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Supporting Information

Naphthalimide End Capped Anthraquinone Based Solution-Processable *n*-Channel Organic Semiconductors: Effect of Alkyl Chain Engineering on Charge Transport

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Keywords: 1,8-Naphthalimide, 9,10-Anthraquinone, Branched Alkyl Chain, Organic Semiconductors, Field Effect Transistors.

Contents

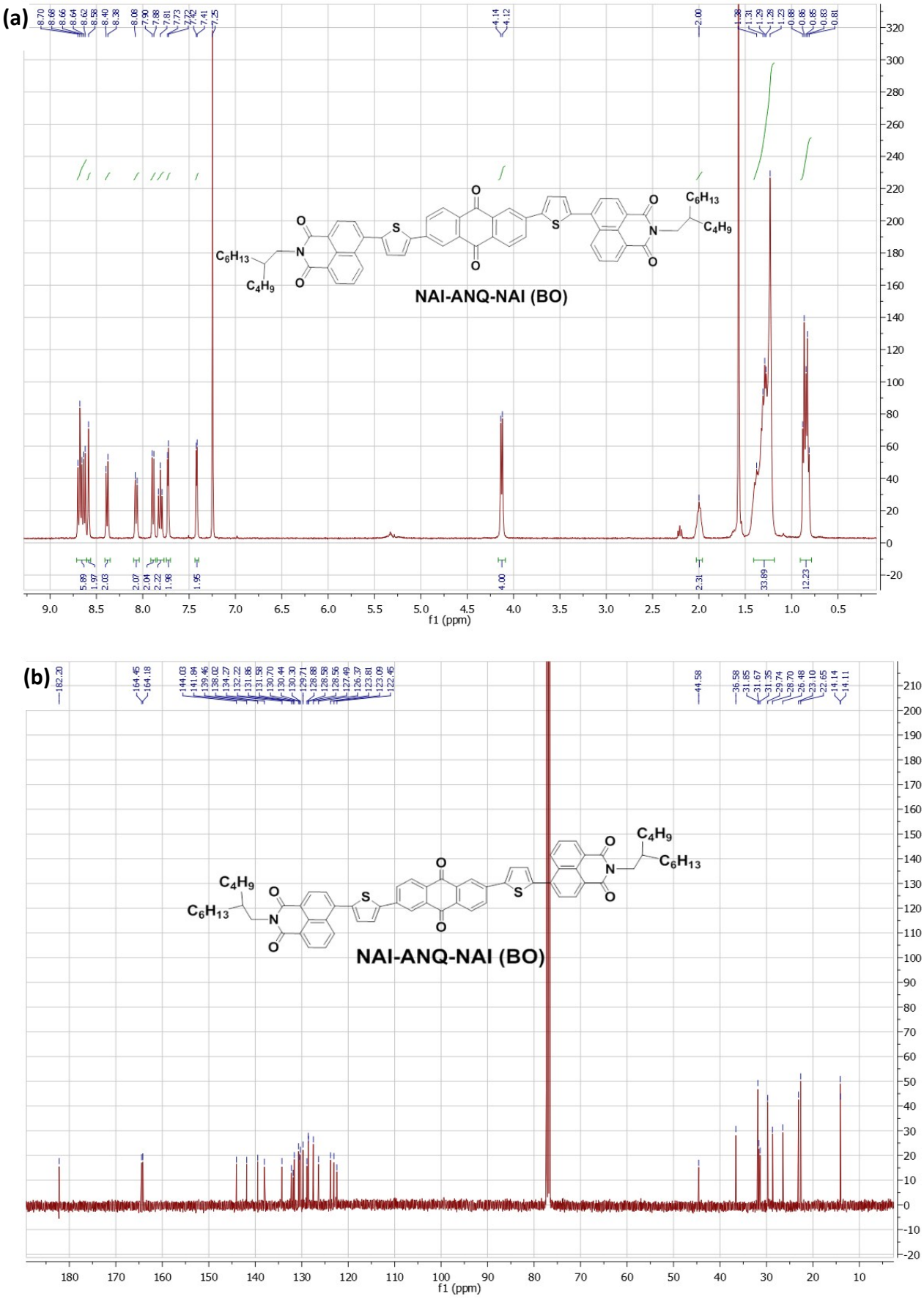

Figure S1. (a) ^{1}H NMR (400 MHz, $CDCl_3$) spectrum and (b) ^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **NAI-ANQ-NAI (BO)**

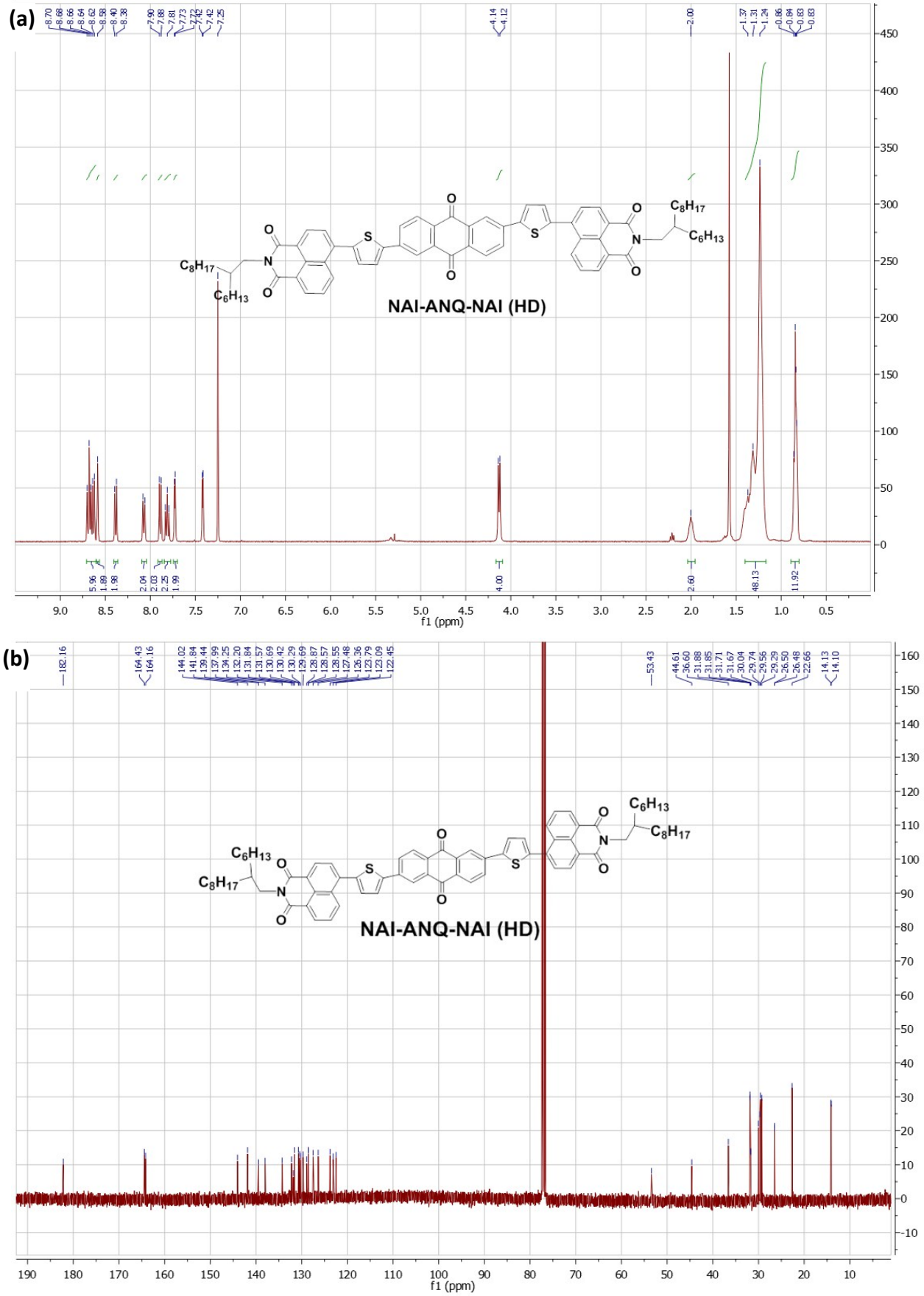

Figure S2. (a) ^{1}H NMR (400 MHz, $CDCl_3$) spectrum and (b) ^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **NAI-ANQ-NAI (HD)**

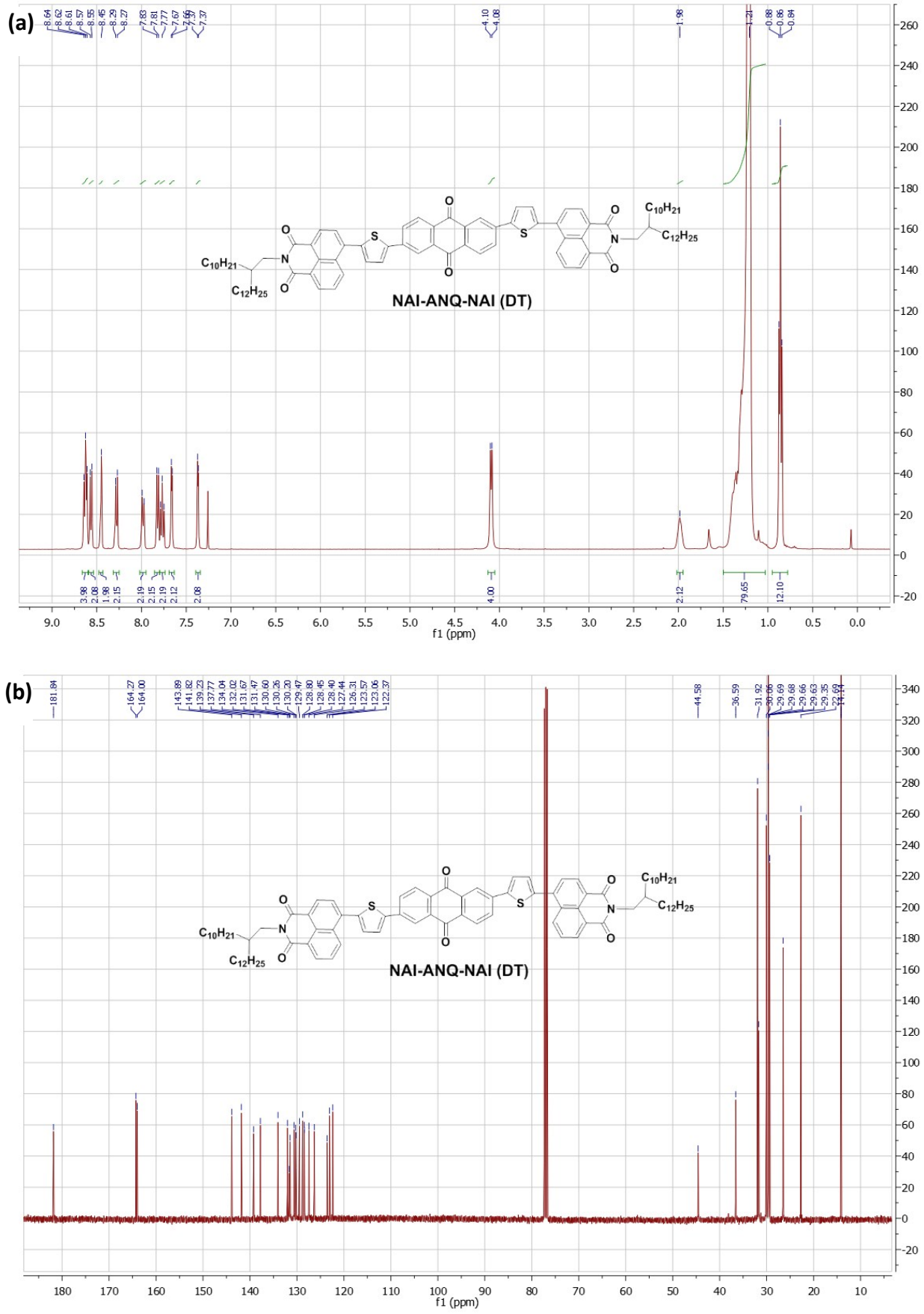

Figure S3. (a) ^{1}H NMR (400 MHz, $CDCl_3$) spectrum and (b) ^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **NAI-ANQ-NAI (DT)**

NAI-ANQ-NAI (BO) **NAI-ANQ-NAI (HD)** **NAI-ANQ-NAI (DT)**

Precipitation Precipitation No Precipitation

Figure S4. Solubility of **NAI-ANQ-NAIs** (0.5wt %) in chlorobenzene at room temperature

NAI-ANQ-NAI (BO) **NAI-ANQ-NAI (HD)** **NAI-ANQ-NAI (DT)**

No Precipitation No Precipitation No Precipitation

Figure S5. Solubility of **NAI-ANQ-NAIs** (0.5wt %) in chlorobenzene at 120 ^{o}C

NAI-ANQ-NAI (BO) **NAI-ANQ-NAI (HD)** **NAI-ANQ-NAI (DT)**

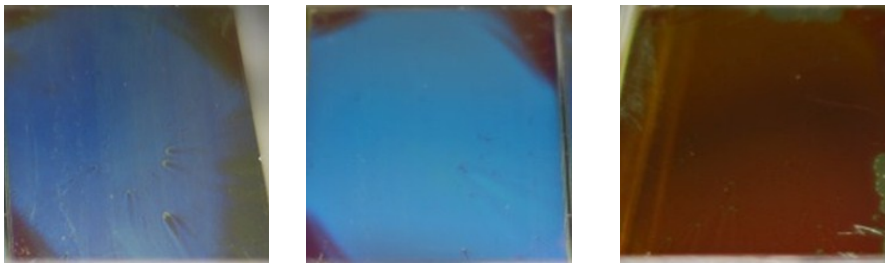

Figure S6. Film quality of **NAI-ANQ-NAI** after spin-coating at 1000 rpm for 60 s

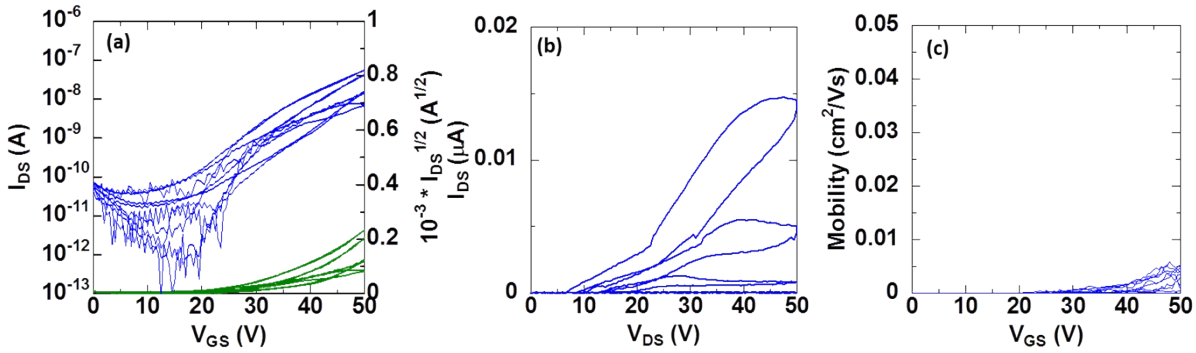

Figure S7. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (BO)** at annealing temperature of 140 °C

Table S1. Electron-transport properties of **NAI-ANQ-NAI (BO)** compounds based OFET devices annealed at 140 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	3.45×10^{-4}	4.68×10^{3}	33.02
2	2.57×10^{-3}	6.44×10^{4}	40.61
3	1.47×10^{-3}	2.12×10^{5}	38.44
4	3.53×10^{-3}	1.95×10^{4}	35.40
5	**3.94×10^{-3}**	**3.68×10^{5}**	**38.13**
Avg	2.37×10^{-3}	1.34×10^{5}	37.1

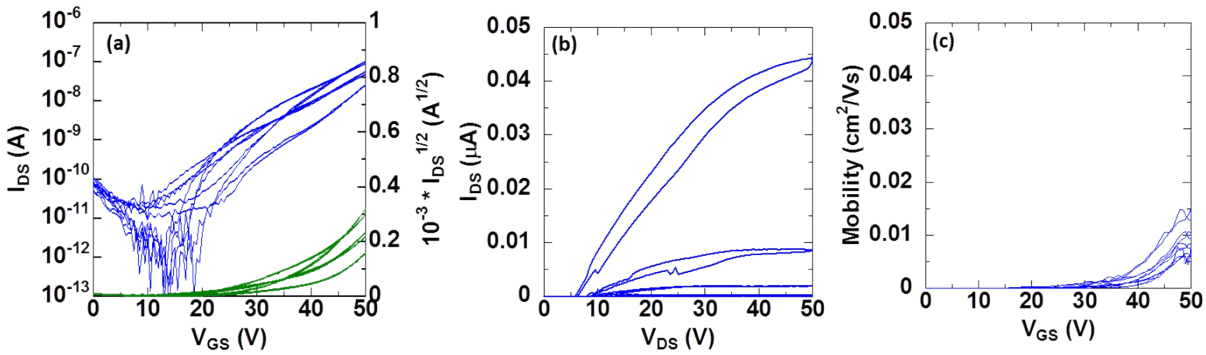

Figure S8. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (BO)** at annealing temperature of 160 °C

Table S2. Electron-transport properties of **NAI-ANQ-NAI (BO)** compounds based OFET devices annealed at 160 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	5.69×10^{-3}	3.33×10^{5}	38.44
2	5.21×10^{-3}	6.00×10^{5}	41.65
3	4.41×10^{-3}	1.29×10^{5}	37.96
4	7.13×10^{-3}	6.26×10^{5}	36.94
5	**9.93×10^{-3}**	**4.21×10^{6}**	**38.37**
Avg	6.47×10^{-3}	1.18×10^{6}	38.7

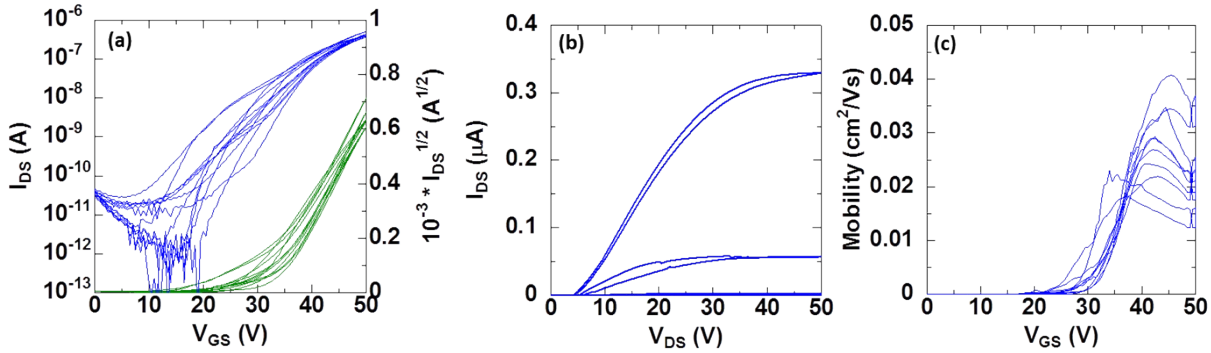

Figure S9. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (BO)** at annealing temperature of 180 °C

Table S3. Electron-transport properties of **NAI-ANQ-NAI (BO)** compounds based OFET devices annealed at 180 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	1.95×10^{-2}	1.16×10^{6}	33.69
2	1.53×10^{-2}	1.63×10^{7}	29.80
3	**2.71×10^{-2}**	**1.78×10^{7}**	**34.96**
4	2.27×10^{-2}	4.17×10^{5}	32.30
5	2.31×10^{-2}	1.27×10^{7}	34.59
Avg	2.16×10^{-2}	9.68×10^{6}	38.7

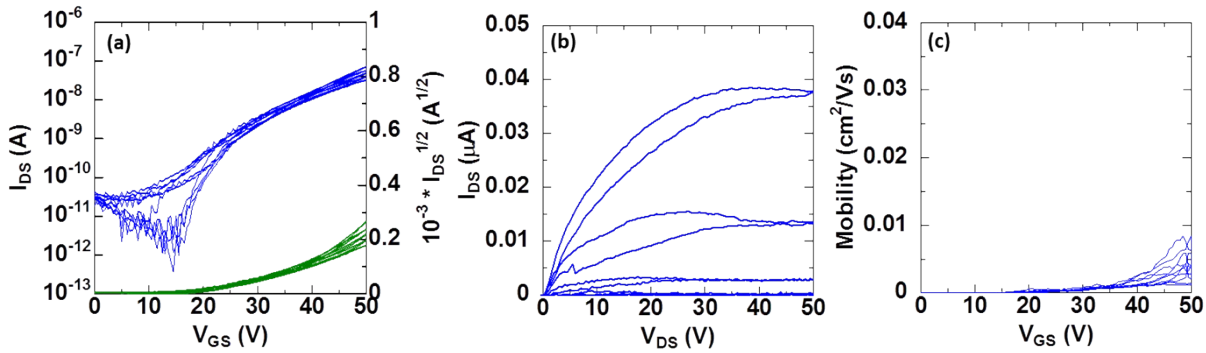

Figure S10. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (HD)** at annealing temperature of 140 °C

Table S4. Electron-transport properties of **NAI-ANQ-NAI (HD)** compounds based OFET devices annealed at 140 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	**5.59 x 10^{-3}**	**3.08 x 10^4**	**37.11**
2	2.81 x 10^{-3}	1.63 x 10^4	33.23
3	2.92 x 10^{-3}	1.07 x 10^5	36.89
4	1.20 x 10^{-3}	3.00 x 10^4	29.96
5	3.95 x 10^{-3}	5.04 x 10^4	36.65
Avg	3.29 x 10^{-3}	4.69 x 10^4	34.77

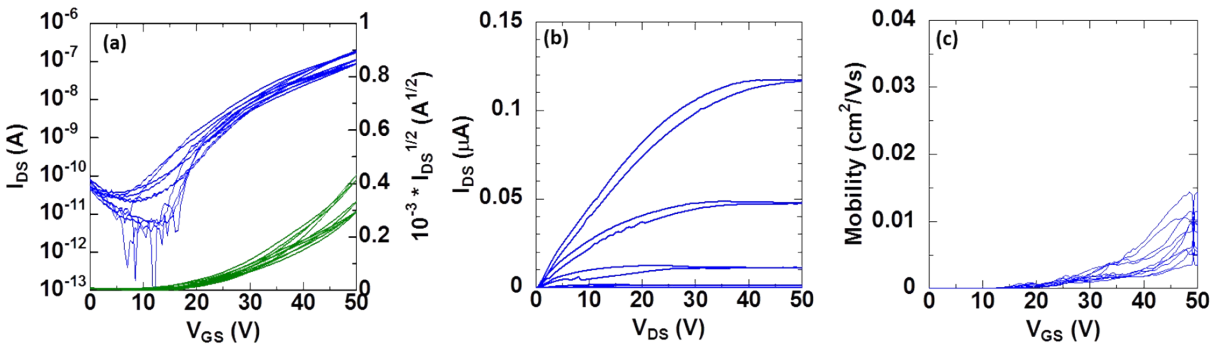

Figure S11. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (HD)** at annealing temperature of 160 °C

Table S5. Electron-transport properties of **NAI-ANQ-NAI (HD)** compounds based OFET devices annealed at 160 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	3.91×10^{-3}	2.51×10^{4}	31.91
2	6.64×10^{-3}	1.79×10^{4}	36.18
3	**9.60×10^{-3}**	**1.39×10^{7}**	**34.01**
4	7.67×10^{-3}	1.79×10^{4}	32.34
5	6.48×10^{-3}	2.88×10^{5}	35.24
Avg	6.87×10^{-3}	2.86×10^{6}	33.9

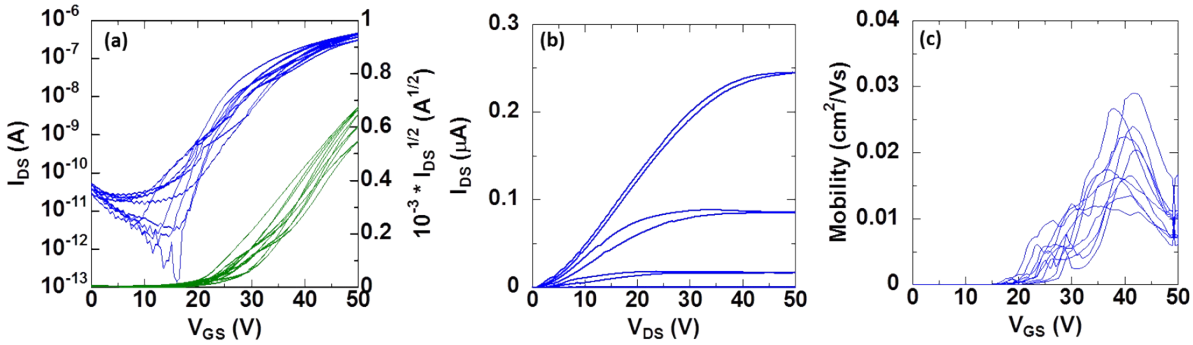

Figure S12. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (HD)** at annealing temperature of 180 °C

Table S6. Electron-transport properties of **NAI-ANQ-NAI (HD)** compounds based OFET devices annealed at 180 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	1.08×10^{-2}	1.88×10^{5}	25.60
2	1.60×10^{-2}	6.67×10^{5}	31.07
3	1.78×10^{-2}	3.17×10^{5}	30.06
4	1.36×10^{-2}	2.23×10^{5}	31.02
5	**1.93×10^{-2}**	**1.40×10^{5}**	**31.48**
Avg	1.55×10^{-2}	7.57×10^{5}	29.9

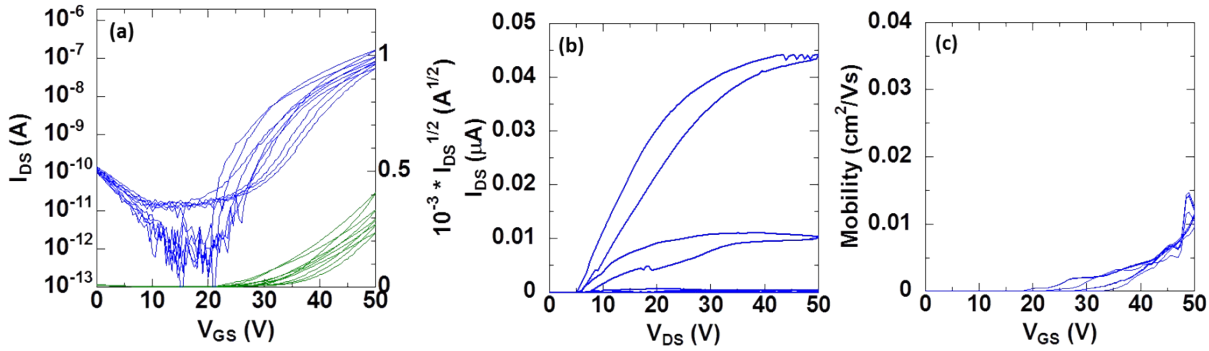

Figure S13. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (DT)** at annealing temperature of 140 °C

Table S7. Electron-transport properties of **NAI-ANQ-NAI (DT)** compounds based OFET devices annealed at 140 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	9.53×10^{-3}	6.15×10^{5}	38.70
2	7.87×10^{-3}	4.73×10^{5}	39.44
3	9.40×10^{-3}	9.27×10^{5}	39.25
4	**9.80×10^{-3}**	**1.29×10^{6}**	**40.58**
5	9.40×10^{-3}	3.24×10^{5}	40.26
Avg	9.20×10^{-3}	7.26×10^{5}	39.65

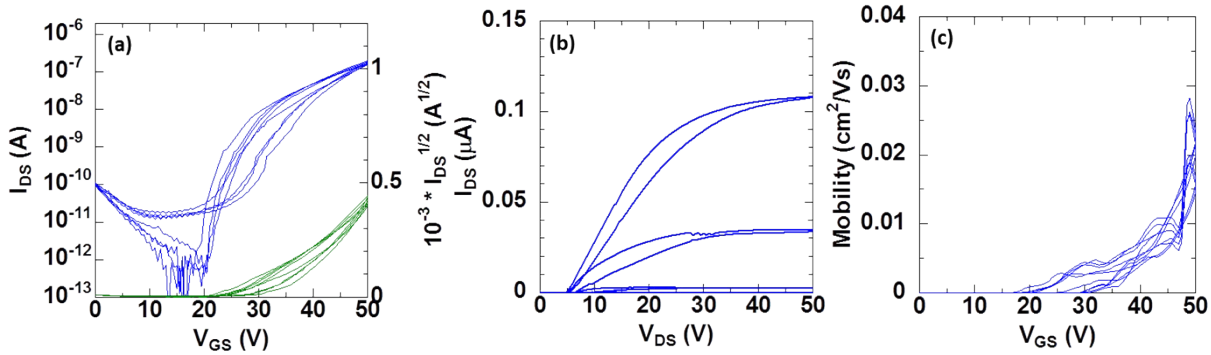

Figure S14. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (DT)** at annealing temperature of 160 °C

Table S8. Electron-transport properties of **NAI-ANQ-NAI (DT)** compounds based OFET devices annealed at 160 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	1.33×10^{-2}	1.08×10^{5}	37.35
2	1.72×10^{-2}	4.93×10^{7}	38.37
3	**1.88×10^{-2}**	**4.93×10^{7}**	**38.34**
4	1.26×10^{-2}	3.18×10^{6}	38.39
5	1.75×10^{-2}	5.69×10^{6}	38.72
Avg	1.59×10^{-2}	2.15×10^{7}	38.23

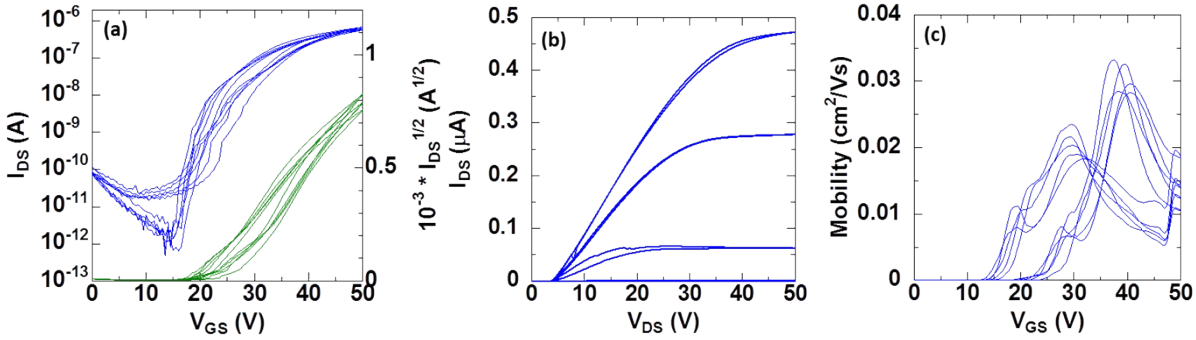

Figure S15. Transfer (a), output (b) characteristics and (c) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (DT)** at annealing temperature of 180 °C

Table S9. Electron-transport properties of **NAI-ANQ-NAI (DT)** compounds based OFET devices annealed at 180 °C

Device	Mobility ($cm^2.v^{-1}s^{-1}$)	I_{on}/I_{off}	V_{TH} (V)
1	1.89×10^{-2}	7.65×10^{5}	26.90
2	**2.21×10^{-2}**	**9.43×10^{5}**	**26.89**
3	1.97×10^{-2}	7.28×10^{5}	27.02
4	1.89×10^{-2}	1.34×10^{5}	25.83
5	2.17×10^{-2}	9.01×10^{5}	28.20
Avg	2.03×10^{-2}	9.34×10^{5}	26.97

Table S10. Electron-transport properties of **NAI-ANQ-NAI (BO)** compounds based OFET devices annealed at 200 °C

Compound	Device	Electron Mobility ($cm^2.V^{-1}s^{-1}$)	I_{on}/I_{off}	V_{th} (V)
	1	**2.79 x 10^{-2}**	**1.06 x 10^{7}**	**24.27**
	2	1.89 x 10^{-2}	1.44 x 10^{7}	24.62
NAI-ANQ-NAI	3	2.25 x 10^{-2}	9.93 x 10^{4}	25.06
(BO)	4	1.53 x 10^{-2}	9.86 x 10^{4}	23.58
	5	1.61 x 10^{-2}	2.88 x 10^{5}	23.01
	Avg	2.01 x 10^{-2}	5.10 x 10^{6}	24.1

Table S11. Electron-transport properties of **NAI-ANQ-NAI (HD)** compounds based OFET devices annealed at 200 °C

Compound	Device	Electron Mobility ($cm^2.V^{-1}s^{-1}$)	I_{on}/I_{off}	V_{th} (V)
	1	1.32 x 10^{-2}	1.09 x 10^{5}	19.31
	2	**2.09 x 10^{-2}**	**2.39 x 10^{5}**	**22.37**
NAI-ANQ-NAI	3	1.73 x 10^{-2}	1.45 x 10^{6}	21.32
(HD)	4	1.39 x 10^{-2}	3.21 x 10^{5}	21.88
	5	2.05 x 10^{-2}	2.45 x 10^{5}	21.75
	Avg	1.71 x 10^{-2}	4.73 x 10^{5}	21.3

Table S12. Electron-transport properties of **NAI-ANQ-NAI (DT)** compounds based OFET devices annealed at 200 °C

Compound	Device	Electron Mobility ($cm^2.V^{-1}s^{-1}$)	I_{on}/I_{off}	V_{th} (V)
	1	1.52 x 10^{-2}	1.54 x 10^{5}	17.03
	2	**2.40 x 10^{-2}**	**2.56 x 10^{5}**	**13.38**
NAI-ANQ-	3	8.40 x 10^{-3}	1.02 x 10^{5}	16.90
NAI (DT)	4	1.41 x 10^{-2}	2.26 x 10^{5}	18.42
	5	2.27 x 10^{-2}	3.65 x 10^{5}	19.37
	Avg	1.69 x 10^{-2}	2.28 x 10^{5}	21.3

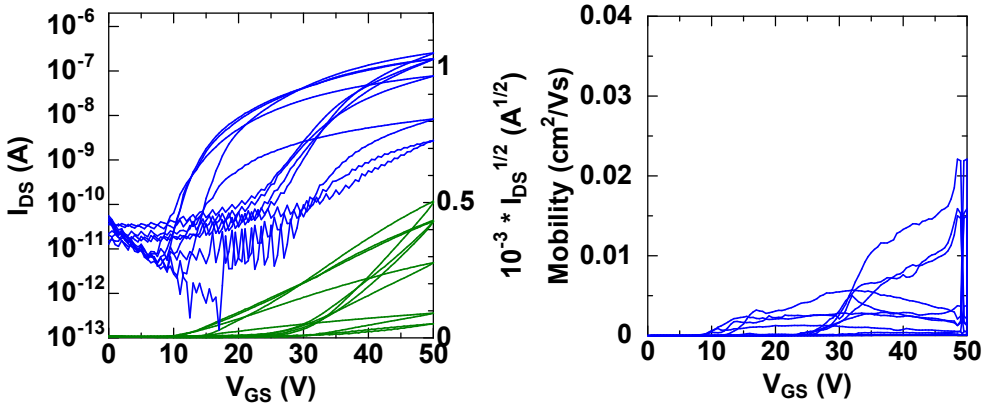

Figure S16. Transfer (left) characteristics and (right) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (BO)** at annealing temperature of 240 °C.

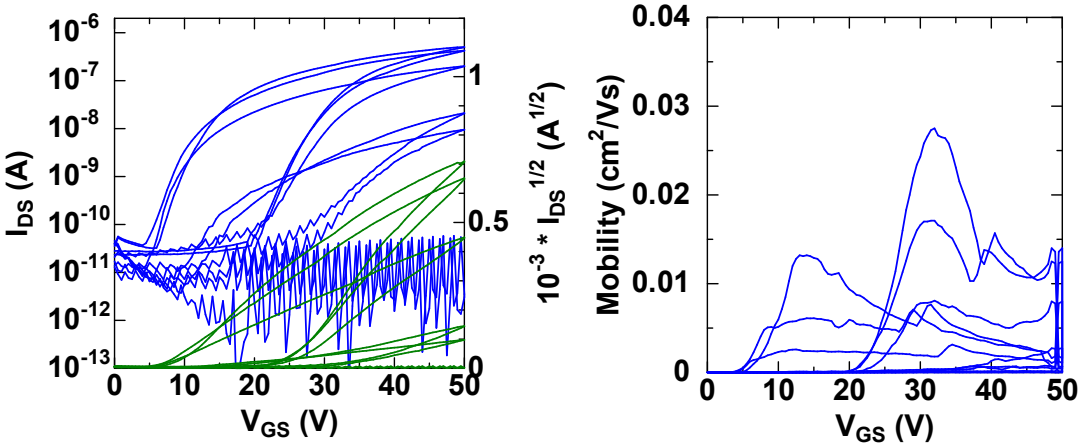

Figure S17. Transfer (left) characteristics and (right) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (HD)** at annealing temperature of 240 °C.

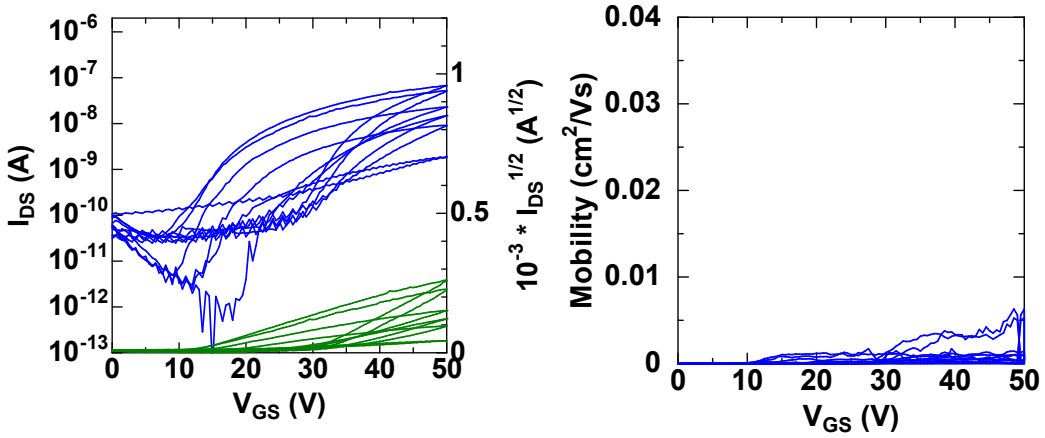

Figure S18. Transfer (left) characteristics and (right) gate-field dependent mobility of BGTC OFETs based on **NAI-ANQ-NAI (DT)** at annealing temperature of 240 °C.

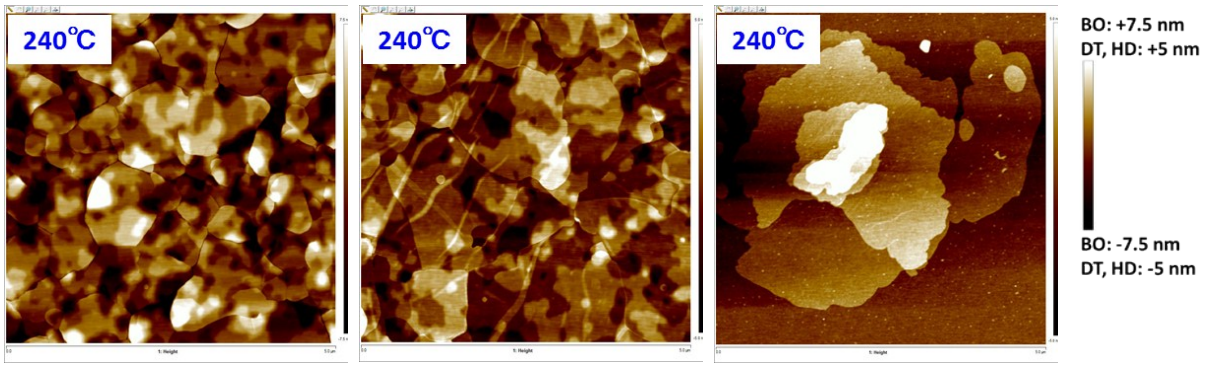

Figure S19. AFM images (5μ x 5μ) of thin films of **NAI-ANQ-NAI (BO)**, **NAI-ANQ-NAI (HD)** and **NAI-ANQ-NAI (DT)** at annealing temperature of 240°C.