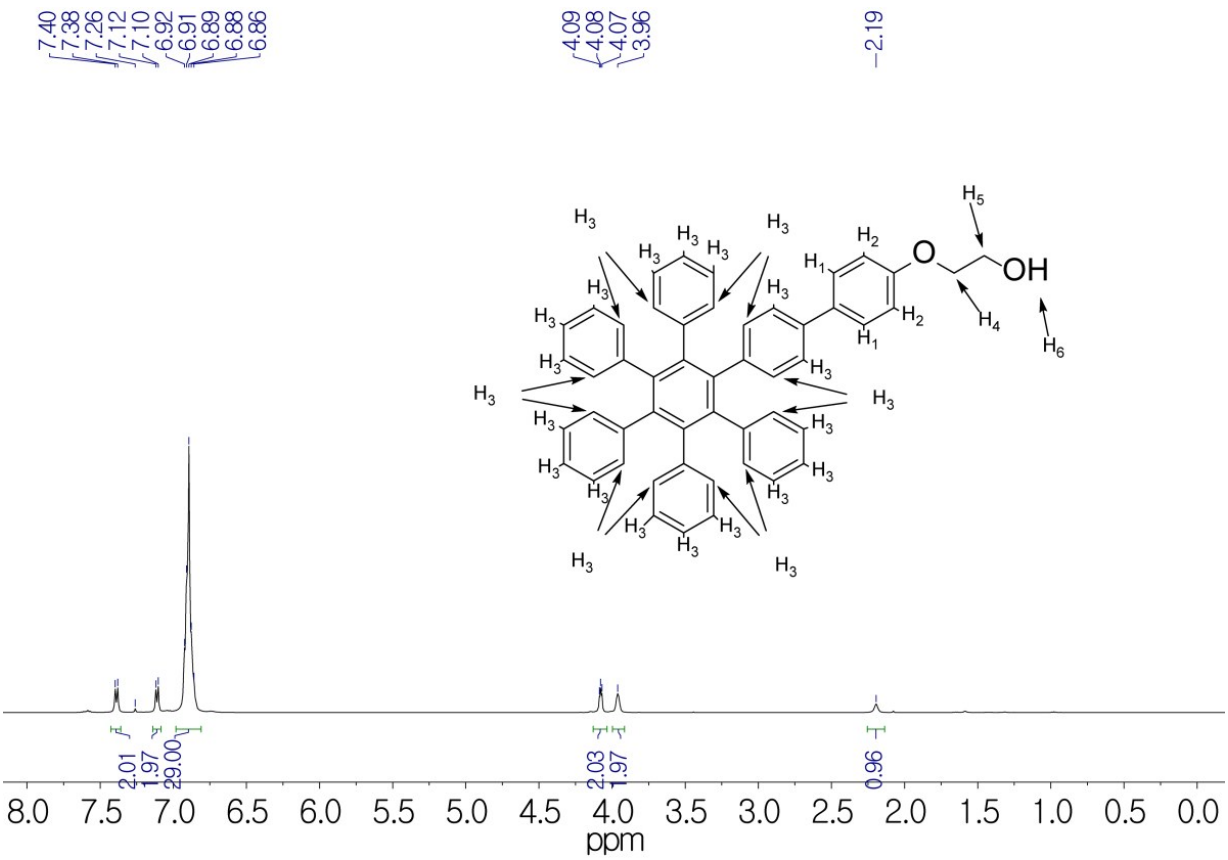


Fig. S4-1. ^{1}H NMR ($CDCl_3$) of 2-[(4'-{2,4,5,6-tetraphenyl-[1,1'-biphenyl]-3-yl}-[1,1'-biphenyl]-4-yl)oxy]-1-ethanol, compound 4.

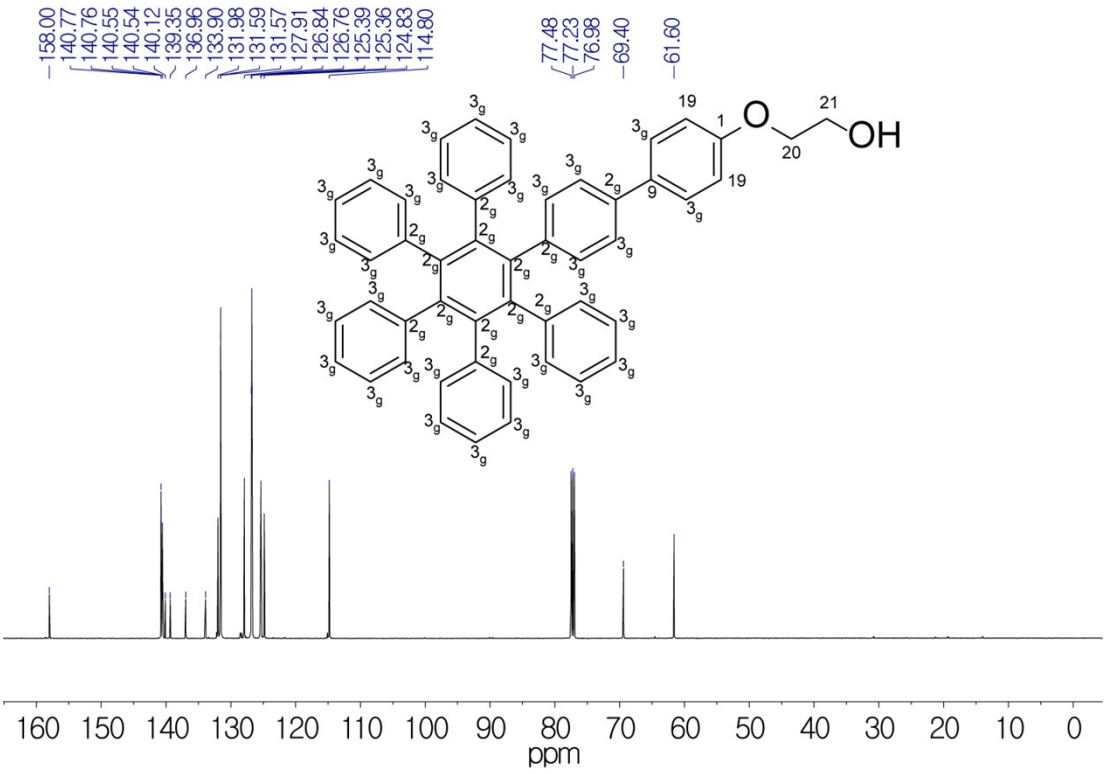


Fig. S4-2. ^{13}C NMR ($CDCl_3$) of 2-[(4'-{2,4,5,6-tetraphenyl-[1,1'-biphenyl]-3-yl}-[1,1'-biphenyl]-4-yl)oxy]-1-ethanol, compound 4.

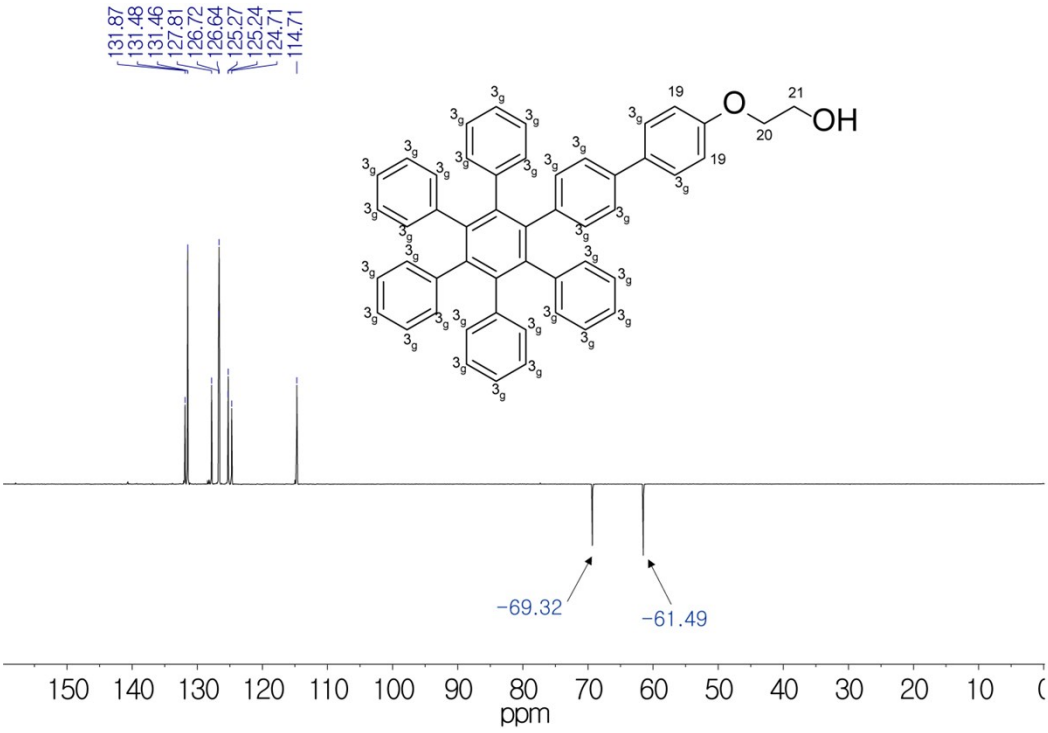


Fig. S4-3. ^{13}C 135-DEPT NMR ($CDCl_3$) of 2-[(4'-{2,4,5,6-tetraphenyl-[1,1'-biphenyl]-3-yl}-[1,1'-biphenyl]-4-yl)oxy]-1-ethanol, compound 4.

S5. Synthesis of 2-[(4'-{3,4,5,6-tetraphenyl-[1,1'-biphenyl]-2-yl}-[1,1'-biphenyl]-4-yl)oxy]ethyl 2-bromo-2-methylpropanoate, compound 5.

A solution of **4** (0.37 g, 0.55 mmol), triethylamine (0.36 mL, 2.6 mmol) in anhydrous DCM (33 mL) was slowly added to 2-bromo-2-methylpropionyl bromide (0.32 mL, 2.6 mmol) in a 200 mL Schlenk flask placed in an ice bath. The reaction mixture was stirred on the ice bath for 30 min and then for 16 h at room temperature. The reaction mixture was filtered, and the filtrate was washed with 0.1% HCl solution (50 mL × 2), saturated $NaHCO_3$ solution, distilled water, brine, and dried over Na_2SO_4. The solvent was then removed under reduced pressure and the resulting mixture was purified by column chromatography on silica gel with Hexane/DCM (2:1) to obtain **5** as a light yellow colored powder (0.43 g, 93 %).

^1H NMR (500 MHz, $CDCl_3$): δ 7.39 (dd, 2H; H_1, J = 6.6, 2.1 Hz), 7.10 (dd, 2H; H_2, J = 6.5, 1.8 Hz), 6.87 (m, 29H; H_3), 4.53 (m, 2H; H_4), 4.20 (m, 2H; H_5), 1.94 (s, 6H; H_6).

^{13}C NMR (125 MHz, $CDCl_3$): δ 171.82 (C_1), 157.87 (C_2), 140.78 (C_{3g}), 140.77 (C_{3g}), 140.56 (C_{3g}), 140.54 (C_{3g}), 140.12 (C_{4g}), 139.39 (C_{4g}), 136.94 (C_{4g}), 134.09 (C_{10}), 131.99 (C_{5g}), 131.60 (C_{5g}), 131.58 (C_{5g}), 127.93 (C_{5g}), 126.84 (C_{5g}), 126.77 (C_{5g}), 125.39 (C_{5g}), 125.37 (C_{5g}), 124.85 (C_{5g}), 115.01 (C_{20}), 65.88 (C_{21}), 64.33 (C_{22}), 55.69 (C_{23}), 30.90 (C_{24}).

ESI-HR: 843.2281, 843.2259 (calculated m/z: $M+Na^+$, 843.2281; found m/z: $M+Na^+$, 843.2259).

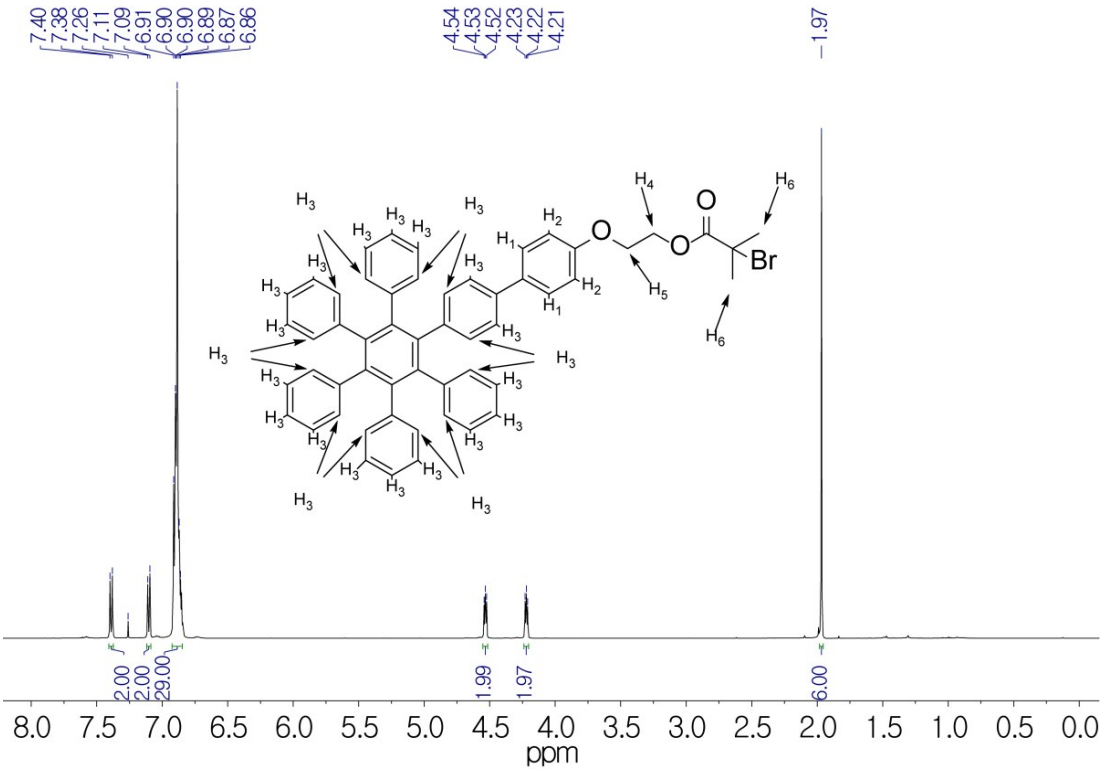


Fig. S5-1. ^{1}H NMR ($CDCl_3$) of HPB functionalized with ATRP initiator, compound 5.

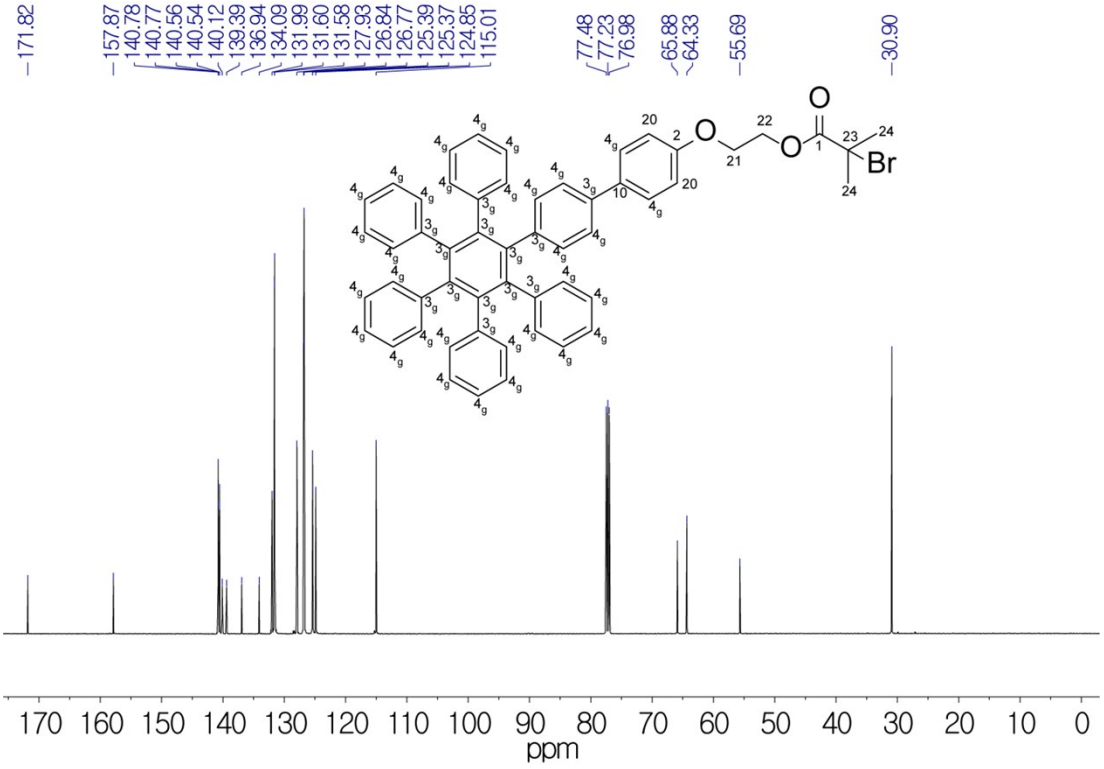


Fig. S5-2. ^{13}C NMR ($CDCl_3$) of HPB functionalized with ATRP initiator, compound 5.

Fig. S5-3. ESI-Mass of HPB functionalized with ATRP initiator, compound 5.

S6. Synthesis of HPB functionalized with PMMA (HPB-PMMA), compound 6.

A 200 mL Schlenk flask containing **5** (43 mg, 0.0524 mmol), and Cu wire (0.32g) was degassed (for 3 times) by freeze-pump-thaw method. The contents of the flask was then stirred for 30 min until all chemicals were dissolved after adding DMSO (degassed, 2.6mL) and MMA (degassed, 2.6mL, 24.38 mmol) by syringe. After dropping of Me_6TREN (0.035mL from 0.1M solution in DMSO, 0.0035 mmol) by syringe, the contents of the flask was stirred for 35 min at room temperature. The reaction mixture was poured into methanol (600mL) to quench the reaction. The resulting precipitate was isolated by filtration, and washed with methanol for several times, and dried under reduced pressure to obtain **6** as a light brown powder (0.119 g, M_n: 15,067, M_w: 18,151, $Đ$: 1.20).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 (m; H_1), 7.05 (m; H_2), 6.83 (m; H_3), 4.36 (m; H_4), 4.13 (m; H_5), 3.58 (br, m; H_6), 1.91 (m, br; H_7), 1.80 (br; H_7), 1.69 (br; H_7), 1.20 (br; H_8) 1.01 (br; H_9), 0.82 (br; H_9).

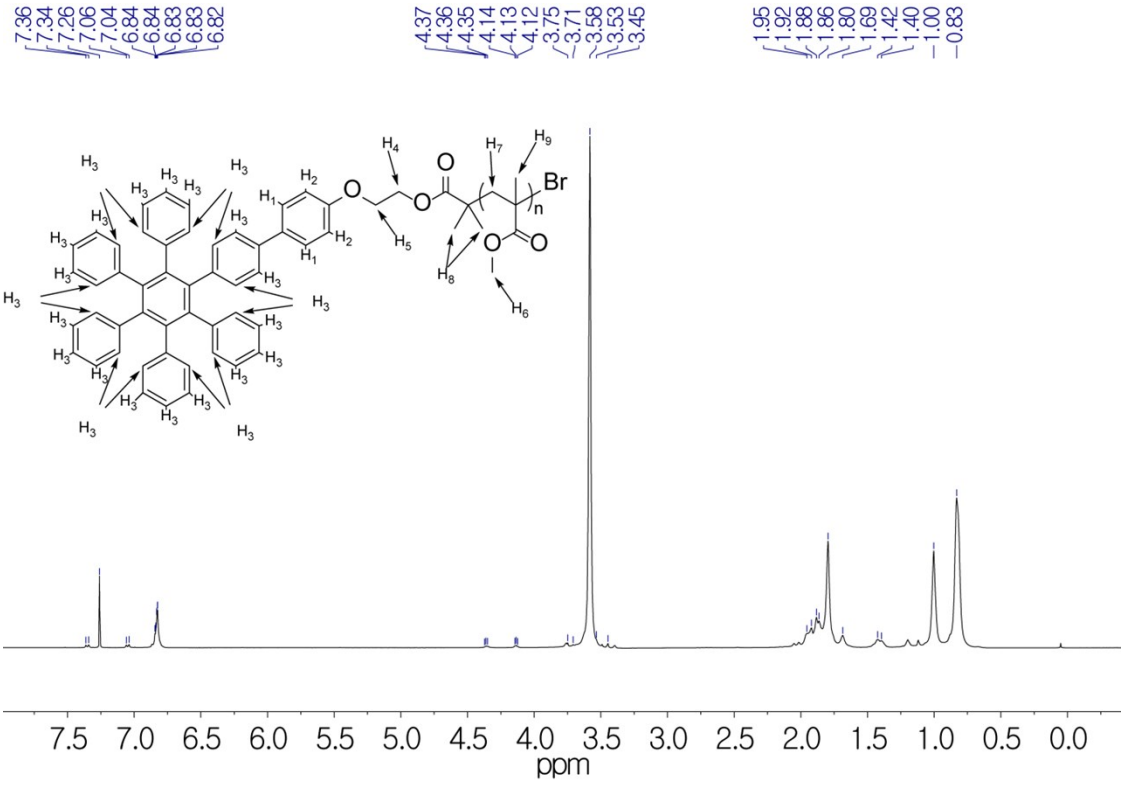


Fig. S6. ^{1}H NMR ($CDCl_3$) of HPB functionalized with PMMA (HPB-PMMA), compound 6.

S7. Synthesis of HBC functionalized with PMMA (HBC-PMMA), compound 7.

The Scholl oxidation of Compound **6** was carried out using a procedure slightly modified from the literature.[iii] Anhydrous $FeCl_3$ (0.22 g, 1.36 mmol) was dissolved nitromethane (1.94 mL) and this solution was slowly added to a solution of **6** (83 mg, ~ 0.0055 mmol) in anhydrous DCM (90 mL) in a 100 mL round bottom flask with argon bubbling through the solution using a glass capillary. An argon stream was bubbled through the reaction mixture for 2h. The reaction mixture was poured into methanol (500mL). The resulting brown precipitate was isolated by filtration, and washed with methanol for several times, and dried under reduced pressure to obtain **7** as a light brown powder (67 mg, M_n: 14,671, M_w: 20,403, $Đ$: 1.39).

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.29 (br; H_1), 7.82 (br; H_1), 3.59 (br; H_2), 1.89 (br, m; H_3), 1.81 (br; H_3), 1.60 (br; H_3), 1.01 (br; H_4), 0.84 (br; H_4).

^{1}H NMR (400 MHz, 1,1,2,2-Tetrachloroethane-d_2 (TCE), at room temperature): δ 8.76 (br; H_1), 7.90 (br; H_1), 7.31 (br), 3.61 (br, m; H_2), 1.81 (br; H_3), 1.43 (br; H_3), 1.19 (br), 1.00 (br, s; H_4), 0.82 (br, s; H_4).

^{13}C NMR (125 MHz, $CDCl_3$): δ 176.98 ~ 178.39 (C_1), 120.61 ~ 129.0 (C_2), 54.19 ~ 54.42 (C_3), 51.77 ~ 51.83 (C_4), 44.55 ~ 44.90 (C_5), 18.72 (C_6), 16.48 (C_6).

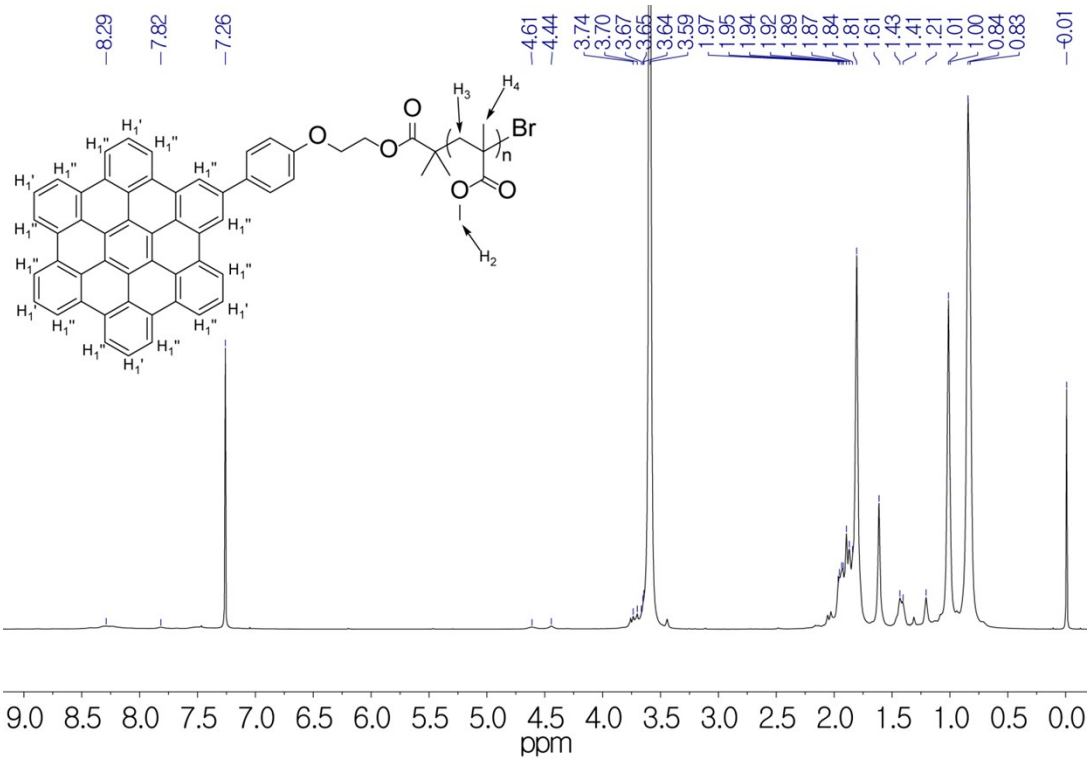


Fig. S7-1. ^{1}H NMR ($CDCl_3$) of HBC functionalized with PMMA (HBC-PMMA), compound 7.

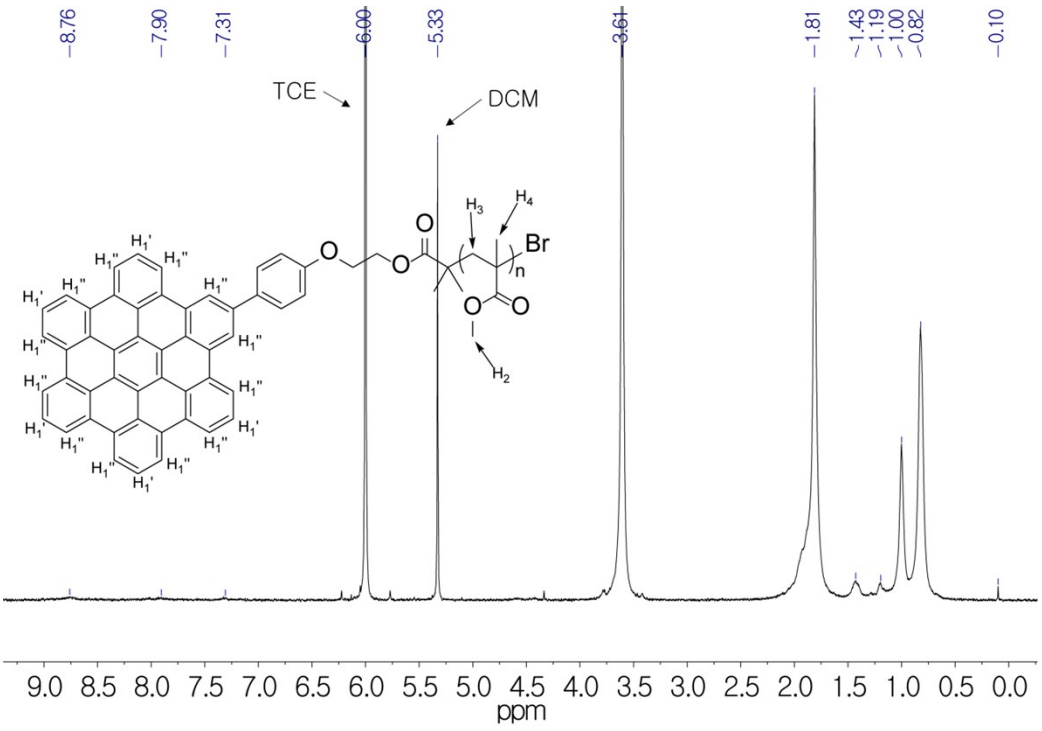


Fig. S7-2. Variable temperature ^{1}H NMR (d-TCE) spectra of HBC functionalized with PMMA (HBC-PMMA).

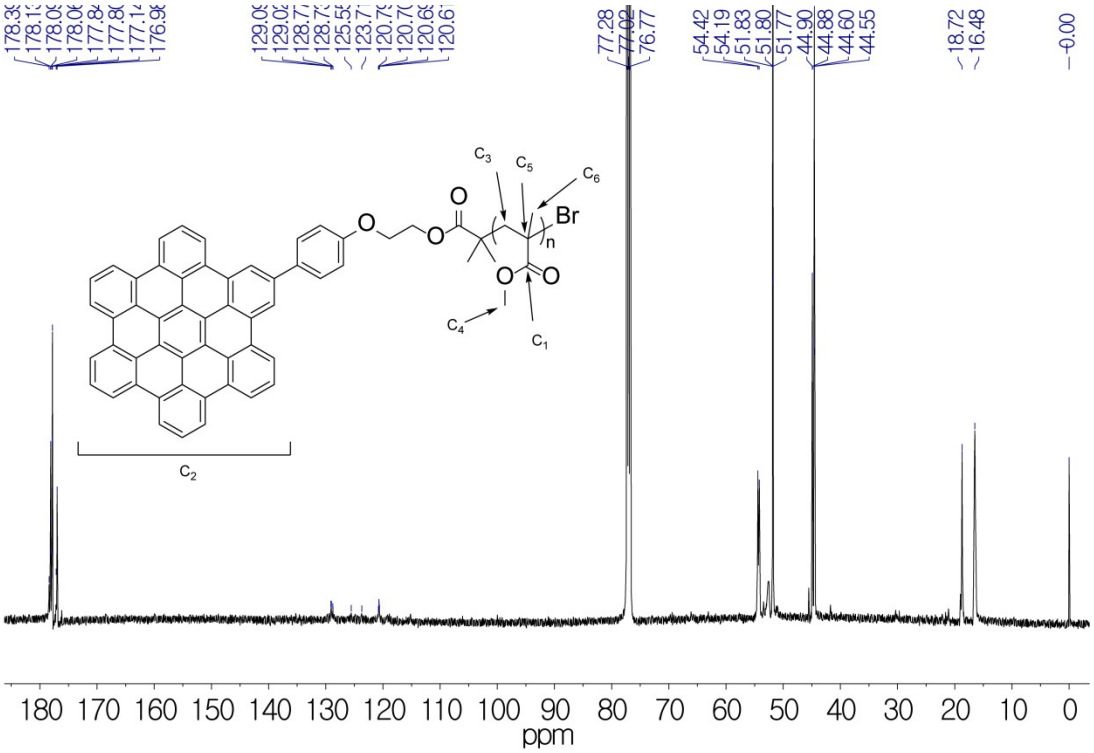


Fig. S7-3. ^{13}C NMR ($CDCl_3$) of HBC functionalized with PMMA (HBC-PMMA), compound 7.

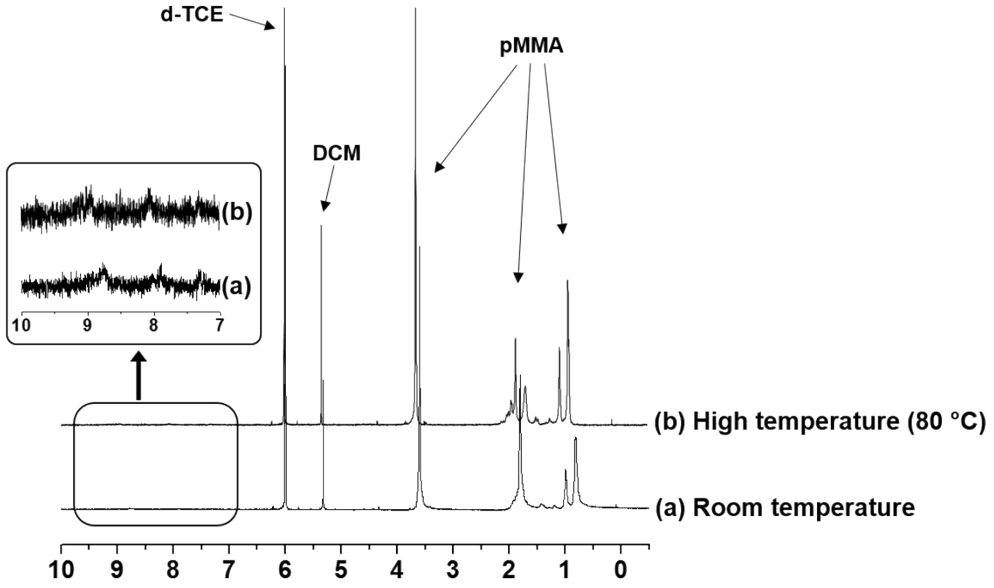


Fig. S7-4. Variable temperature ^1H NMR (d-TCE) spectra of HBC functionalized with PMMA (HBC-PMMA) in (a) room temperature, (b) high temperature.

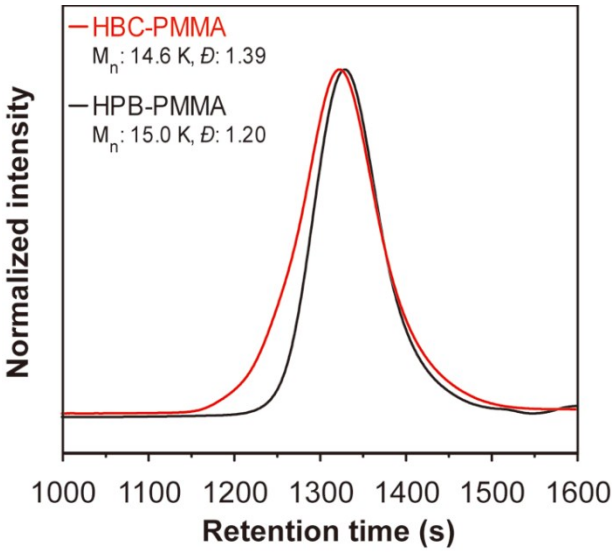


Fig. S7-5. Normalized GPC curves of HPB-PMMA (compound 6) and HBC-PMMA (compound 7).

S8. Synthesis of 4-(pyren-1-yl)butyl 2-bromo-2-methylpropanoate, compound 8.

A solution of 1-pyrenebutanol (0.446 g, 1.625 mmol), triethylamine (1.14 mL, 8.11 mmol) in anhydrous DCM (17 mL) was slowly added to 2-bromo-2-methylpropionyl bromide (0.41 mL, 3.317 mmol) in a 200 mL Schlenk flask placed in an ice bath. The reaction mixture was then stirred on the ice bath for 30 min and then for 2 h at room temperature. The reaction mixture was washed with distilled water, extracted with DCM, and dried over Na_2SO_4. The solvent was removed under reduced pressure and the resulting mixture was purified by column chromatography on silica gel with hexane/DCM (5:1) to obtain **8** as a white powder (0.61 g, 88 %).

^{1}H NMR (500 MHz, $CDCl_3$): δ 8.27 (d, 1H; H_1, J = 9.2 Hz), 8.18 (m, 2H; H_2), 8.11 (m, 2H; H_3), 8.03 (m, 3H; H_4), 7.87 (d, 1H; H_5, J = 7.7 Hz), 4.28 (t, 2H; H_6, J = 6.4 Hz), 3.39 (t, 2H; H_7, J = 7.7 Hz), 2.00 (m, 2H; H_8), 1.96 (s, 6H; H_9), 1.89 (m, 2H; H_{10}).

^{13}C NMR (125 MHz, $CDCl_3$): δ 171.90 (C_1), 136.38 (C_2), 131.59 (C_{3g}), 131.05 (C_{3g}), 130.05 (C_{3g}), 128.77 (C_{3g}), 127.66 (C_{4g}), 127.46 (C_{4g}), 127.36 (C_{4g}), 126.82 (C_{4g}), 125.99 (C_{4g}), 125.26 (C_{5g}), 125.18 (C_{5g}), 125.07 (C_{4g}), 124.98 (C_{4g}), 124.90 (C_{4g}), 123.45 (C_{4g}), 65.94 (C_{18}), 56.15 (C_{19}), 33.17 (C_{20}), 30.95 (C_{21}), 28.58 (C_{22}), 28.13 (C_{23}).

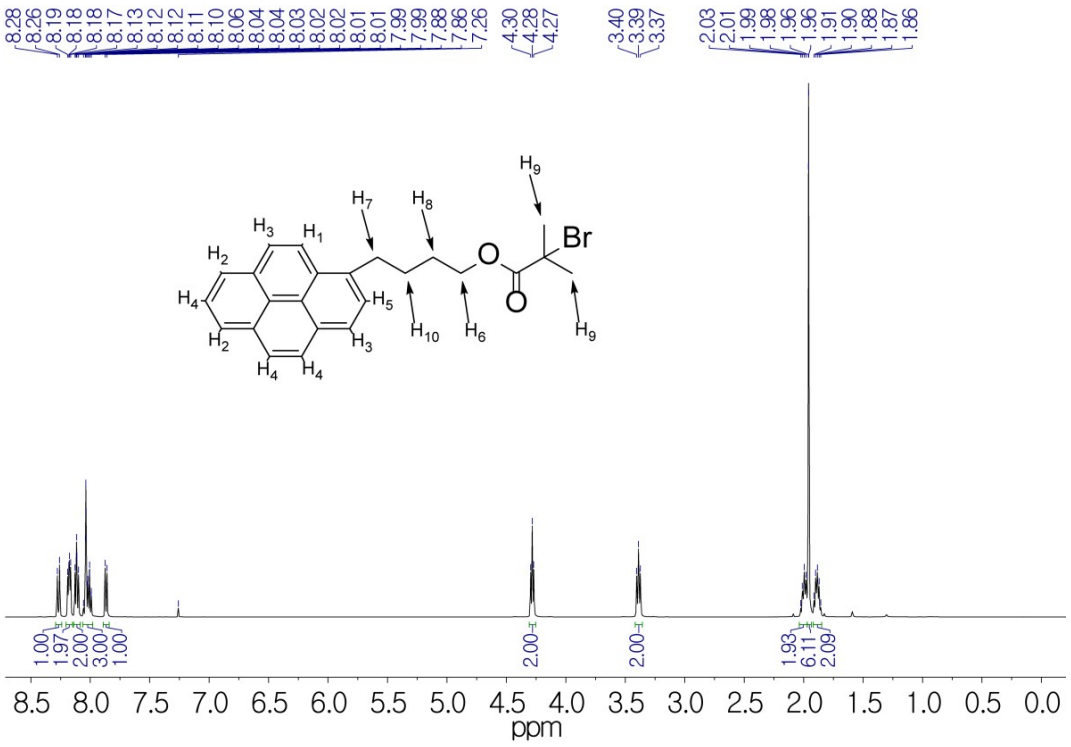


Fig. S8-1. ^{1}H NMR ($CDCl_3$) of 4-(pyren-1-yl)butyl 2-bromo-2-methylpropanoate, compound 8.

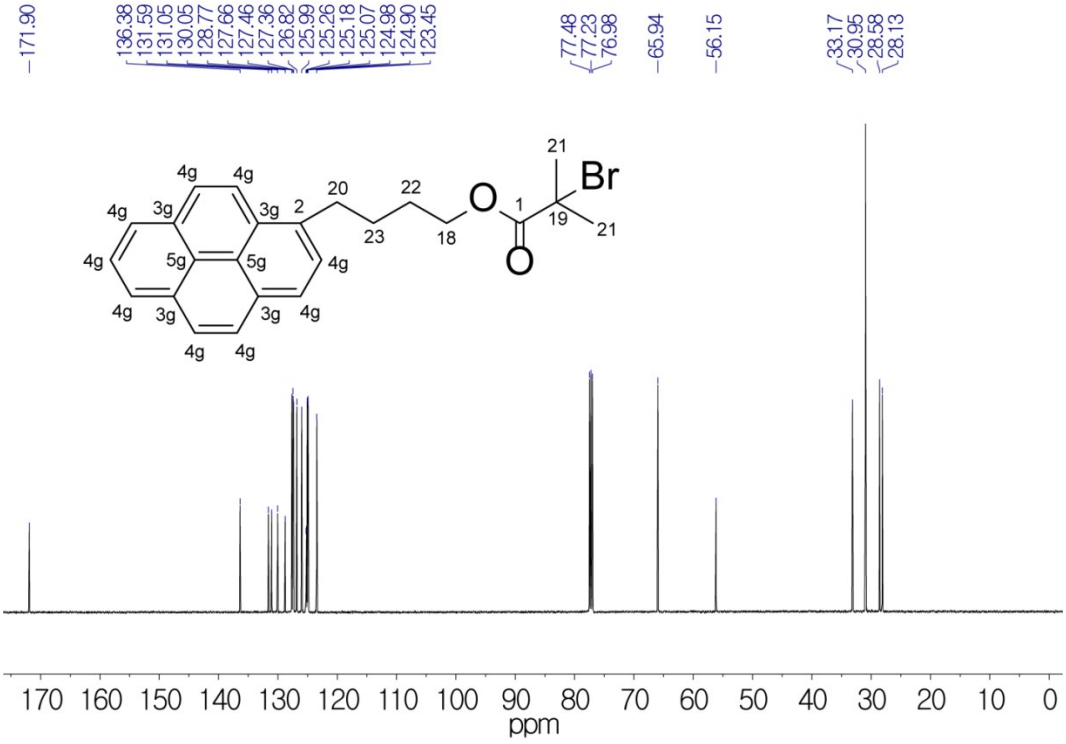


Fig. S8-2. ^{13}C NMR ($CDCl_3$) of 4-(pyren-1-yl)butyl 2-bromo-2-methylpropanoate, compound 8.

S9. Synthesis of pyrene functionalized with PMMA (pyrene-PMMA), compound 9.

A 200 mL Schlenk flask charged with **8** (42 mg, 0.099 mmol), and Cu wire (0.63g) was degassed (for 3 times) by freeze-pump-thaw method. The contents of the flask was stirred for 10 min until all chemicals were dissolved after adding DMF (degassed, 4.5 mL) and MMA (degassed, 4.5 mL, 42.25 mmol) by syringe. After dropping of Me_6TREN (0.05mL from 0.1M solution in DMSO, 0.005 mmol) by syringe, the contents of flask was stirred for 45 min at room temperature. The reaction mixture was poured into methanol (600 mL) to quench the reaction. The resulting precipitate was isolated by filtration, and washed with methanol for several times, and dried under reduced pressure to obtain **8** as a white powder (0.176 g, M_n: 12,772, M_w: 15,090, $Đ$: 1.18).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.26 (d; H_1, J = 9.3 Hz), 8.17 (m; H_2), 8.10 (m; H_3), 8.02 (m; H_4), 7.87 (m; H_5), 3.58 (s, br; H_6), 1.90 (m; H_7), 1.69 (s; H_7), 1.00 (s; H_8), 0.83 (s; H_8).

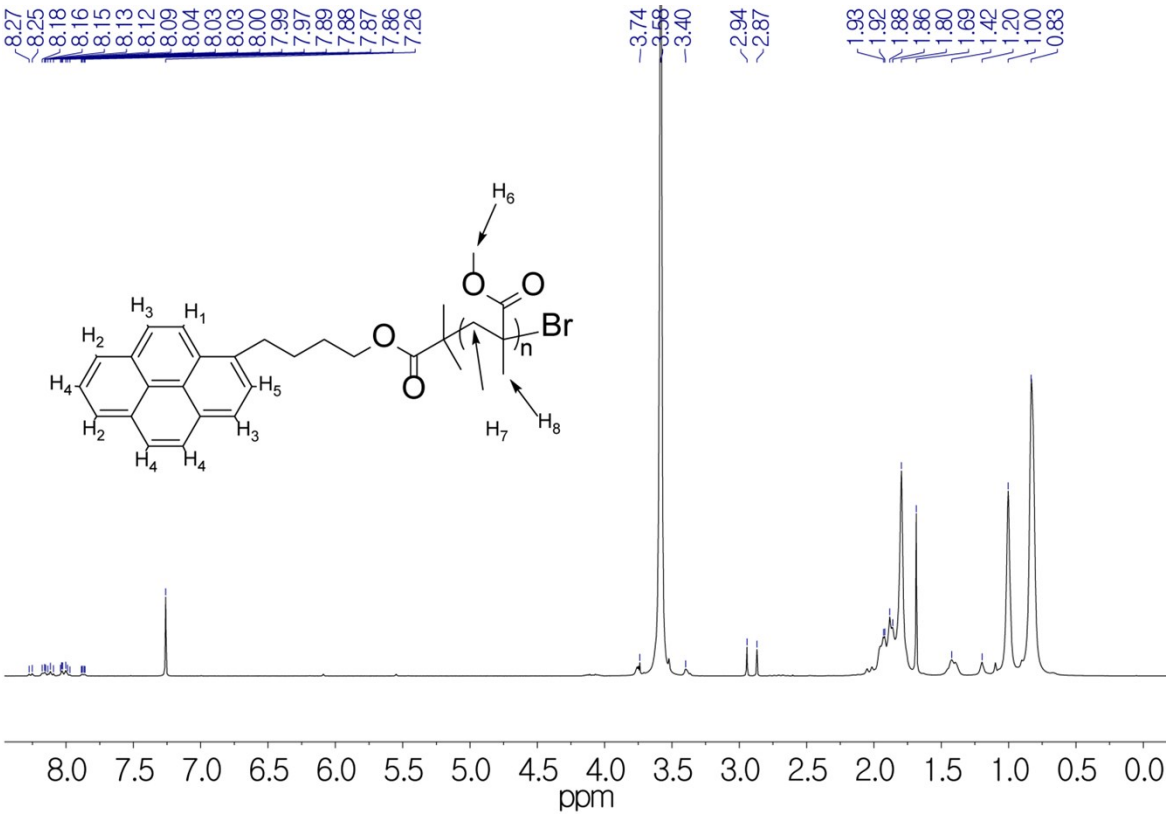


Fig. S9-1. ^{1}H NMR ($CDCl_3$) of pyrene functionalized with PMMA (pyrene-PMMA), compound 9.

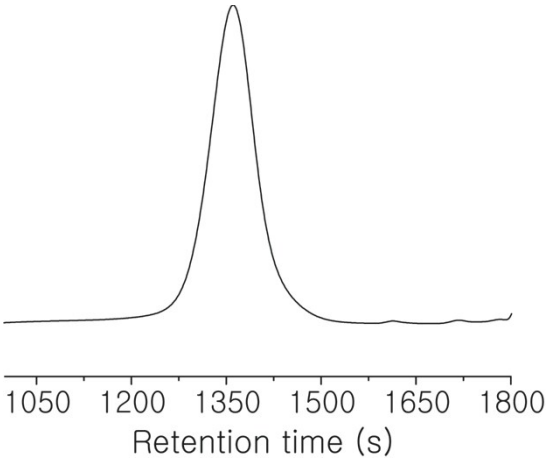


Fig. S9-2. THF GPC curve of pyrene functionalized with PMMA (pyrene-PMMA), compound 9.

UV-Vis absorption spectra

S10. UV-vis absorption spectra of PMMA and HPB terminated alcohol (compound 4) in chloroform.

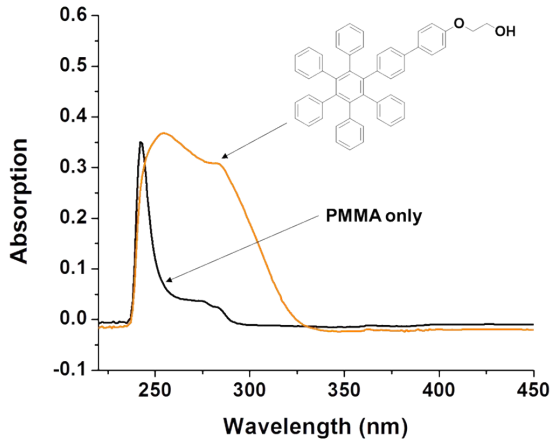


Fig. S10. UV-vis absorption spectra of PMMA and HPB terminated alcohol in chloroform, compound 4.

S11. UV-vis absorption spectra of dispersion of MWCNTs in the different concentration ratio of MWCNTs and HBC-PMMA at 550 nm

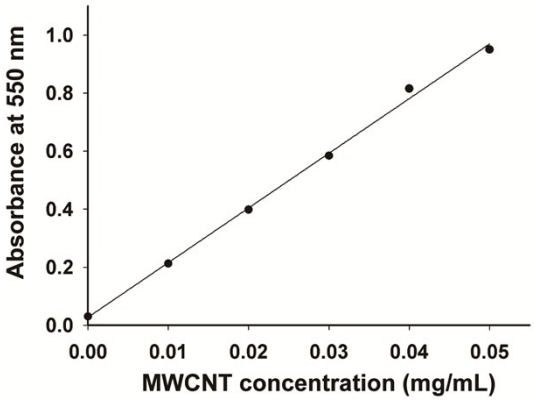


Fig. S11. UV-vis absorption spectra of dispersion of MWCNTs with HBC-PMMA by increasing the concentration of MWCNTs at the same concentration of HBC-PMMA (0.05 mg/mL) in acetone.

Dispersion test of MWCNTs

S12. Dispersion test of MWCNTs in toluene dissolved in HBC-PMMA.

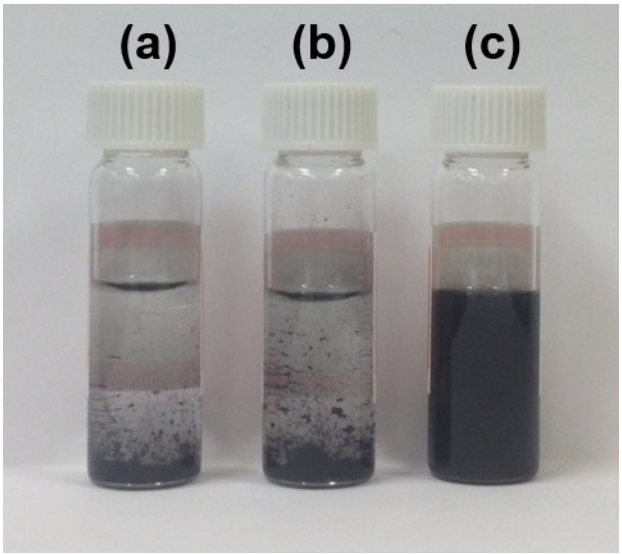
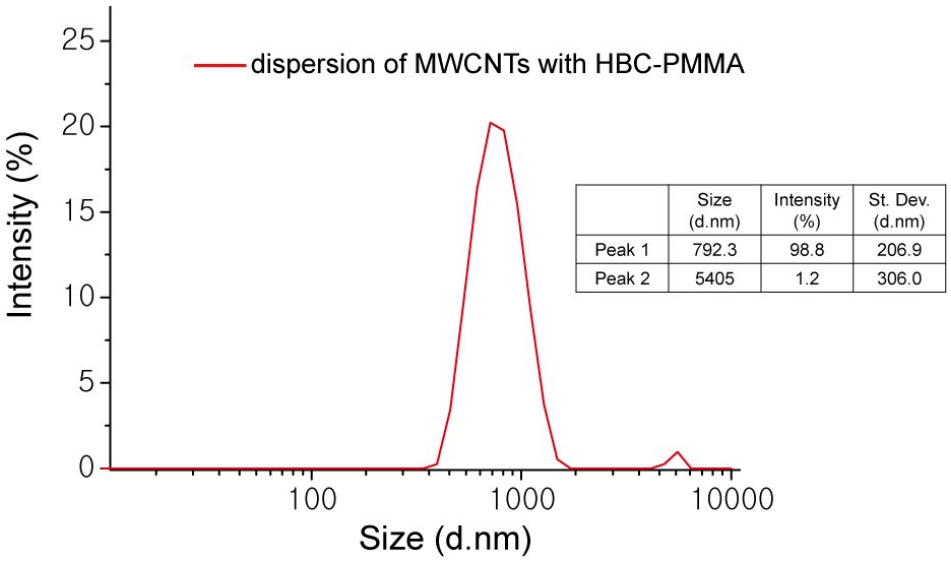


Fig. S12. MWCNTs dispersion test of a) MWCNTs (0.1 mg/mL) in toluene, b) MWCNTs (0.1 mg/mL) with PMMA (1 mg/mL) in toluene, and c) MWCNTs (0.1 mg/mL) with HBC-PMMA (0.1 mg/mL) in toluene.

DLS and zeta potential data of dispersion of MWCNTs with HBC-PMMA

DLS and zeta potential experiments were performed on a Malvern NanoZS Zetasizer using a plastic cuvette in ethanol and water (8:2, v/v). Solution of HBC-PMMA in ethanol and water was prepared by heating for 10 min at 60 °C to dissolve it. We chose this solvent instead of acetone because the cuvettes were sensitive to organic solvents. The MWCNT dispersion with HBC-PMMA was prepared by sonication in an ultrasonic bath for 1min. The temperature (for DLS and zeta potential operation) was maintained at 20 °C throughout the experiment.

S13. Dynamic light scattering (DLS) curve of dispersion of MWCNTs with HBC-PMMA.



	Size (d.nm)	Intensity (%)	St. Dev. (d.nm)
Peak 1	792.3	98.8	206.9
Peak 2	5405	1.2	306.0

Fig. S13. DLS curve of size distribution of dispersion of MWCNTs (0.1 mg/mL) with HBC-PMMA (0.1 mg/mL) in ethanol and water (8:2 volume ratio) at 20 °C.

S14. Zeta potential curve of dispersion of MWCNTs with HBC-PMMA.

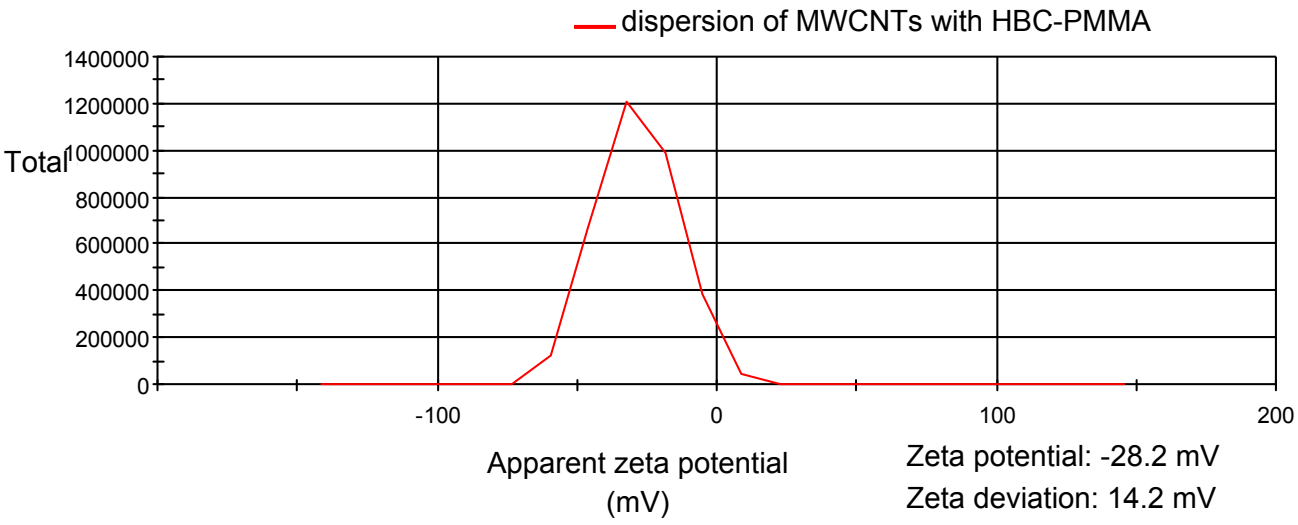


Fig. S14. Zeta potential distribution curve of dispersion of MWCNTs (0.1 mg/mL) with HBC-PMMA (0.1 mg/mL) in ethanol and water (8:2 v/v) at 20 °C.

Histogram of SEM image

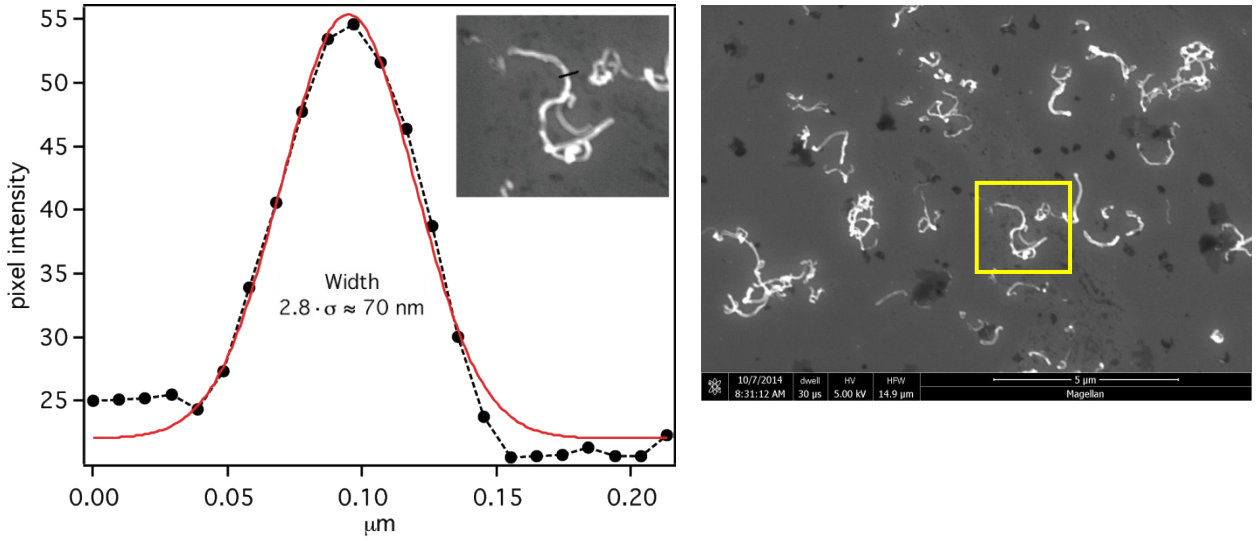


Fig. S15. Histogram of SEM image of air dried sample on silicon wafer after the drop of solution of MWCNTs (0.09 mg/mL) with HBC-PMMA (0.09 mg/mL) in acetone

TEM images of dispersion of MWCNT

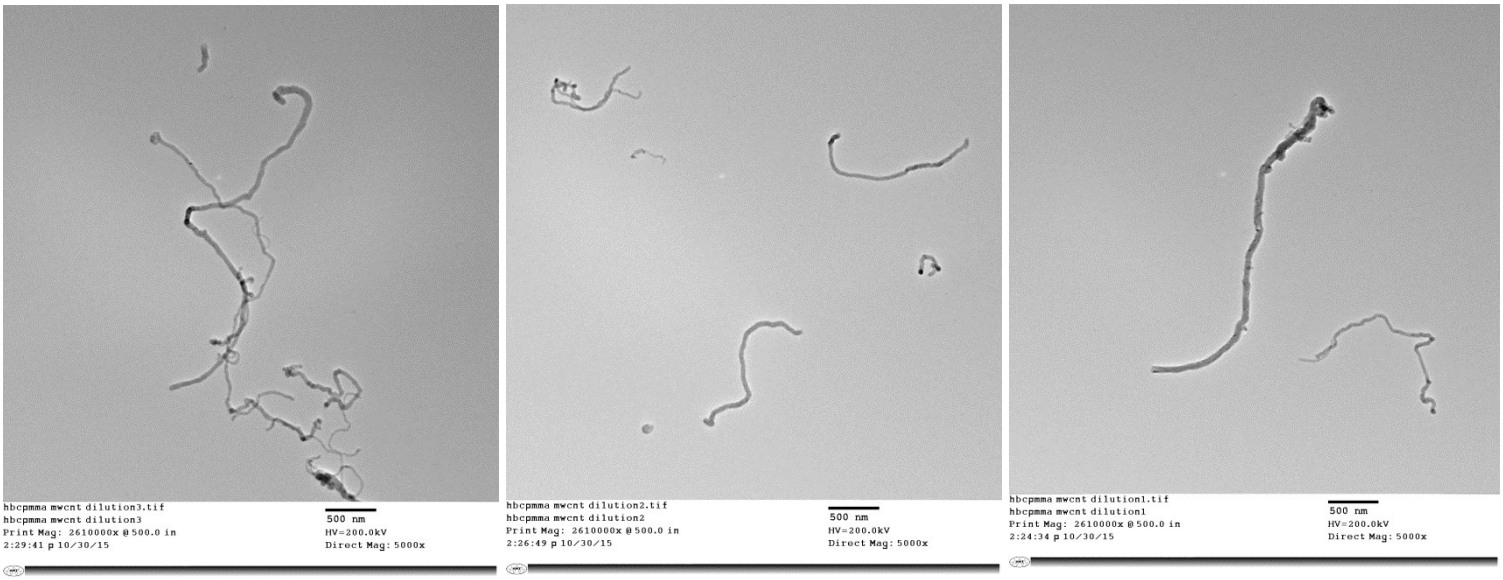


Fig. S16. SEM image of air dried sample on TEM Cu grid after the drop of solution of MWCNTs (0.01 mg/mL) with HBC-PMMA (0.05 mg/mL) in acetone.

[i] J. R. Johnson, O. Grummit, *Org. Synth.*, 1943, **23**, 92
[ii] L. F. Fieser, *Org. Synth.*, 1966, **46**, 44
[iii] Y. Lu, J. S. Moore, *Tetrahedron Lett.*, 2009, **50**, 4071-4077