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A few-layer molecular film on polymer substrates to enhance the performance of organic devices

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Supplementary Information

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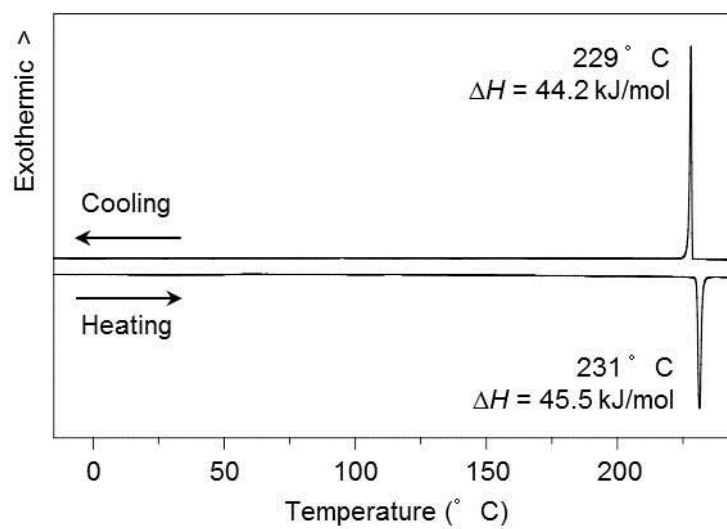
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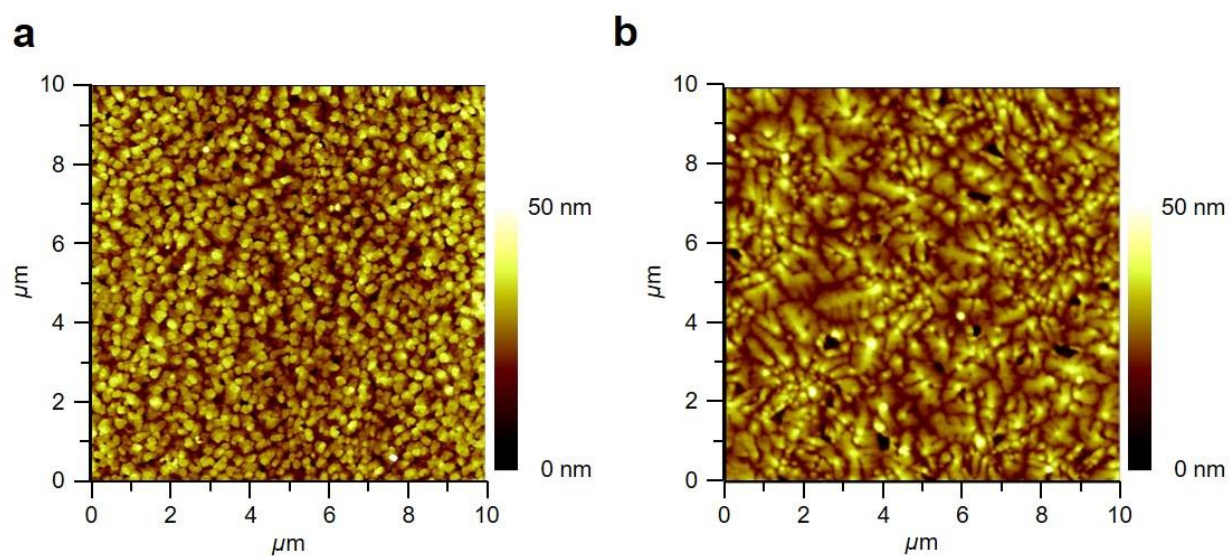
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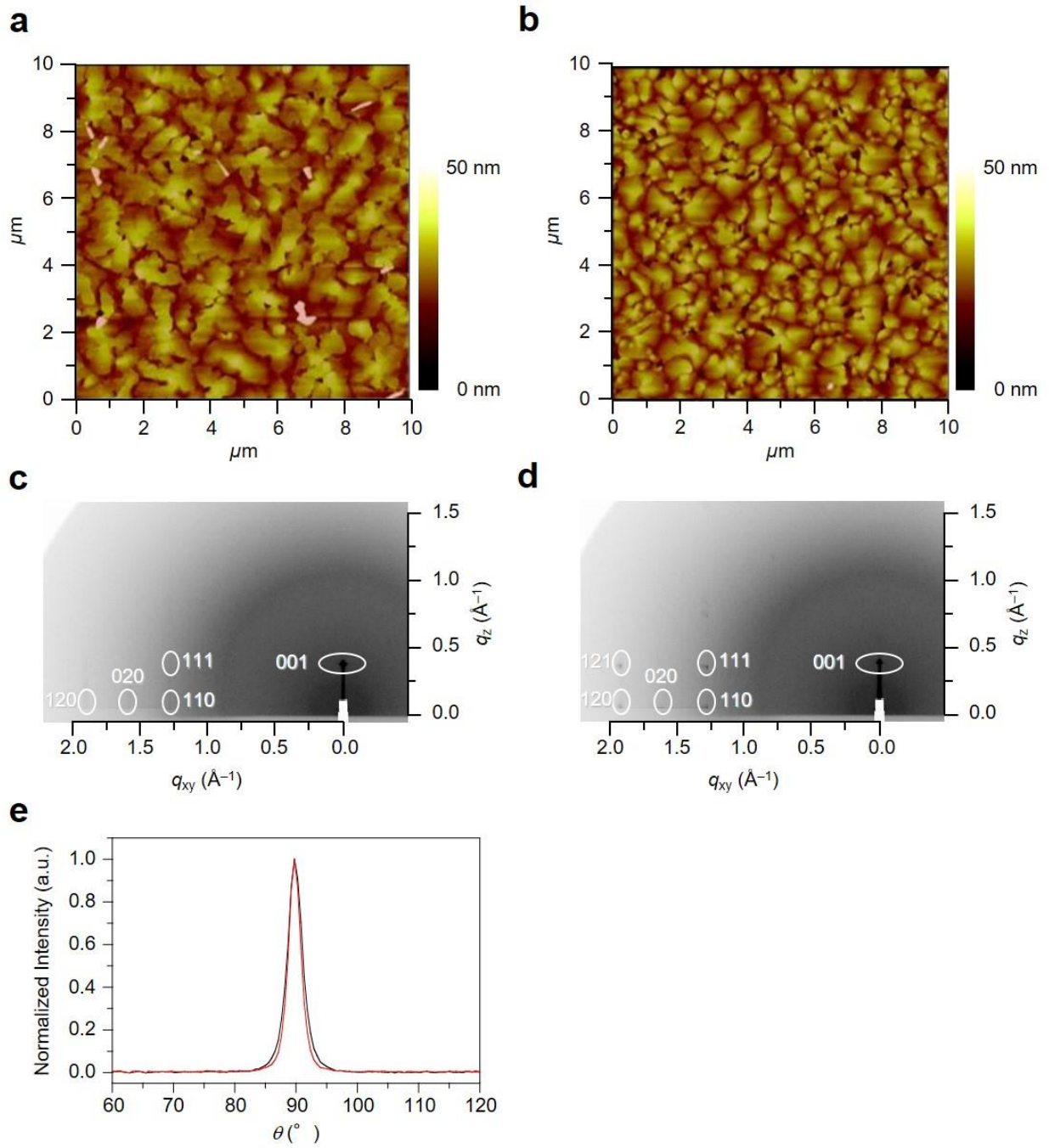
Supplementary Figure 1

DSC profile (second heating/cooling cycle) of triptycene.



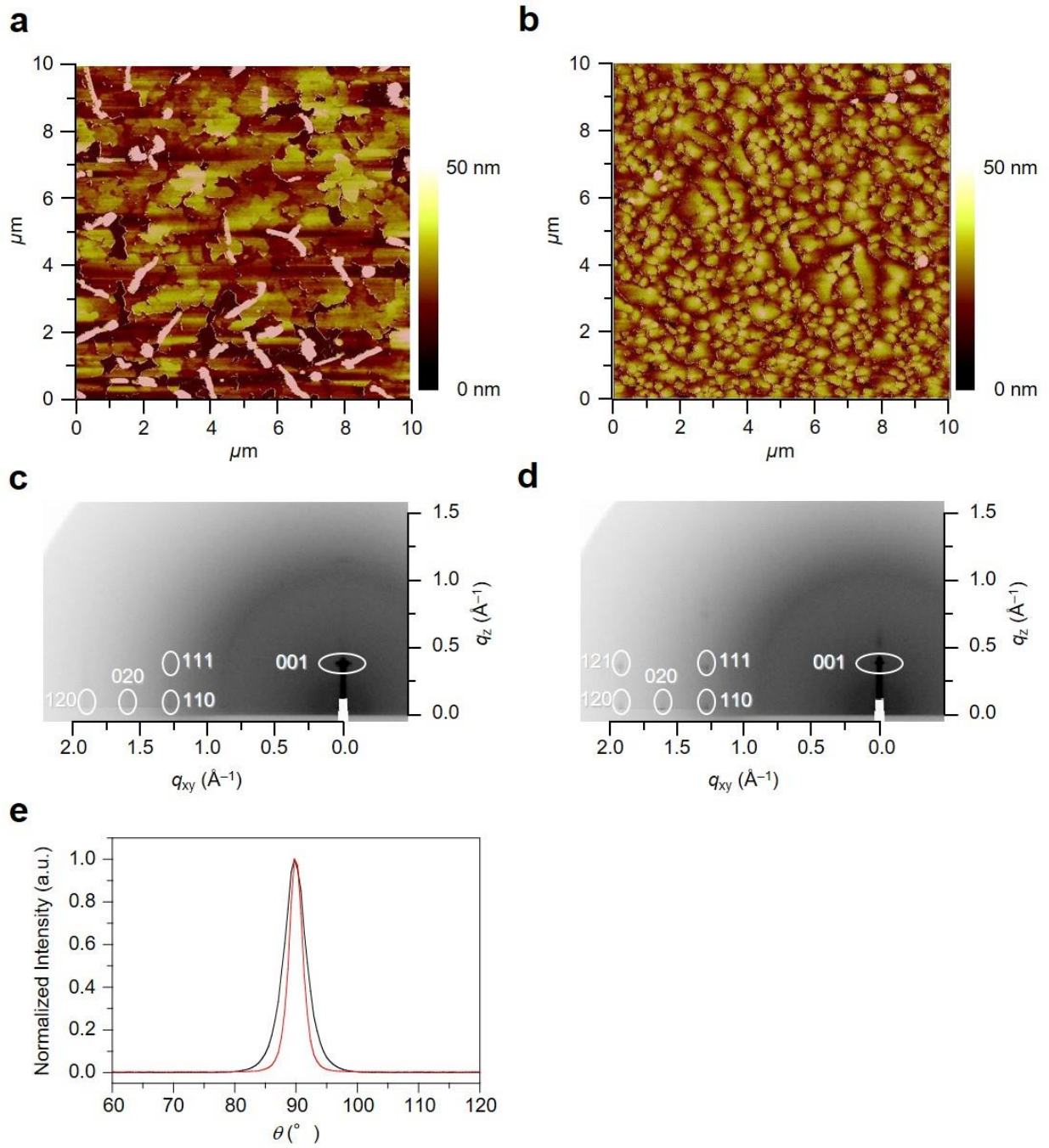
Supplementary Figure 2

AFM height images of evaporated DNTT films on **a**, parylene (diX-SR) and **b**, triptycene-coated parylene (diX-SR) gate dielectrics.



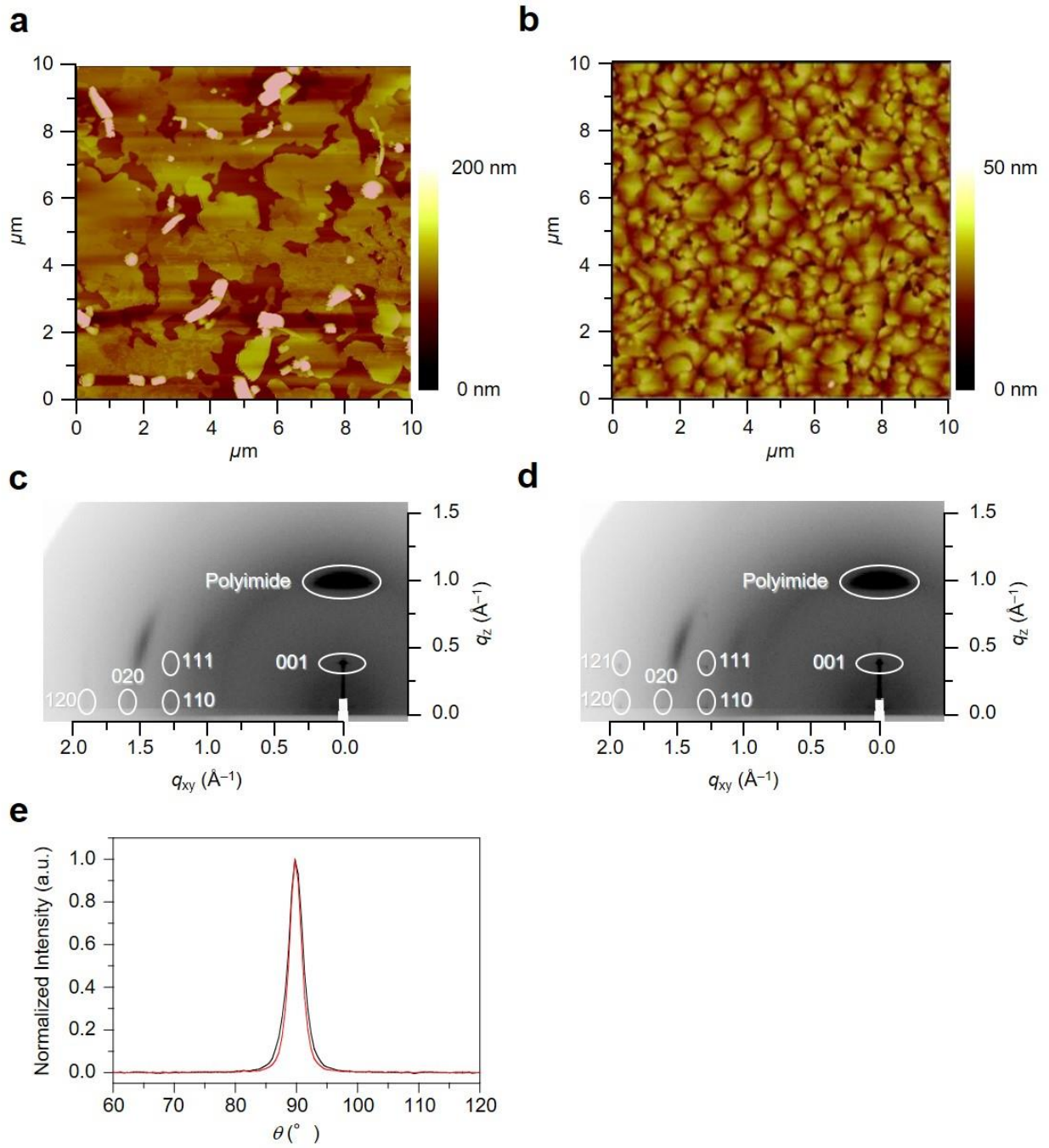
Supplementary Figure 3

Structural characterization of 30 nm-thick films of DNTT, prepared by vacuum evaporation of DNTT onto Si/SiO₂ and triptycene-coated Si/SiO₂ at 25 $^\circ\text{C}$. AFM height images of evaporated DNTT films on **a**, Si/SiO₂ and **b**, triptycene-coated Si/SiO₂. 2D GI-XRD images at 25 $^\circ\text{C}$ and their peak assignments of evaporated films of DNTT on **c**, Si/SiO₂ and **d**, triptycene-coated Si/SiO₂; Miller indices are shown in the 2D GI-XRD images. **e**, Angular dependency of the diffraction peak intensity from the (001) plane of evaporated DNTT on Si/SiO₂ (black) and triptycene-coated Si/SiO₂ (red), converted from the GI-XRD images.



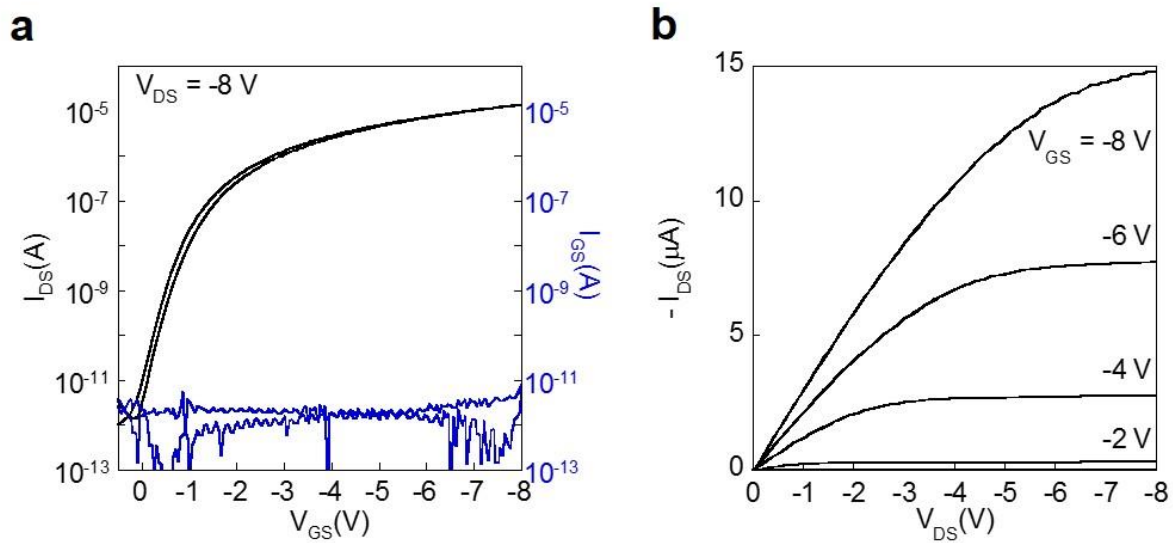
Supplementary Figure 4

Structural characterization of 30 nm-thick films of DNTT, prepared by vacuum evaporation of DNTT onto AlO_x and triptycene-coated AlO_x at 25 $^\circ\text{C}$. AFM height images of evaporated DNTT films on **a**, AlO_x and **b**, triptycene-coated AlO_x . 2D GI-XRD images at 25 $^\circ\text{C}$ and their peak assignments of evaporated films of DNTT on **c**, AlO_x and **d**, triptycene-coated AlO_x ; Miller indices are shown in the 2D GI-XRD images. **e**, Angular dependency of the diffraction peak intensity from the (001) plane of evaporated DNTT on AlO_x (black) and triptycene-coated AlO_x (red), converted from the GI-XRD images.



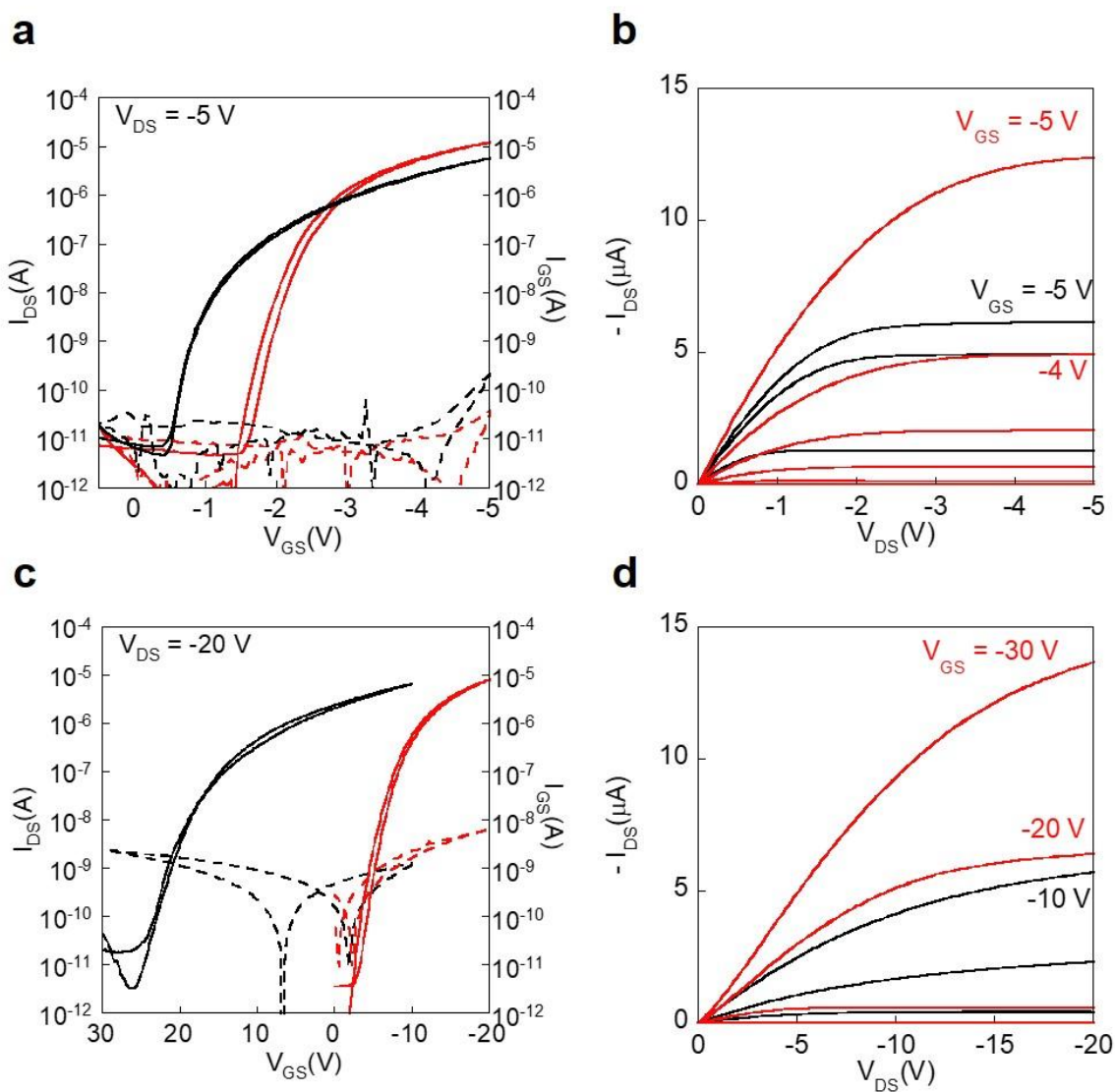
Supplementary Figure 5

Structural characterization of 30 nm-thick films of DNTT, prepared by vacuum evaporation of DNTT onto polyimide and triptycene-coated polyimide at 25 °C. AFM height images of evaporated DNTT films on **a**, polyimide and **b**, triptycene-coated polyimide. 2D GI-XRD images at 25 °C and their peak assignments of evaporated films of DNTT on **c**, polyimide and **d**, triptycene-coated polyimide; Miller indices are shown in the 2D GI-XRD images. **e**, Angular dependency of the diffraction peak intensity from the (001) plane of evaporated DNTT on polyimide (black) and triptycene-coated polyimide (red), converted from the GI-XRD images.



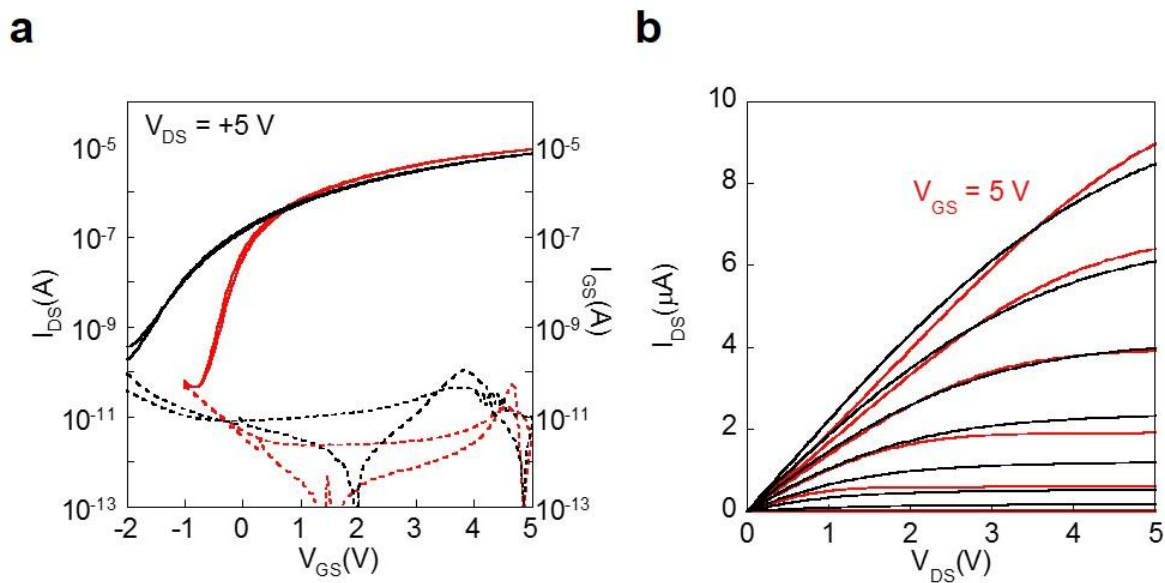
Supplementary Figure 6

a, Transfer and **b**, output curves of OTFTs having a parylene dielectric modified with few-layer triptycene film by drop casting. The calculated mobility and V_{TH} were 1.77 ± 0.1 cm^2/Vs and -0.67 ± 0.25 V, respectively.



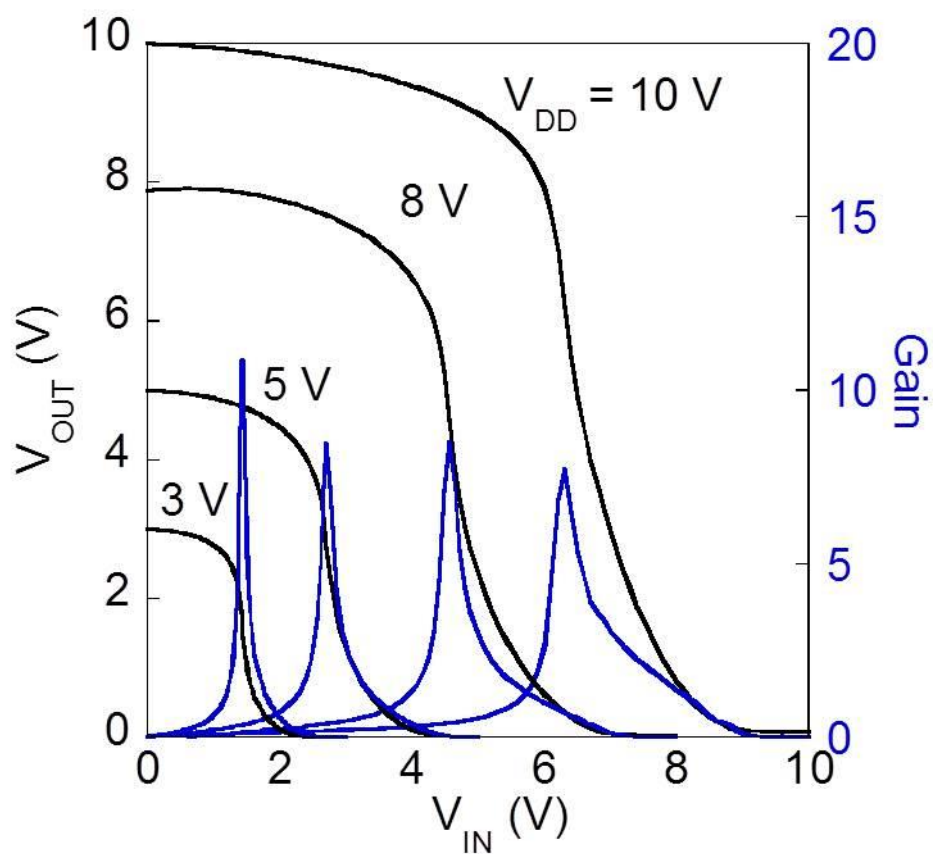
Supplementary Figure 7

Comparison of electrical characteristics of OTFTs in the presence (red) and absence (black) of a few-layer triptycene film. **a**, Transfer and **b**, output curves of OTFT fabricated with an AlO_x gate dielectric. **c**, Transfer and **d**, output curves of OTFT with a SiO_2 gate dielectric.



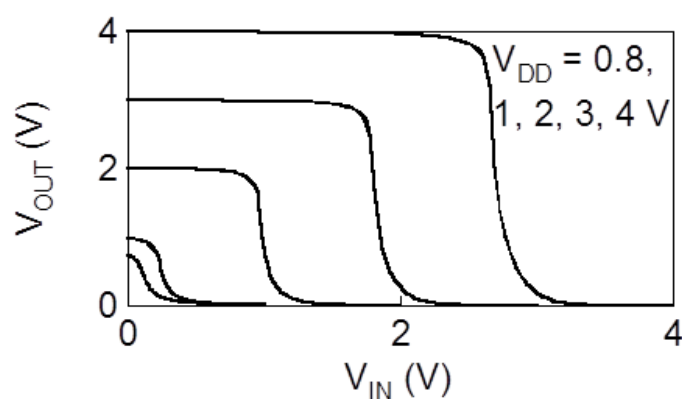
Supplementary Figure 8

Electrical characteristics of PDI8-CN2-based OTFTs fabricated with parylene (diX-SR) gate dielectric layers. **a**, Transfer and **b**, output curves in the presence (red) and absence (black) of a few-layer triptycene film.



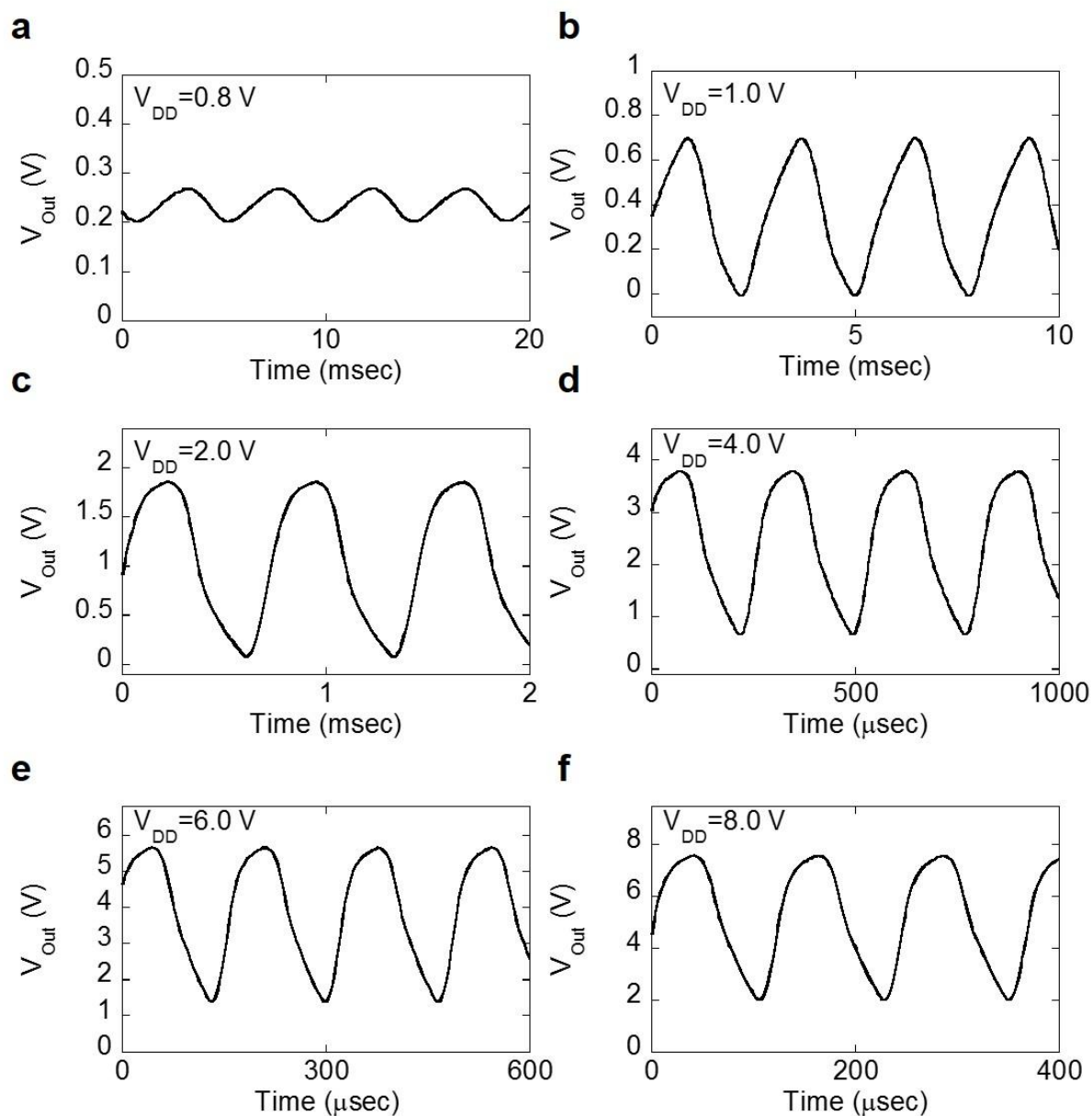
Supplementary Figure 9

Output voltage of complementary inverter circuits in the absence of a few-layer triptycene film. The circuits were operated at 3 V.



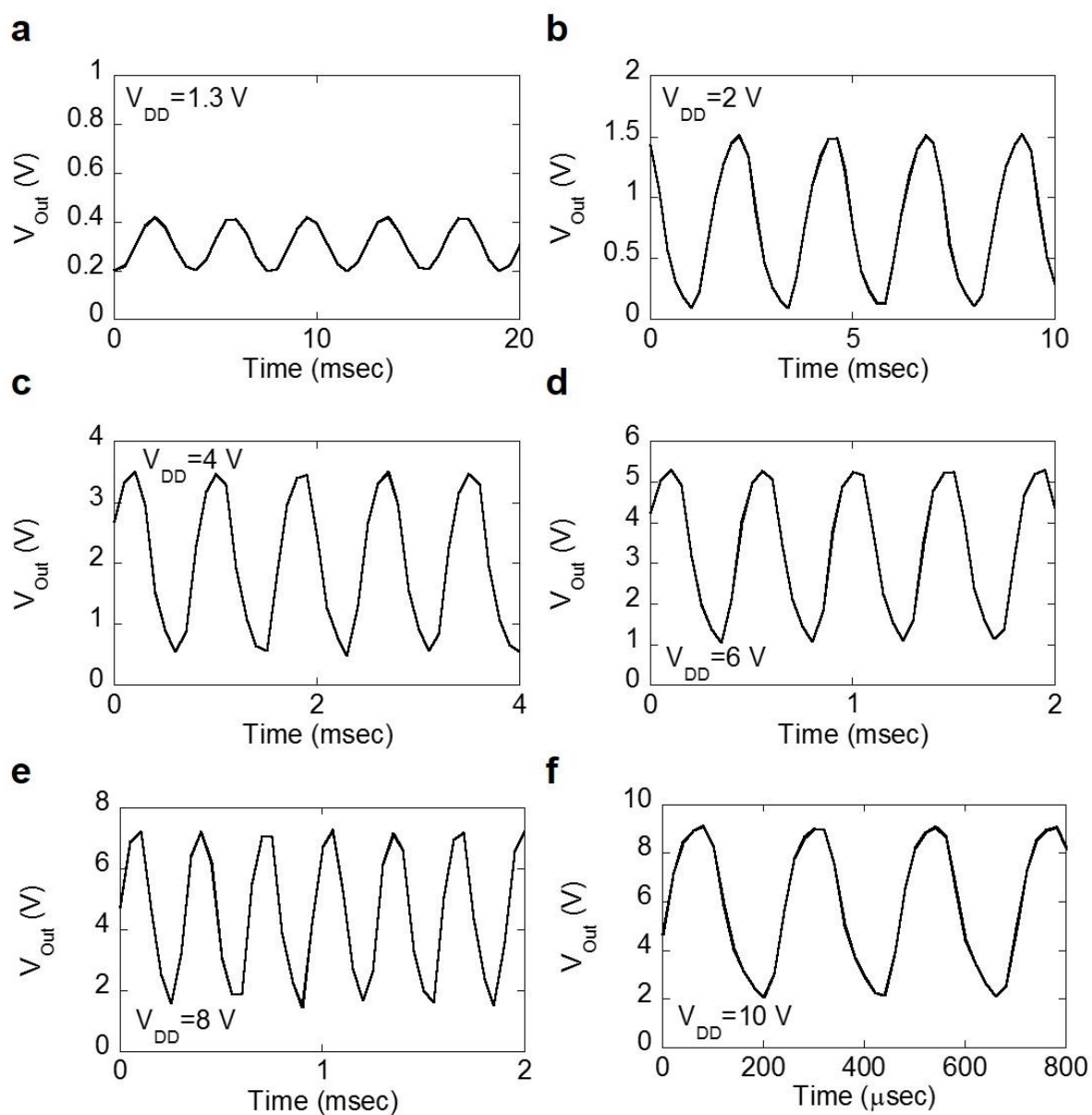
Supplementary Figure 10

Characteristics of complementary inverter circuits constructed from OTFTs having a 30 nm-thick parylene dielectric with a solution-processed triptycene film. The triptycene film was fabricated by drop-casting a mesitylene solution of triptycene (1 mg/mL, 0.3 mL) onto a substrate (polyimide/Au/diX-SR), which has a composition similar to that used for the device with a thermally evaporated triptycene film. The resulting multi-layered film (polyimide/Au/diX-SR/triptycene) was thermally annealed at 120 °C for 1 h under a nitrogen atmosphere.



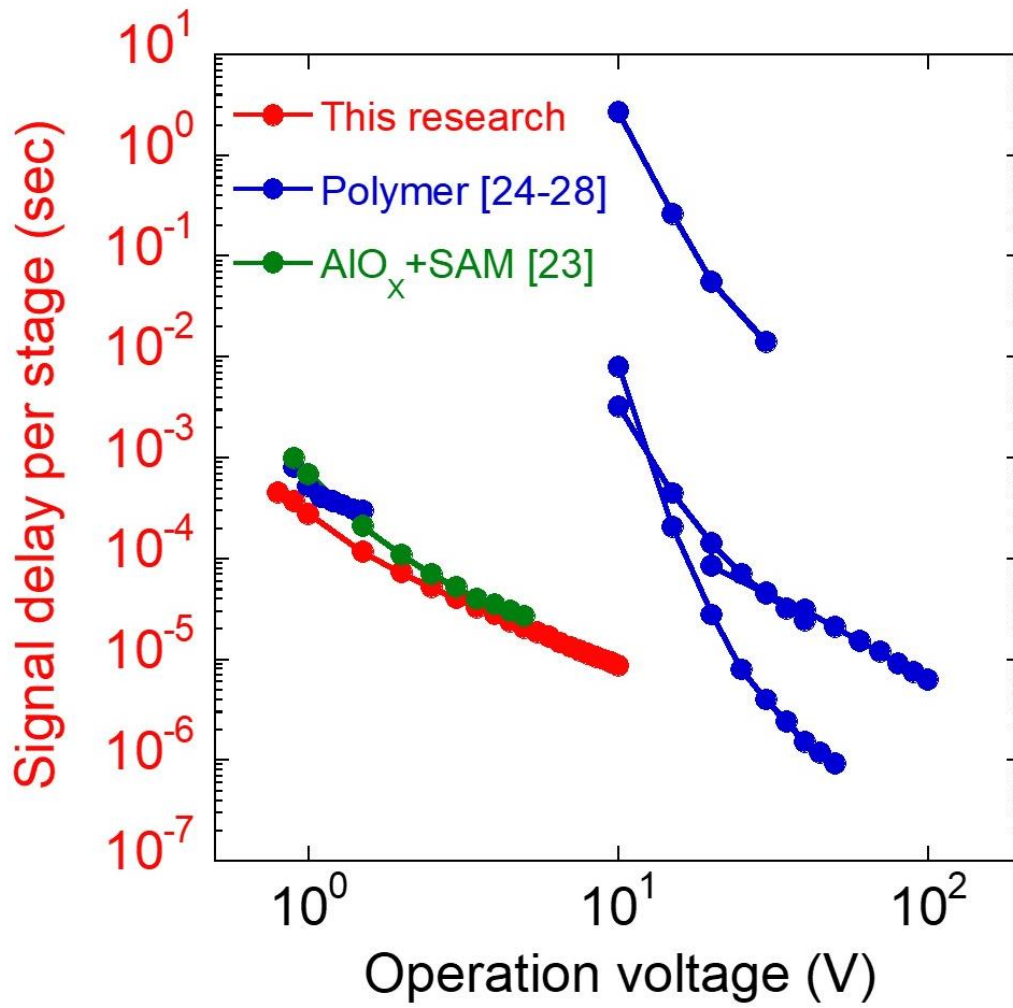
Supplementary Figure 11

Output signal of a ring oscillator with a few-layer triptycene film as a function of V_{DD} . **a**, 0.8, **b**, 1, **c**, 2, **d**, 4, **e**, 6, and **f**, 8 V.



Supplementary Figure 12

Output signal of a ring oscillator without a few-layer triptycene film as a function of V_{DD} . **a**, 1.3, **b**, 2, **c**, 4, **d**, 6, **e**, 8, and **f**, 10 V.



Supplementary Figure 13

Comparison of the present complementary ring oscillator having triptycene film-coated parylene dielectric (red) with previously reported complementary ring oscillators having polymer gate dielectrics (blue) and a complementary ring oscillator having a SAM-coated AlO_x gate dielectric (green) in terms of signal delay per stage values.

Supplementary Table 1

Contact angles (degree) of ethylene glycol and water on various substrates.

Dielectric	Without triptycene		With triptycene	
	water	ethylene glycol	water	ethylene glycol
AlO _x	44.1±1.5	39.9±1.2	110.0±0.3	83.7±0.5
SiO ₂	77.8±0.7	51.9±1.7	110.1±0.7	82.2±0.4
Polyimide	76.6±0.3	49.2±2.1	110.1±0.2	81.9±0.6
Parylene (diX-SR)	87.1±0.4	51.6±0.2	110.0±0.5	82.9±0.7
Parylene (diX-D)	87.0±0.5	52.6±0.6	110.6±0.7	83.0±0.3