Supplementary Information

Organic Transistors with High Thermal Stability for Medical Applications

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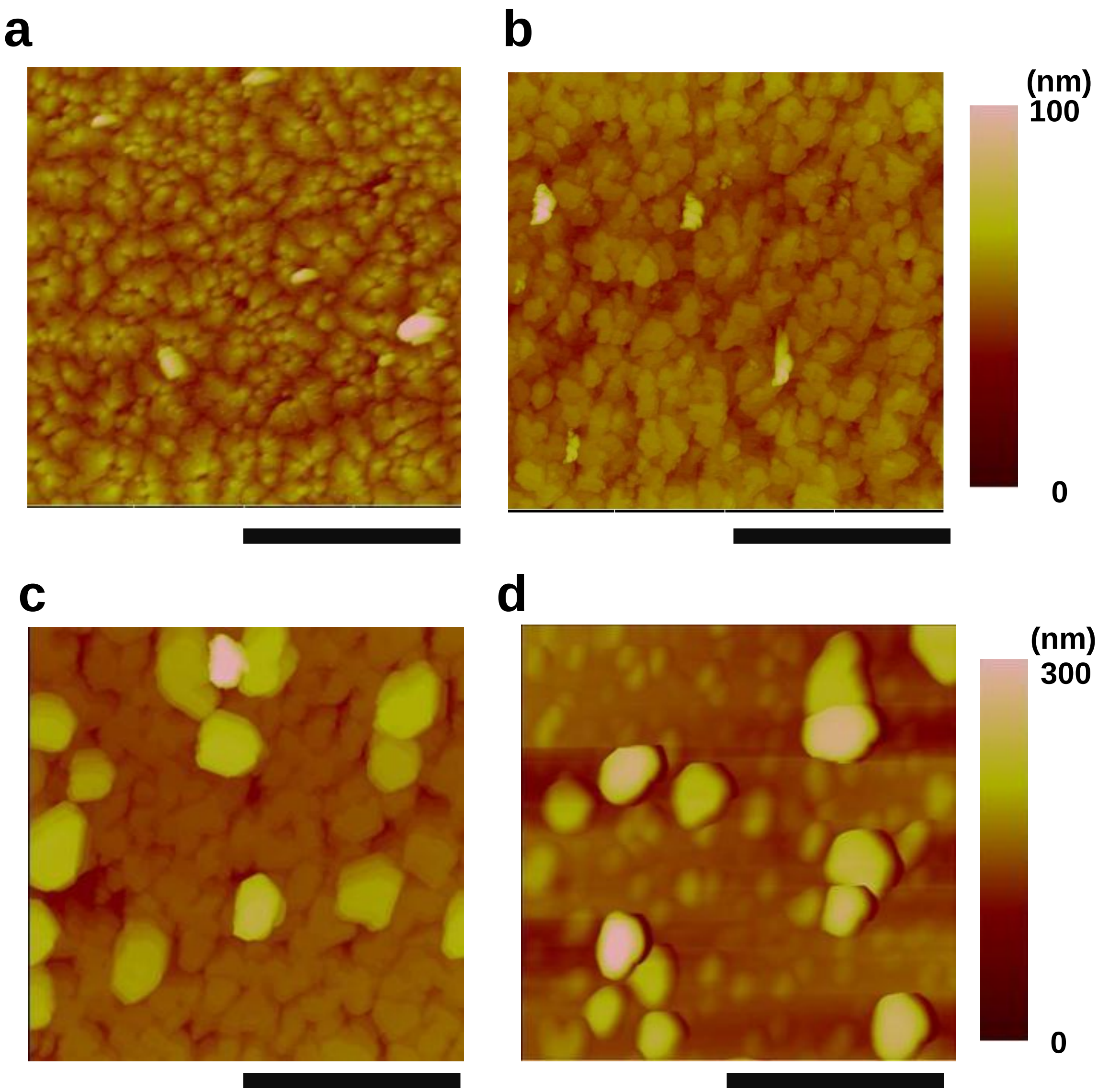
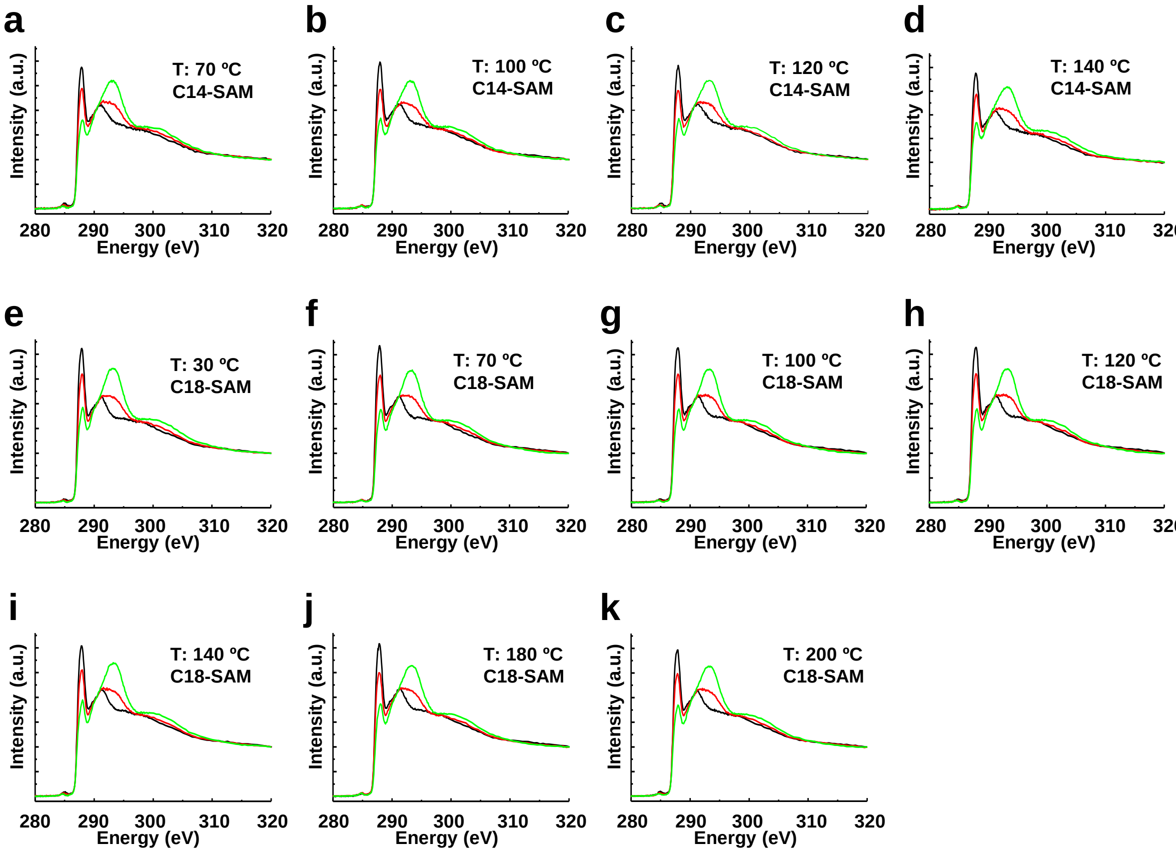


Supplementary Figure S1:

Atomic force microscopy (AFM) images of a DNTT film after annealing.

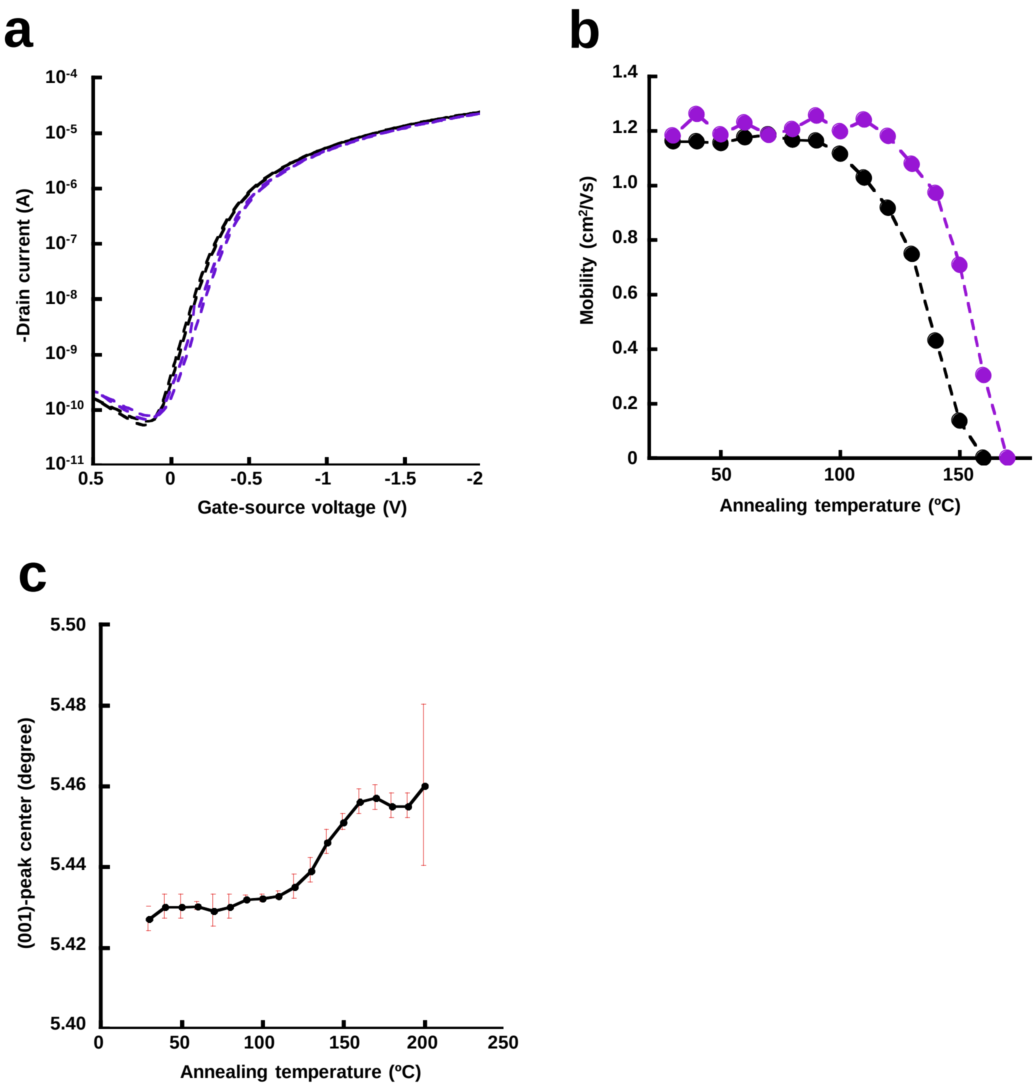
AFM images of DNTT films on the AlO_x/SAM gate dielectric, which are annealed at temperatures of (a) 30 ºC, (b) 70 ºC, (c) 140 ºC, and (d) 160 ºC. After annealing at 140 ºC, partial sublimation of the DNTT are observed, coinciding with a degradation of the electrical performance of the TFTs. Scale bar is 5 μm.



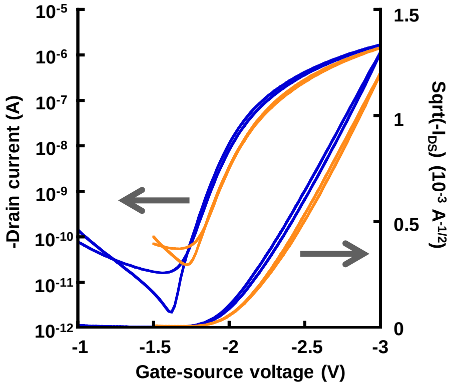
Supplementary Figure S2:

Near edge X-ray absorption fine structure (NEXAFS) spectroscopy.

The pre- and post-edge normalized NEXAFS spectra of a C14-SAM and a C18-SAM on AlO_x annealed at different temperatures, ranging from 30 ºC to 200 ºC. Green lines show data with grazing angle of 35º, and those of 55º and 75º are shown with red and black lines, respectively.

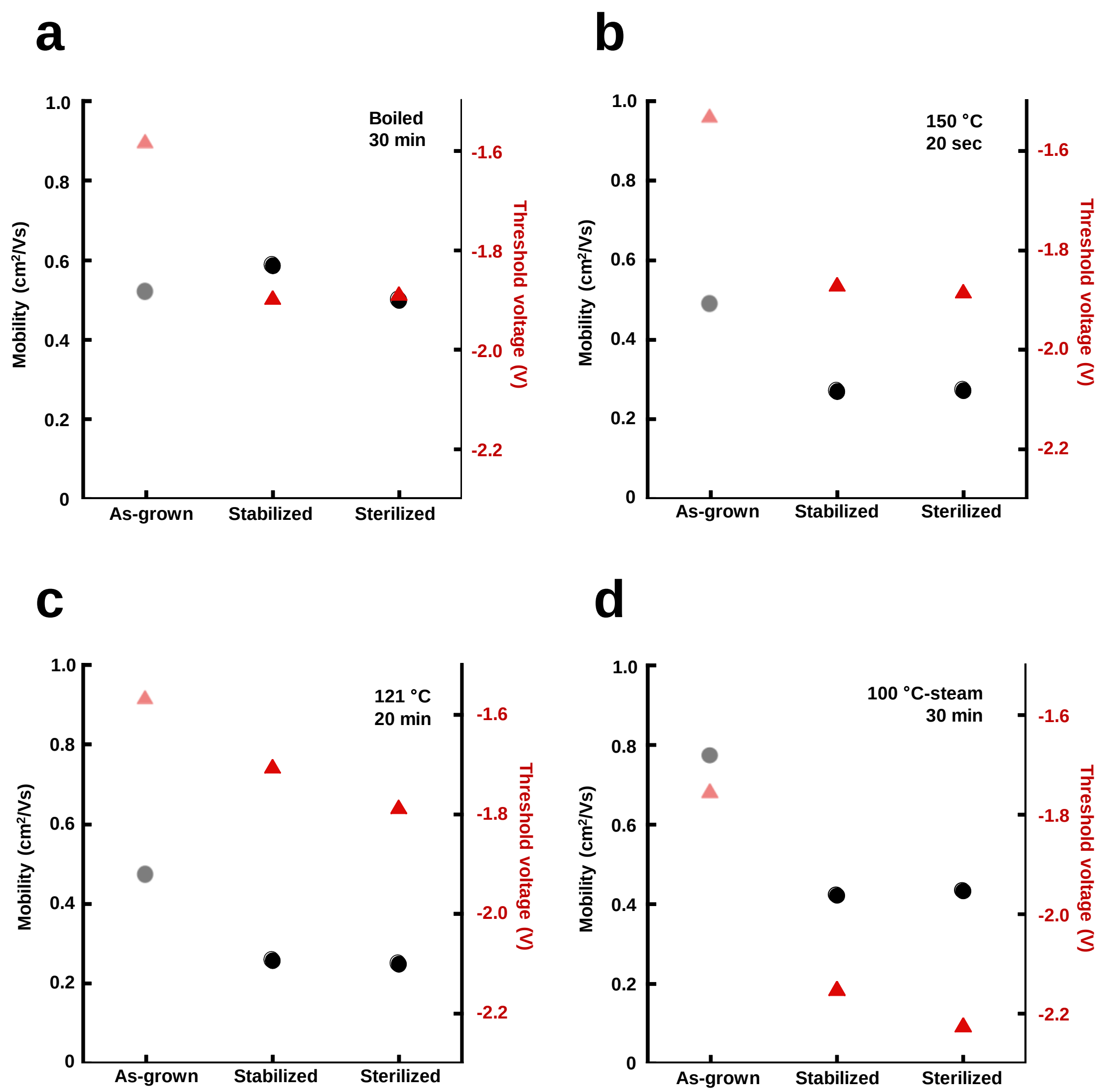


Supplementary Figure S3:
Effects of a parylene passivation layer.
(a) Transfer curves of DNTT TFTs fabricated with (purple line) and without (black line) a 3-μm thick vapor-deposited parylene encapsulation layer, (b) the mobility of these TFTs as a function of annealing temperature, and (c) the shift of the (001) diffraction peak as a function of annealing temperature. Error bars describe standard errors from regression analysis to detect center of diffraction peak.



Supplementary Figure S4

TFT transfer curves before and after sterilization experiments. Transfer curves of a DNTT TFT before (blue line) and after (orange line) annealing at a temperature of 100 ºC for 30 min in saturated steam. Right side labels are square root of drain current (I_{DS}). The sterilization experiments were carried out in ambient atmosphere. The substrate used in this experiment is flexible polyimide.



Supplementary Figure S5:
Changes in mobility and threshold voltage after four different sterilization. (a) TFTs stored in boiling water (100 °C) for 30 min; (b) TFTs heated to a temperature of 150 °C for 20 sec in air; (c) TFTs heated to a temperature of 121 °C for 20 min in air; (d) TFTs subjected to steam with a temperature of 100 °C for 30 min.

Supplementary Methods

Near edge X-ray absorption fine structure (NEXAFS) spectroscopy

In Supplementary Fig. S2, the thermal stability of self-assembled monolayers based on n-tetradecylphosphonic acid (C14-SAM) and n-octadecylphosphonic acid (C18-SAM) was investigated by NEXAFS where samples measured in these experiments were structured as AlO_x/SAM on oxidized silicon substrates.

Supplementary Fig. S2 displays the pre- and post-edge normalized NEXAFS spectra of a C14-SAM and a C18-SAM on AlO_x annealed at different temperatures, ranging from 30 ºC to 200 ºC. We have found that C14-SAMs and C18-SAMs annealed at different temperatures all show similar results as the representative sample in Figure 4a. This indicates that the C14-SAM and the C18-SAM are highly oriented over a wide range of temperatures.

Effects of a parylene passivation layer for thermal stability

Supplementary Fig. S3 shows the transfer curves of DNTT TFTs fabricated with and without a 3-μm thick vapor-deposited parylene encapsulation layer, the mobility of these TFTs as a function of annealing temperature, and the shift of the (001) diffraction peak as a function of annealing temperature. Annealing was carried out in a nitrogen-filled glove box. As can be seen, the TFT with encapsulation has much better thermal stability than the TFT without encapsulation.