Supporting Information

New Selenophene-Based Semiconducting Copolymers for High Performance Organic Thin-Film Transistors

Hoyoul Kong,[a] Dae Sung Chung,[b] In-Nam Kang,[c] Jong-Hwa Park,[a] Moo-Jin Park,[a] In Hwan Jung,[a] Chan Eon Park,[*b] and Hong-Ku Shim[*a]

[a]Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), 373-1 Guseong-Dong, Yuseong-Gu, Daejeon 305-701, Korea

[b]Polymer Research Institute, Department of Chemical Engineering, Pohang University of Science and Technology, Pohang, Korea

[c]Department of Chemistry, The Catholic University of Korea, Bucheon, Gyeonggi-do 420-743, Korea

Synthesis

2,2'-Biselenophene (1). The compound was synthesized according to the previously published procedures.[1] ^{1}H NMR (400 MHz, $CDCl_3$, δ): 7.85 (d, 2H), 7.25 (d, 2H), 7.21 (dd, 2H); ^{13}C NMR (100 MHz, $CDCl_3$, δ): 144.8, 130.2, 129.7, 126.7.

5,5'-Dibromo-4,4'-didodecyl-2,2'-bithiophene (3). The compound was synthesized according to the previously published procedure.[2] Yield: 2.73 g (86%). ^{1}H NMR (400 MHz, $CDCl_3$, δ): 6.75 (s, 2H), 2.50 (t, 4H), 1.56 (m, 4H), 1.29 (m, 36H), 0.87 (t, 6H); ^{13}C NMR (100 MHz, $CDCl_3$, δ): 142.9, 136.2, 124.4, 107.9, 31.9, 29.67, 29.64, 29.61, 29.5, 29.4, 29.3, 29.2, 22.7, 14.1; MS (MALDI-TOF) (m/z) 660 [M^+]; Anal. calcd for $C_{32}H_{52}Br_2S_2$: C 58.17, H 7.93, S 9.71; found: C 58.56, H 7.65, S 9.86.

2-(3-Dodecylthiophen-2-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (4). The synthesis of the compound was based on a procedure reported.[3] Yield: 3.72 g (57%). ^{1}H NMR (400 MHz, CDCl3, δ): 7.46 (d, 1H), 7.01 (d, 1H), 2.89 (t, 2H), 1.59 (m, 2H), 1.33 (m, 30H), 0.89 (t, 3H); ^{13}C NMR (100 MHz, CDCl3, δ): 154.63, 131.21, 130.21, 83.44, 31.91, 31.81, 30.11, 29.68, 29.65, 29.62, 29.45, 29.34, 29.29, 24.75, 22.66, 14.07.

5,5'-Dibromo-2,2'-biselenophene (5). The compound was synthesized according to the previously published procedures.[1] Yield: 2.45 g (87%). ^{1}H NMR (400 MHz, CDCl3, δ): 7.12 (d, 2H), 6.85 (d, 2H); ^{13}C NMR (100 MHz, CDCl3, δ): 145.51, 133.60, 126.54, 114.93.; MS (MALDI-TOF) (m/z) 418 [M^+]; Anal. calcd for $C_8H_4Br_2Se_2$: C 23.00, H 0.96; found: C 23.34, H 1.67.

2-Bromo-3-dodecylthiophene (7). The compound was synthesized according to the previously published procedures.[3]

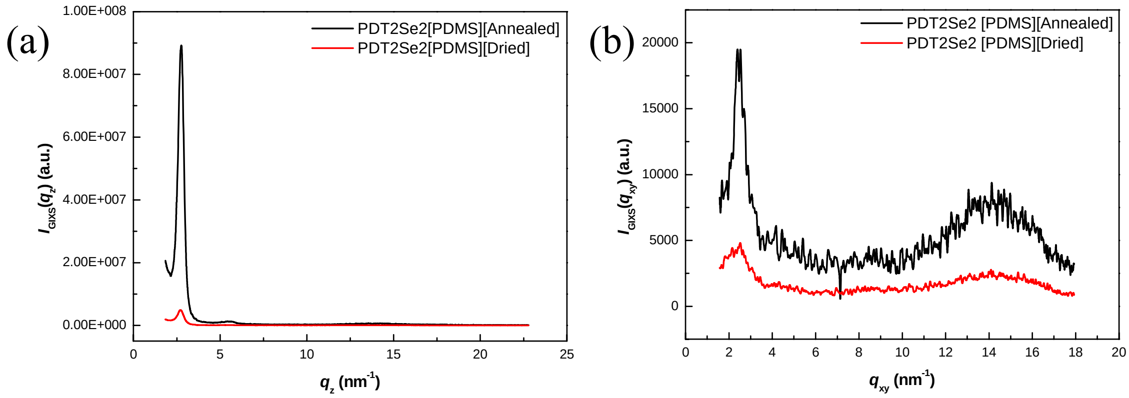

Fig. S1 Two dimensional GIXRD patterns of **PDT2Se2** (a) out-of-plane and (b) in-plane on PDMS-modified substrates.

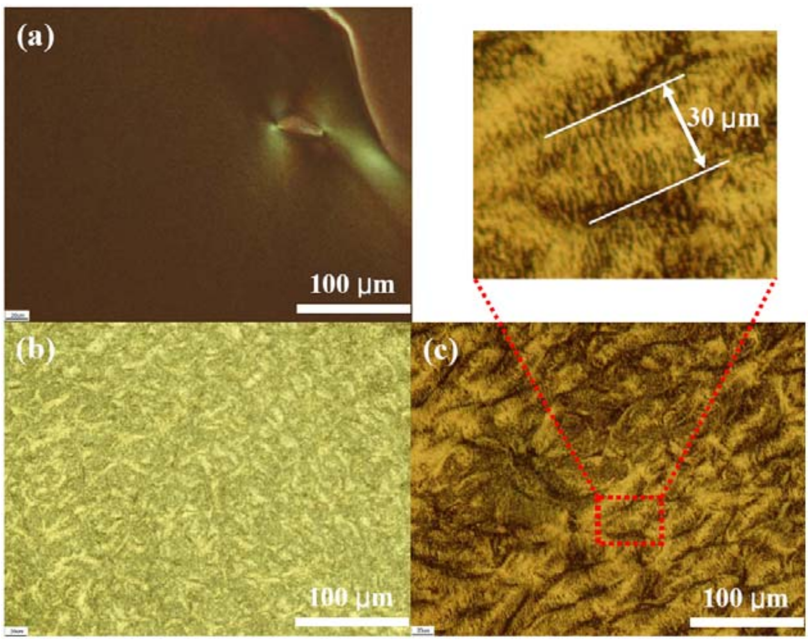

Fig. S2 POM images of higher MW **PDT2Se2**. The film was (a) as-cast, (b) annealed at 90°C for 15 min and then slowly cooled to RT, and (c) annealed at 150°C for 30 min and then quickly quenched.

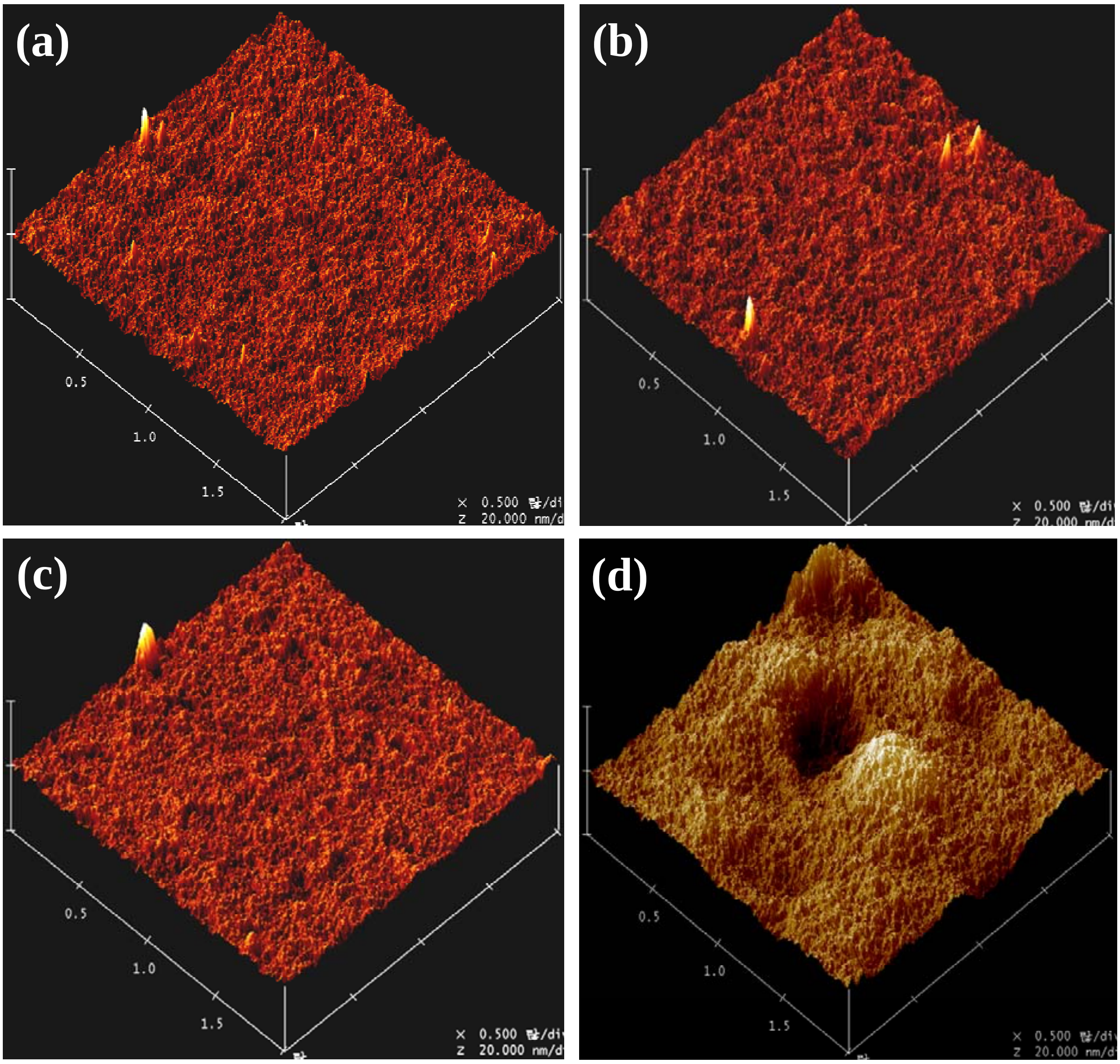

Fig. S3 Z-range AFM topography images of the dried polymer films spin-coated onto ODTS-modified SiO_2/Si substrates: (a) lower MW **PDT2Se2** and (b) higher MW **PDT2Se2** obtained with Stille coupling, (c) **PDT2Se2** obtained with oxidative coupling, and (d) **PDT4Se2**.

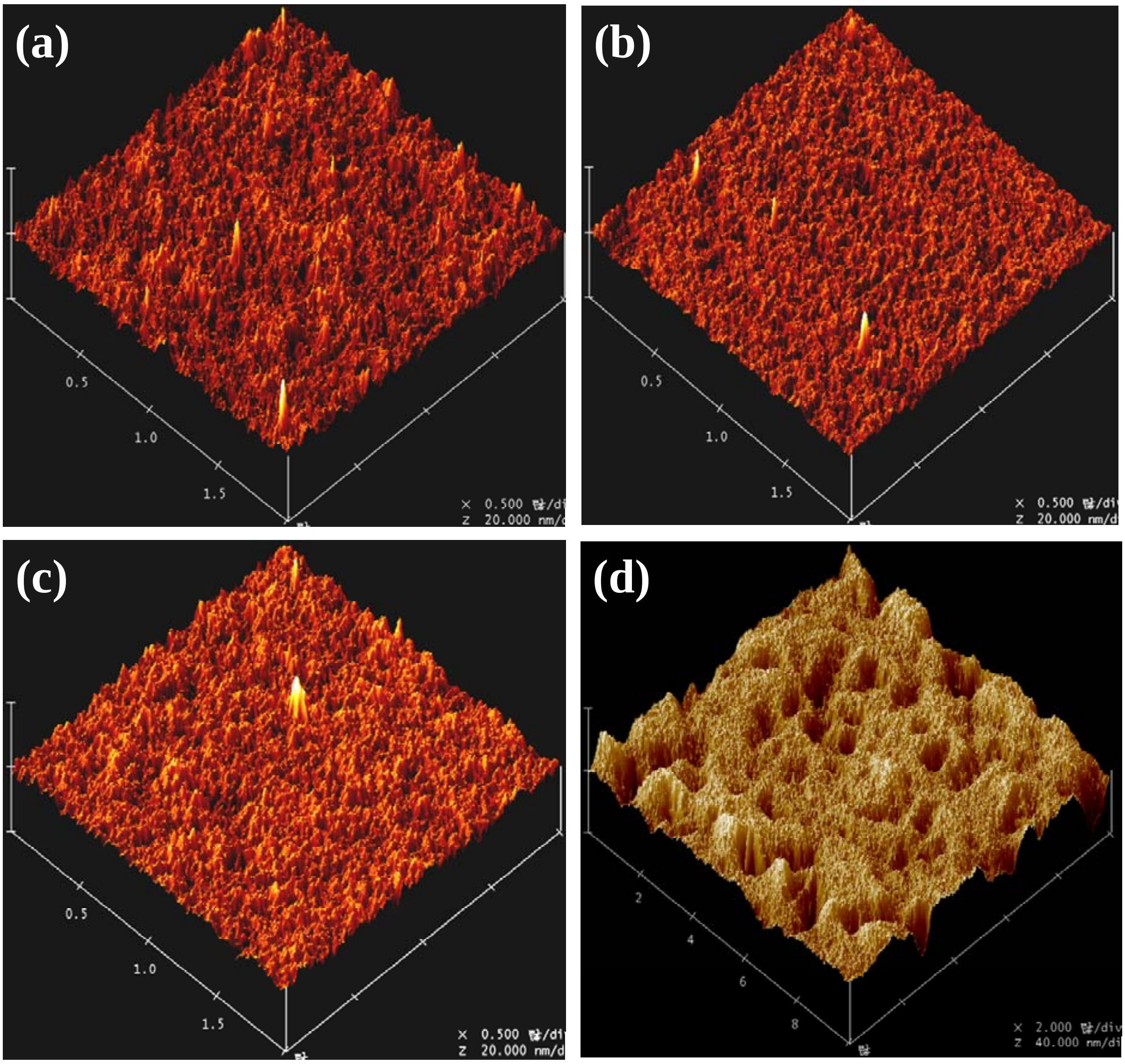

Fig. S4 Z-range AFM topography images of the annealed polymer films spin-coated onto ODTS-modified SiO_2/Si substrates: (a) lower MW **PDT2Se2** and (b) higher MW **PDT2Se2** obtained with Stille coupling, (c) **PDT2Se2** obtained with oxidative coupling, and (d) **PDT4Se2**.

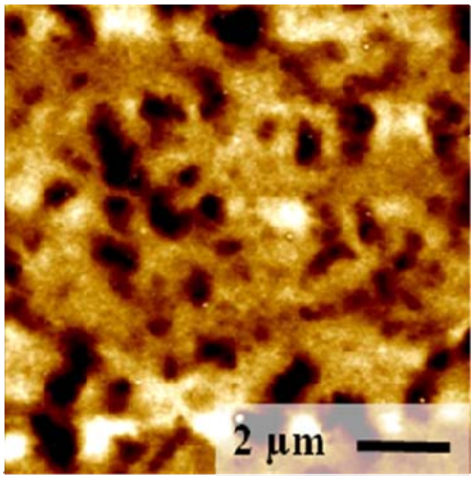

Fig. S5 The enlarged 10 × 10 μm AFM image of annealed **PDT4Se2** film spin-coated onto ODTS-modified SiO_2/Si substrate.

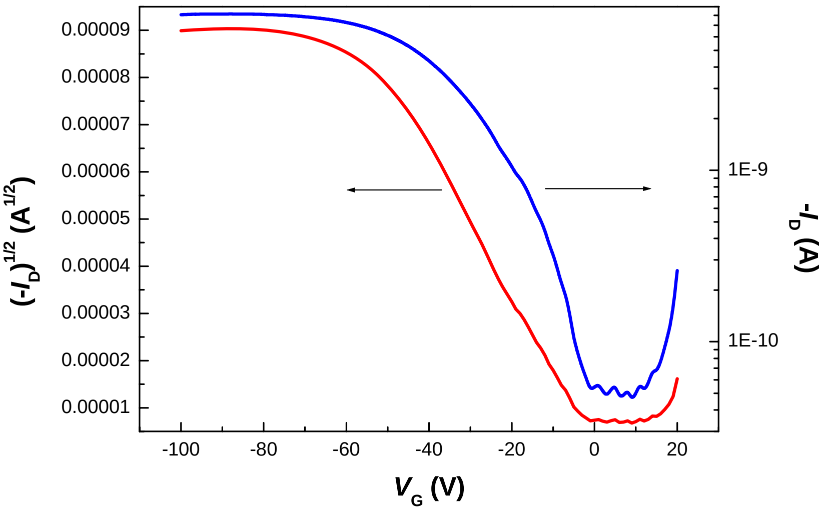

Fig. S6 TFT performance of **PDT4Se2** on ODTS-modified SiO_2/Si substrate: transfer characteristics at a constant source-drain voltage of -100 V (semilogarithmic plot of $-I_D$ vs V_G (blue line) and plot of $(-I_D)^{1/2}$ vs V_G (red line)).

References

1 Y. M. Kim, E. Lim, I.-N. Kang, B.-J. Jung, J. Lee, B. W. Koo, L.-M. Do, H.-K. Shim, *Macromolecules* 2006, **39**, 4081.

2 I. Mcculloch, M. Heeney, C. Bailey, K. Genevicius, I. Macdonald, M. Shkunov, D. Sparrowe, S. Tierney, R. Wagner, W. M. Zhang, M. L. Chabinyc, R. J. Kline, M. D. Mcgehee, M. F. Toney, *Nat. Mater.* 2006, **5**, 328.

3 Dang, T. T. M.; Park, S.-J.; Park, J.-W.; Chung, D.-S.; Park, C. E.; Kim, Y.-H.; Kwon, S.-K. *J. Polym Sci. Part A* **2007**, *45*, 5277.