Supporting information for

Synthesis of (4-hexyloxybenzoyl)butylsaure Methyl Amide/Poly(3-hexylthiophene) Heterojunction Nanowire Arrays

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Scheme S1. Synthesis route of (4-hexyloxybenzoyl)butylsaure methyl amide (H-t-B)

The [6,6]-phenyl-C₆₁ were synthesized according to the method developed by Hummelen et al^[S1] (**Scheme S1**). A mixture of hydrazone (1 mmol), freshly prepared sodium methoxide (1.2 mmol) and dry pyridine (15 mL) was placed under nitrogen and stirred for 15~30 min. Then a solution of fullerene (1 mmol) in dry 1,2-dichlorobenzene (*o*-DCB) (50 mL) was added. The mixture was stirred at 80~120 °C for 24 h, then removed solvent *in vacuo*. The crude product was chromatographed on silica gel (200~300 mesh) by 0~50 % ethyl acetate in toluene as eluent. The product resolved in *o*-DCB and refluxed for 24 h to ensure most of [5,6] open shell changed to [6,6] close shell methanofullerenes. Then the product was solved in a little dichloromethane and precipitated with Methanol, centrifuged and decanted, the remaining pellet was washed three times with methanol in supersonic bath to remove small molecule impurities, moreover, using ethyl acetate to treat materials with previous precipitation and wash procedure to remove silica and impurities in solvent. Finally the product was dried *in vacuo* at 100 °C for 24 hours. ¹H NMR (400 MHz, CDCl₃): δ (7.93): (d, J = 8.8 Hz, 2H), 6.91 (d, J = 8.8 Hz, 2H), 5.39 (s, 1H), 4.01 (t, J = 6.6 Hz, 2H), 2.99 (t, J = 6.9 Hz, 2H), 2.19 (t, J = 7.2 Hz, 2H), 2.04 (m, 2H), 1.86-1.75 (m, 2H), 1.46 (m, 2H), 1.35 (m, 12H), 0.91 (t, J = 6.9 Hz, 3H).

Scheme S2. ¹H NMR of H-*t*-B



Figure S1. SEM images of H-t-B nanowire arrays and P3HT nanowire arrays.

Figure S1 showed the SEM images of H-t-B nanowire arrays and P3HT

nanowire arrays, which were synthesized with the same approach like H-*t*-B/P3HT nanowire arrays.



Figure S2. Energy-dispersive X-microanalysis (EDS) images of H-*t*-B nanowire arrays, P3HT nanowire arrays, and H-*t*-B/P3HT nanowire arrays (a).

Based on the elements of the two components of H-*t*-B and P3HT, EDS was used to confirm the structure of the hybrid nanowires. **Figure S2** shows the EDS results of H-*t*-B nanowire arrays, P3HT nanowire arrays, and H-*t*-B/P3HT nanowire arrays. EDS of H-*t*-B/P3HT heterojunction nanowires show that the compositions of the product were carbon, oxygen, and sulfur, while the compositions of H-*t*-B nanowires and P3HT nanowires were carbon and oxygen, and carbon and sulfur, as shown in **Figure S2**. These data confirmed that H-*t*-B/P3HT heterojunction nanowires were composited by H-*t*-B and P3HT. Furthermore, we can calculate the ratio of two components H-*t*-B and P3HT in the

heterojunction nanowires from the EDS results (Figure S2c), we should first set the two components of H-*t*-B ($C_{81}H_{33}NO_2$) and P3HT ($(C_{10}H_{14}S)_n$) was *x* and *y*, respectively.

$$2x : y = 7.39 : 5 \tag{1}$$

$$x : y = 7.39 : 10 \tag{2}$$



Figure S3. On/off switching of H-*t*-B (a) and P3HT (b) nanowire arrays upon pulsed illumination from full color with a power density of 45 mW/cm^2 .



Figure S4. Energy level diagram of H-*t*-B/P3HT heterojunction nanowire arrays device (Au and ITO electrode), The LUMO level of H-*t*-B was calculated by electrochemistry, and the HOMO level of H-*t*-B was calculated at the level of Becke, three-parameter, Lee-Yang-Parr (B3LYP)^[s2, 23] and the 6-31G basis; the energy level of P3HT was adjusted to Onoda group ^[s4].



Figure S5. The nanodevice of single H-*t*-B/P3HT nanowire with large area heterojunction that not annealed (a) and annealed at 373 K (b) under optical microscope.



Figure S6. TGA images of H-t-B (a) and P3HT (b).



Figure S7. Typical current-voltage (*I-V*) curves of single H-*t*-B/P3HT nanowire with large area heterojunction that unannealed (a) and annealed at 373 K (b).



Figure S8. Phase images of H-t-B/P3HT heterojunction nanowire: the unannealed (a) and annealed samples (b).

References

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