Electronic supplementary information for Journal of Materials Chemistry

Nano-hybrid luminescent dot: synthesis, characterization and optical properties

1 Monomer synthesis

1-Bromo-4-[2-ethylhexyloxy]-p-xylene (1a)[17]. A colorless liquid was prepared according to the literature by reaction between 2-Ethylhexyl bromide with 2,5-dimethyl-phenol with NaOH in acetone (yield 90%), followed by brominating at 0-10°C in $CHCl_3$ (yield 98%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.231 (s, 1H), 6.663 (s, 1H), 3.803 (d, 2H), 2.332 (s, 3H), 2.146 (s, 3H), 1.730 (m, 1H), 1.545(m, 8H), 0.923(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 157.903, 136.865, 135.683, 134.076, 127.650, 115.658, 115.369, 113.815. MS (EI, *m/z*): 313.2. Calculate (%) C, 61.34, H, 7.99; Found (%) C, 61.29, H, 8.02.

4-Bromo-4'-[2-ethylhexyloxy]-2',5'-dimethyl-biphenyl (2a). A Grignard reagent of 4-[2-ethylhexyloxy]p-xylene-1-magnesium bromide (31.95mmol) prepared from the reaction of 10g (31,95mmol) of 1-bromo-4-[2-ethylhexyloxy]p-xylene (**1a**) with 0.92g (38.34mmol) of Mg in 80ml of dry THF, was added dropwise into a solution of 1,4-dibromo-benzene (6.28g, 26.62mmol) in 40ml of dry THF containing $Pd(PPh_3)_4$ (0.6mmol) as catalyst over a period of 1 hour. After refluxing for 24 hours, the reaction mixture was quenched with saturated NH_4Cl aqueous solution and extracted with ether. The extract was washed with water two times and with brine once and then dried over anhydrous MgSO4. After removal of solvent, the dark-brown liquid of mixture was subjected to purification by column chromatography on silica gel using hexane as eluant. A 8.45g (yield 68%) of colorless liquid was obtained. ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.556 (d, 2H), 7.224 (d, 2H), 7.021(s, 1H), 6.761(s, 1H), 3.936(d, 2H), 2.283 (s, 3H), 2.263 (s, 3H), 1.822 (m, 1H), 1.547(m, 8H), 1.004(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 158.252, 142.273, 134.798, 133.986, 133.611, 133.326, 132.435, 131.695, 125.669, 121.962, 121.845, 121.733, 114.823, 113.283. MS (EI, *m/z*): 389.1. Calculate (%) C, 67.87, H, 7.46; Found (%) C, 67.80, H, 7.49.

4-Bromo-4''-[2-ethylhexyloxy]-2'',5''-dimethyl-triphenyl (3a). A white crystalline was obtained following a similar method of obtaining **2a** using 4,4'-Dibromobiphenyl to replace 1,4-dibromo-benzene (yield 51%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.615 (d, 4H), 7.545 (d, 2H), 7.421(d, 2H), 7.083(s, 1H), 6.770(s, 1H), 3.932(d, 2H), 2.233 (s, 3H), 2.262 (s, 3H), 1.811 (m, 1H), 1.553(m, 8H), 0.991(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 157.971, 142.731, 141.210, 139.150, 134.022, 132.527, 132.347, 132.108, 130.706, 130.532, 129.137, 128.582, 126.986, 125.512, 122.719, 114.752, 113.202. MS (EI, *m/z*): 466.3. Calculate (%) C, 72.26, H, 7.10; Found (%) C, 72.24, H, 7.13.

4-Bromo-2,5-dimethyl-4'-[2-ethylhexyl]-biphenyl (4a). A colorless liquid was synthesized following a similar method of obtaining **2a** using 2,5-Dibromo-p-xylene and 1-bromo-4-Ethylhexyl-benzene (yield 62%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.497 (s, 1H), 7.247 (d, 4H), 7.165(s, 1H), 2,651(d, 2H), 2.444 (s, 3H), 2.277 (s, 3H), 1.687 (m, 1H), 1.379(m, 8H), 0.973(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 142.512, 142.007, 139.467, 136.202, 135.847, 134.243, 132.689, 131.102, 130.867, 129.540, 129.294, 124.589. MS (EI, *m/z*): 372.1. Calculate (%) C, 70.78, H, 7.78; Found (%) C, 70.89, H, 7.82.

4-Bromo-2,5-dimethyl-4'-[2-ethylhexyloxy]-biphenyl (5a). A colorless liquid was obtained following a similar method of obtaining **2a** using 2,5-Dibromo-p-xylene and 1-bromo-4-Ethylhexyloxy-benzene (yield 59%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.556 (d, 2H), 7.223 (d, 2H), 7.020(s, 1H), 6.760(s, 1H), 3.936(d, 2H), 2.281 (s, 3H), 2.263 (s, 3H), 1.823 (m, 1H), 1.581(m, 8H), 1.004(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 159.922, 142.230, 136.210, 135.870, 134.317, 132.749, 132.219, 132.011, 130.582, 124.460, 116.327, 114.752. MS (EI, *m/z*): 388.1. Calculate (%) C, 67.87, H, 7.46; Found (%) C, 67.89, H, 7.45.

4-Bromo-2,5-dimethoxy-4'-[2-ethylhexyloxy]-biphenyl (6a). A colorless liquid was obtained following a similar method of obtaining **2a** using 1,4-dibromo-2,5-dimethoxy-benzene and 1-bromo-4-Ethylhexyloxy-benzene (yield 58%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.463 (d, 2H), 7.178 (s, 1H), 7.020(s, 1H), 6.986(d, 2H), 6.904(s, 1H), 3.902(s, 5H), 3.782(s, 3H), 1.816 (m, 1H), 1.463(m, 8H), 0.923(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 160.117, 152.154, 151.584, 132.564, 132.454, 131.828, 131.073, 130.950119.054, 117.443, 116.843, 116.322, 115.273, 114.739, 111.136. MS (EI, *m/z*): 420.2. Calculate (%) C, 62.71, H, 6.89; Found (%) C, 62.78, H, 6.90.

2 Organic chain synthesis (for comparison with hybrid dots)

4-[2-ethylhexyloxy]-2,5-dimethyl-biphenyl (1c). A colorless liquid was obtained following a similar method of obtaining **2a** using Bromobenzene and **1a** (yield 72%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.484 (m, 2H), 7.412 (m, 3H), 7.135(s, 1H), 6.834(s, 1H), 3.995(d, 2H), 2.369 (s, 3H), 2.338 (s, 3H), 1.863 (m, 1H), 1.598(m, 8H), 1.063(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 158.076, 143.468, 135.039, 134.314, 132.767, 131.720, 130.405, 128.819, 126.963, 125.519,

114.797, 113.262. MS (EI, *m/z*): 310.1. Calculate (%) C, 85.16, H, 9.68; Found (%) C, 85.17, H, 9.68.

4-[2-ethylhexyloxy]-2,5-dimethyl-triphenyl (2c). A color-less liquid was obtained following a similar method of obtaining **2a** using Bromobenzene and **2a** (yield 67%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.804 (m, 4H), 7.575 (m, 4H), 7.505(t, 1H), 7.266(s, 1H), 6.936(s, 1H), 4.092(d, 2H), 2.502 (s, 3H), 2.442 (s, 3H), 1.945 (m, 1H), 1.720(m, 8H), 1.159(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 158.148, 142.442, 140.552, 135.010, 134.536, 134.307, 132.765, 132.122, 131.044, 130.542, 129.406, 129.291, 128.958, 127.722, 127.383, 125.616, 114.88, 113.358. MS (EI, *m/z*): 386.2. Calculate (%) C, 87.05, H, 8.81; Found (%) C, 86.98, H, 8.79.

4-[2-ethylhexyloxy]-2,5-dimethyl-p-quaterphenyl (3c). A white crystalline was obtained following a similar method of obtaining **2a** using Bromobenzene and **3a** (yield 62%). ^{1}H NMR ($CDCl_3$, 400 MHz, ppm) δ 7.788 (m, 8H), 7.511 (m, 2H), 7.460(m, 3H), 7.130(s, 1H), 6.798(s, 1H), 3.956(d, 2H), 2.233(s, 3H), 2.291(s, 3H), 1.835(m, 1H), 1.577(m, 8H), 1.015(m, 6H). ^{13}C ($CDCl_3$, 400 MHz, ppm) δ 157.914, 142.411, 142.068, 141.246, 139.874, 134.919, 134.326, 134.156, 132.566, 132.029, 130.972, 130.487, 129.610, 129.484, 129.301, 129.149, 128.708, 128.123, 127.910, 127.568, 127.144, 125.517, 114.761, 113.226. MS (EI, *m/z*): 462.2. Calculate (%) C, 88.31, H, 8.22; Found (%) C, 88.34, H, 8.24.