Supporting Information

Damage-free Hybrid Encapsulation of Organic Field-Effect Transistors to Reduce Environmental Instability

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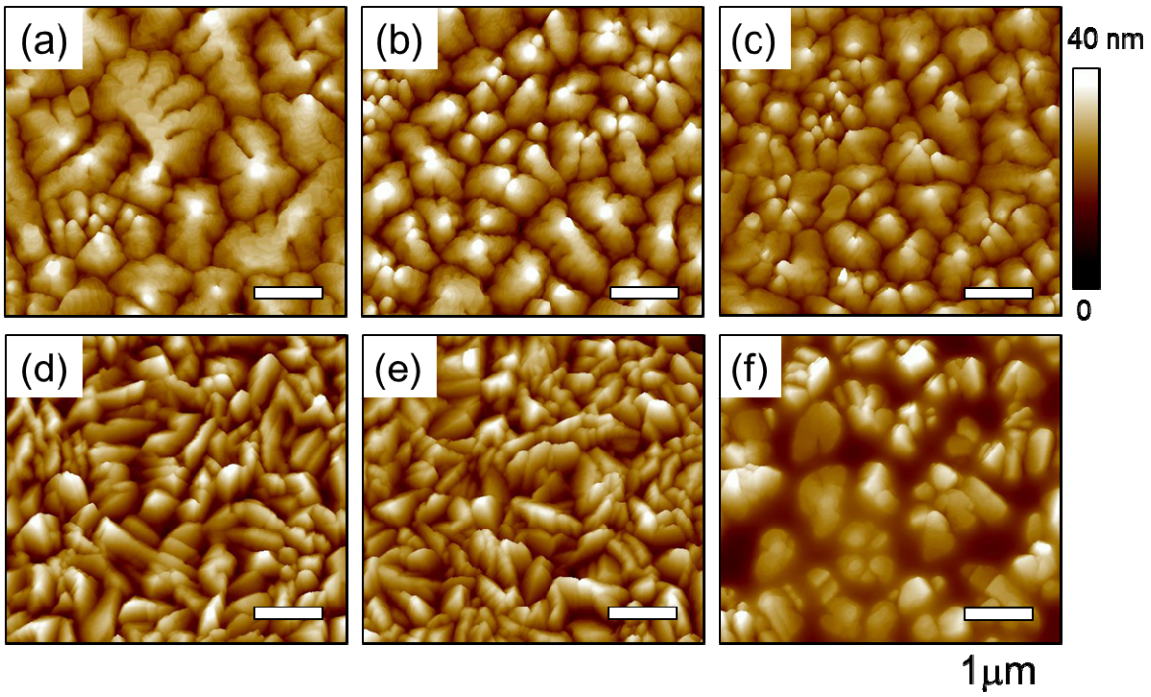

Fig. S1. AFM topographies of 50 nm thick pentacene films on the PS/SiO_2 dielectrics after annealing at various temperatures for 1 h: (a) 30 ^{o}C; (b) 60 ^{o}C; (c) 90 ^{o}C; (d) 120 ^{o}C; (e) 150 ^{o}C; (f) 180 ^{o}C.

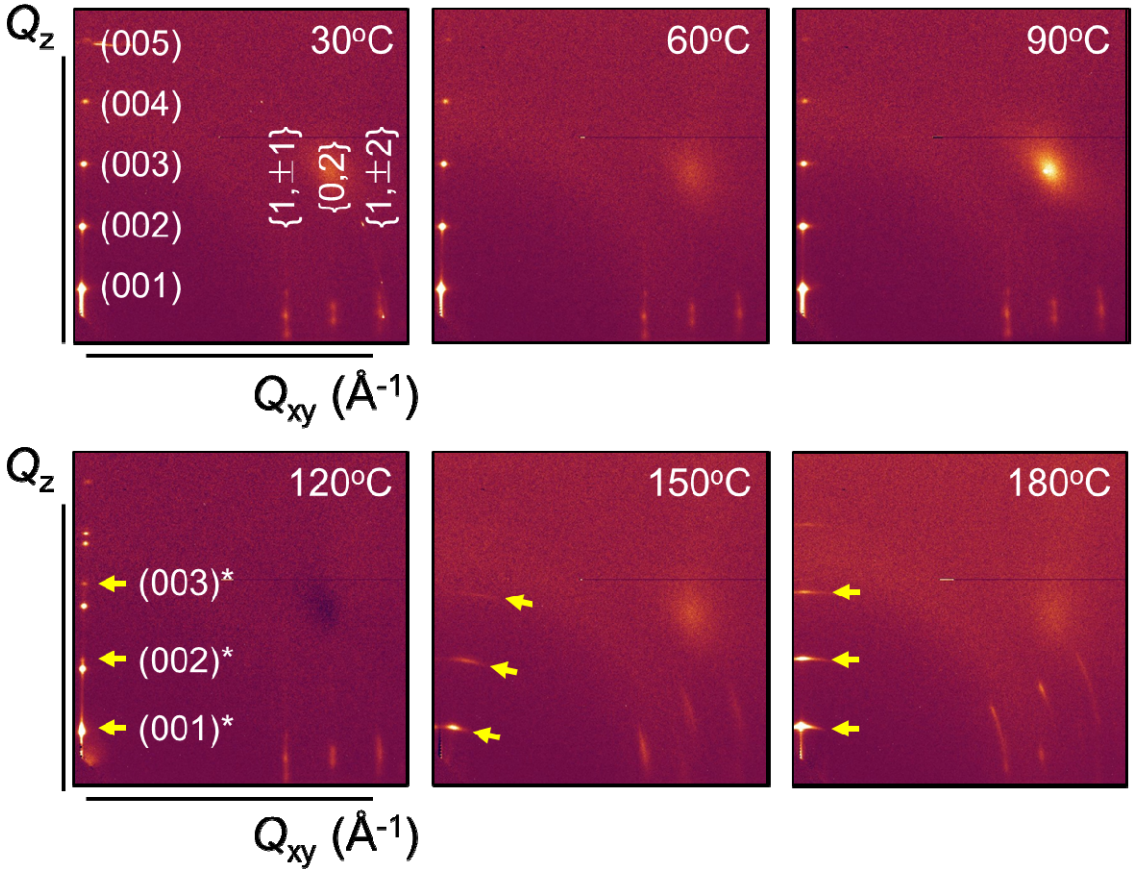

Fig. S2. 2D X-ray θ/2θ scanning patterns showing the overall crystal structures of 50 nm thick pentacene films on the PS/SiO_2 dielectrics after annealing at various temperatures for 1 h. (Based on two different X-ray modes: GIXD and θ/2θ scanning, it was found that the 120 ^{o}C sample contained two different types of "*bulk phase*", located at different film levels.)

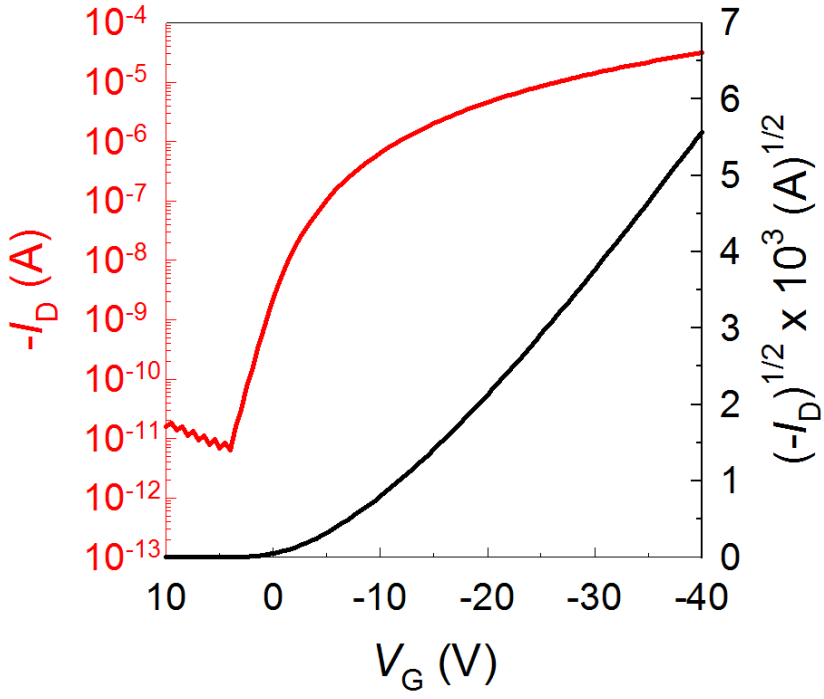

Fig. S3. I_D-V_G transfer characteristics of a top-contact electrode pentacene OFET (with channel length L = 100 μm and width W = 1500 μm) employing a PI/SiO_2 dielectric (V_{DS} = -40 V).

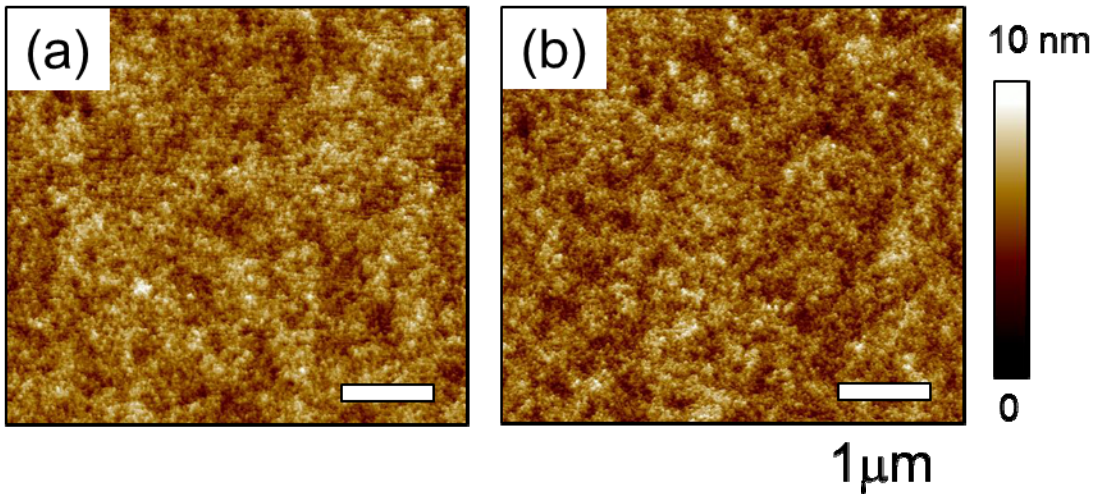

Fig. S4. AFM surface topographies of a PS/SiO_2 dielectric before (a) and after (b) SiO_x layer coating.

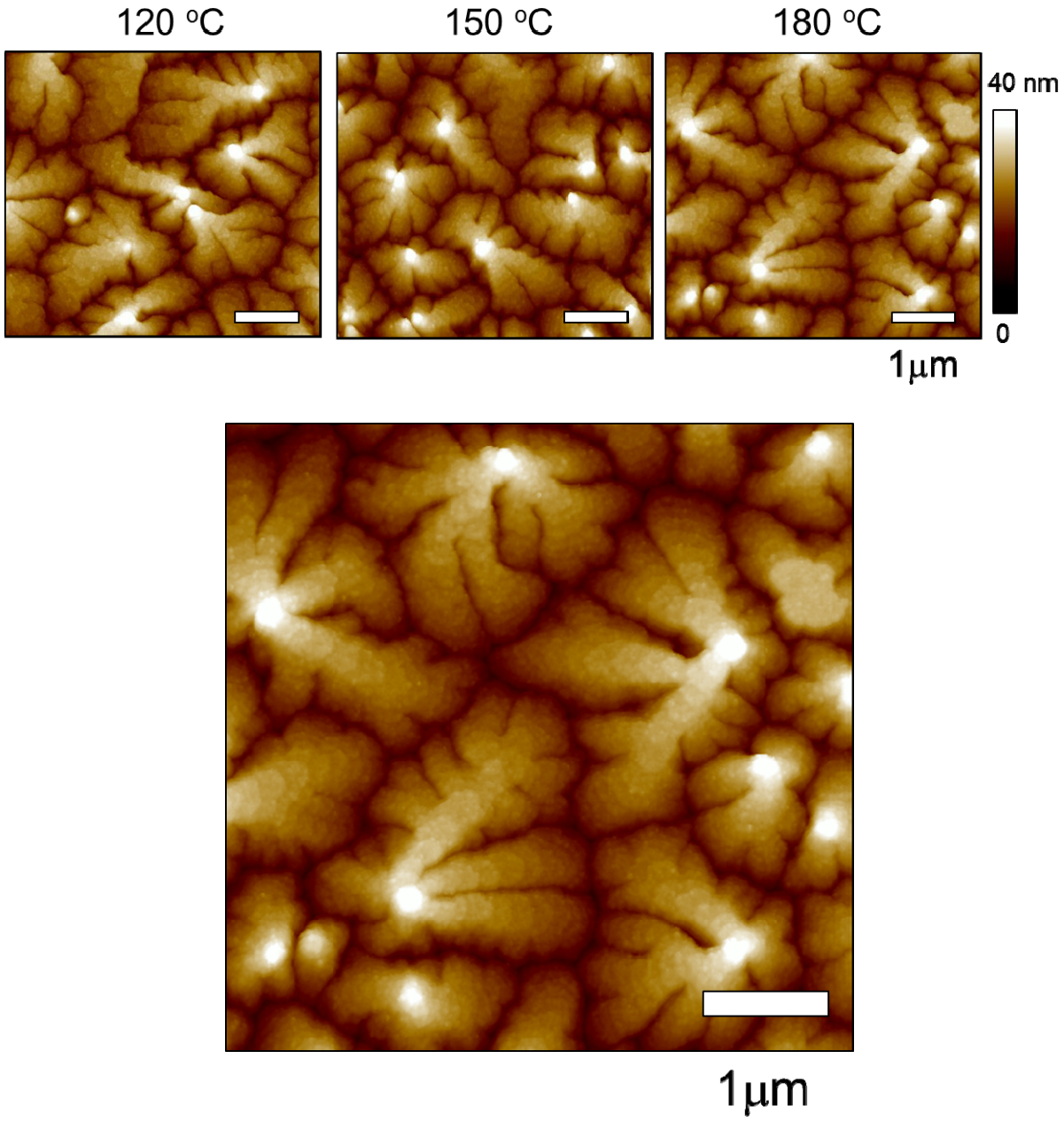

Fig. S5. AFM topographies of SiO_x-capped pentacene films on PI/SiO_2 dielectrics after thermal annealing at various temperatures for 1 h.

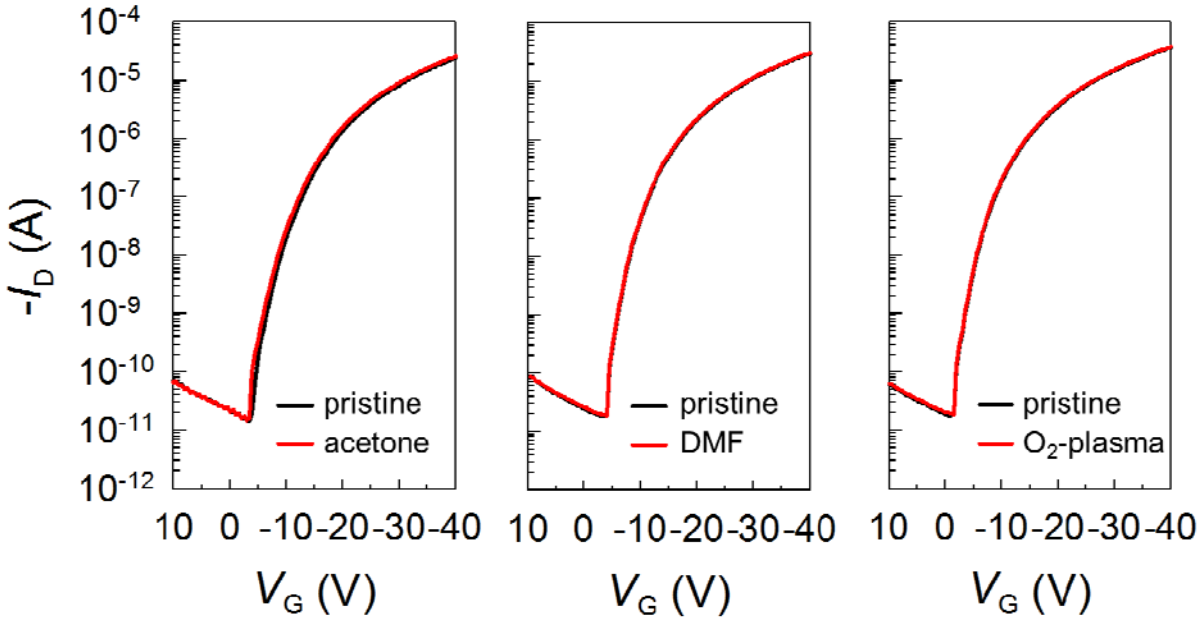

Fig. S6. I_D-V_G transfer curves of SiO_x-capped pentacene OFETs employing PS/SiO_2 dielectrics before and after aging in various environments: acetone, DMF, and O_2 plasma (V_D = -40 V).

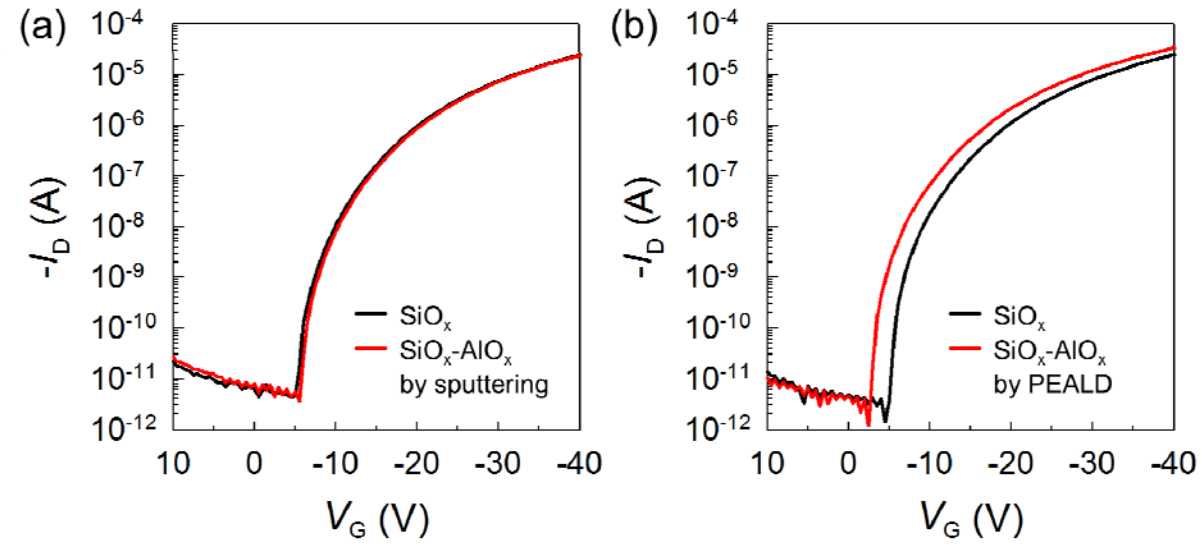

Fig. S7. I_D-V_G transfer curves of SiO_x-capped pentacene OFETs employing PS/SiO_2 dielectrics before and after the deposition of a 50 nm thick AlO_x-layer by using (a) RF magnetron sputtering and (b) PEALD (V_D = -40 V).

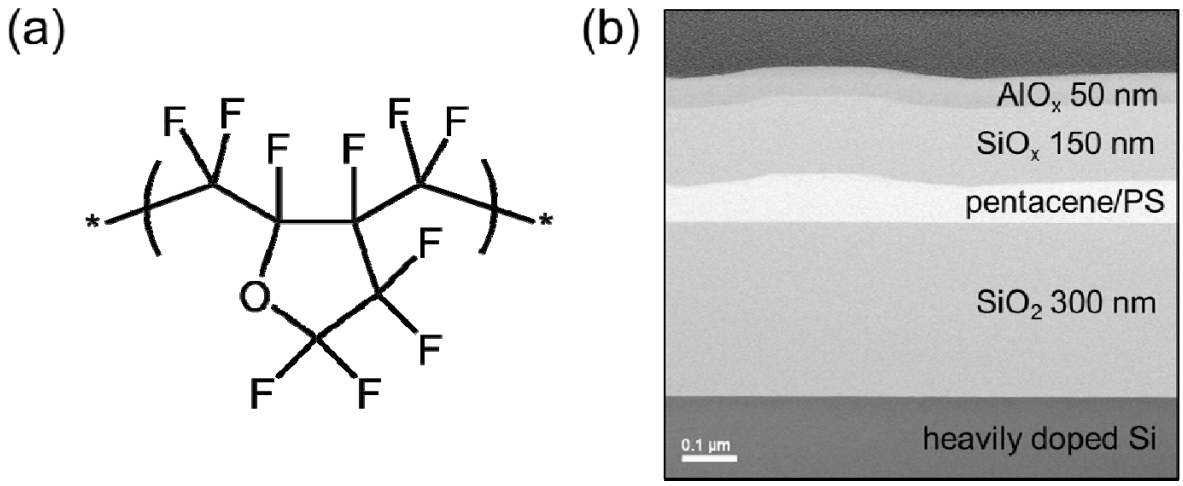

Fig. S8. (a) Chemical structure of the CYTOP^{TM} polymer. (b) Cross-sectional transmission electron microscopy (TEM) image of pentacene OFET device encapsulated by SiO_x-AlO_x bilayer.