

Supplementary Information

High Performance n- and p-Type Organic Single-Crystal Field-Effect Transistors with Air-gap Dielectric Towards Anti-Ambipolar Transport

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Table S1 Crystal data and structure refinement for TTT-CN.

Identification code	TX804D
Empirical formula	C ₃₄ H ₃₈ N ₄ S ₃
Formula weight	598.86
Temperature/K	298.0(2)
Crystal system	triclinic
Space group	P-1
a/Å	7.67420(10)
b/Å	13.5073(2)
c/Å	16.8983(2)
α/°	98.6460(10)
β/°	99.5300(10)
γ/°	97.3210(10)
Volume/Å ³	1686.86(4)
Z	2
ρ _{calc} /cm ³	1.179
μ/mm ⁻¹	2.215
F(000)	636.0
Crystal size/mm ³	0.287 × 0.175035 × 0.068
Radiation	CuKα (λ=1.54184)
2θ range for data collection/°	5.386 to 150.992
Index ranges	-9 ≤ h ≤ 9, -16 ≤ k ≤ 16, -17 ≤ l ≤ 21
Reflections collected	20227
Independent reflections	6710 [R _{int} =0.0211, R _{sigma} =0.0244]
Data/restraints/parameters	6710/0/372
Goodness-of-fit on F ²	1.068
Final R indexes [I>=2σ (I)]	R ₁ =0.0578, wR ₂ =0.1806
Final R indexes [all data]	R ₁ =0.0661, wR ₂ =0.1935
Largest diff. peak/hole / e Å ⁻³	0.48/-0.24

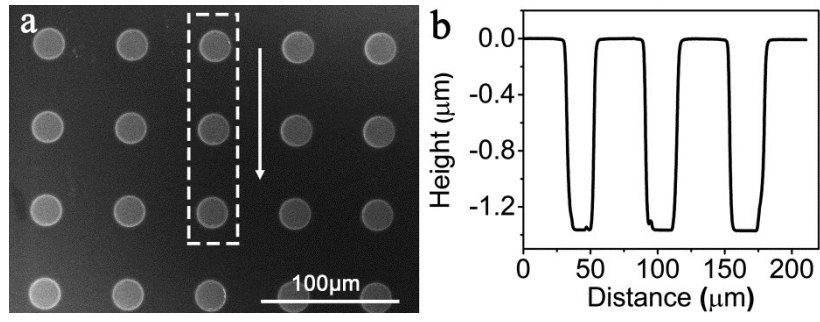


Fig. S1 a) SEM image of the lithographic substrate with grooves (the arrow points in the direction of the test). b) The thickness of photoresist layer (air-gap dielectric), $d=1.353\pm0.02\text{ }\mu\text{m}$.

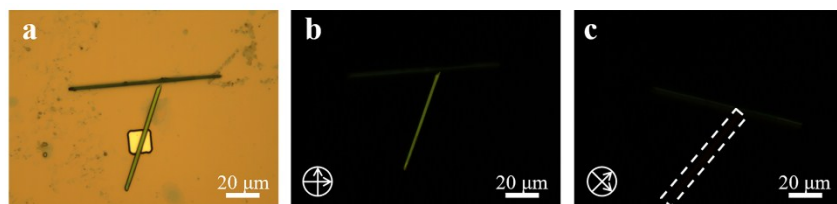


Fig. S2 a) Optical microscopy image of TTT-CN ribbon on air-gap dielectric. b-c) Polarized microscope images of TTT-CN ribbon on air-gap dielectric.

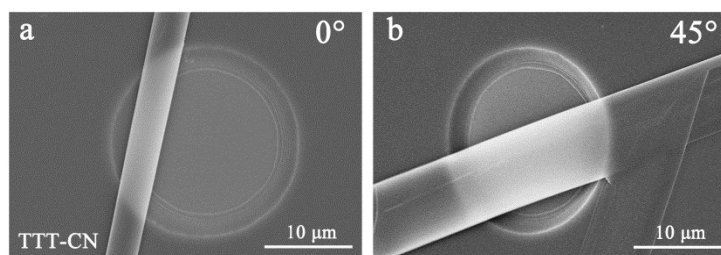


Fig. S3 The SEM images of TTT-CN in different views. a) Top view (0°) and b) 45° view on air-gap dielectric.

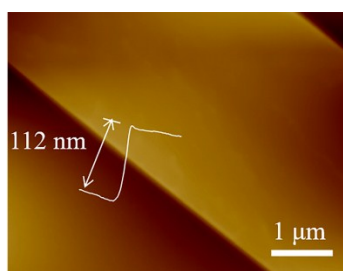


Fig. S4 AFM image of a typical TTT-CN crystal.

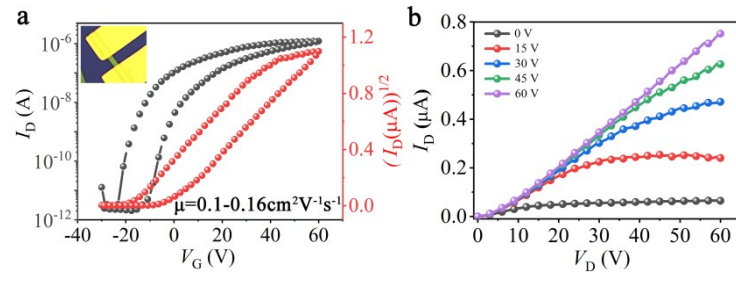


Fig. S5 The typical electrical measurements of TTT-CN transistor on SiO₂ dielectric. a) Transfer curve (the inset is optical microscope image of the device) and b) output curve.

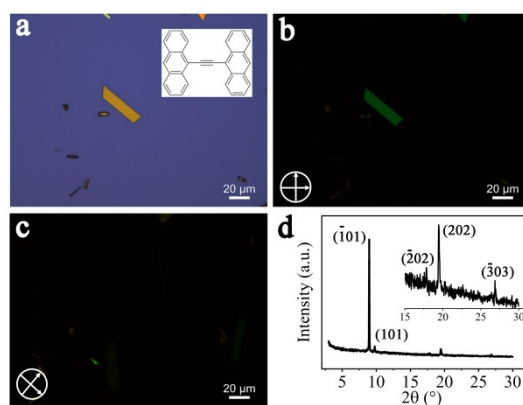


Fig. S6 a) Optical microscopy image of individual H-Type ribbon (the inset is molecular structure of H-Type). b–c) Polarized microscope images of individual H-Type ribbon. d) XRD pattern of H-Type crystals.

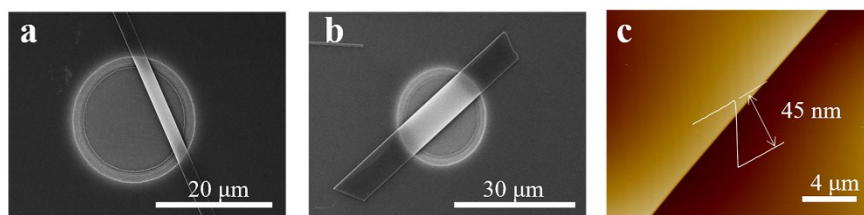


Fig. S7 a-b) SEM images of the H-Type crystal on air-gap dielectric. c) AFM image of a typical H-Type crystal.

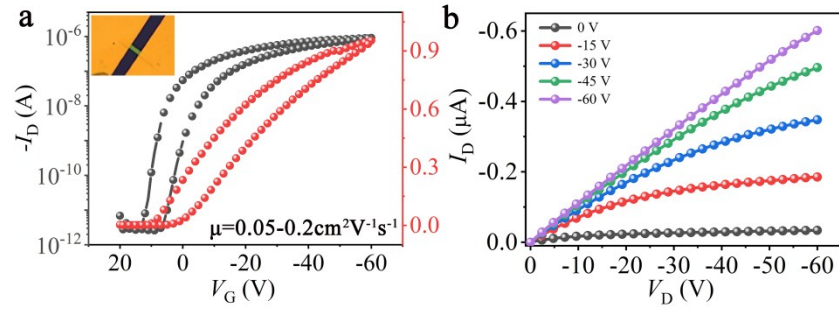


Fig.S8 The typical electrical measurements of individual H-Type transistor on SiO_2 dielectric. a) Transfer curve (the inset is optical microscope image of the device) and b) output curve.

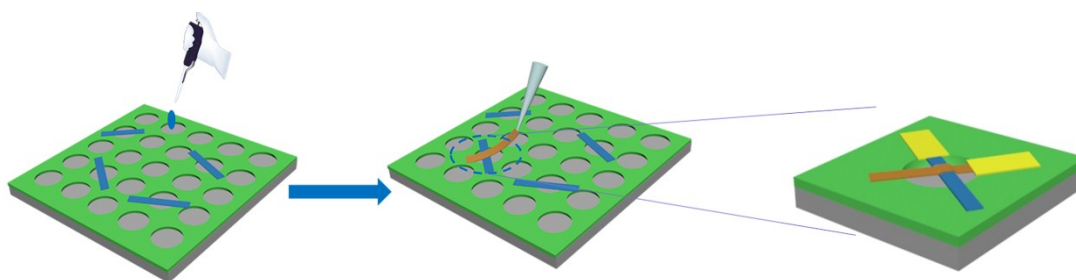


Fig. S9 Schematic illustration of the steps used to fabricate H-Type/TTT-CN p-n heterojunction on air-gap dielectric.