Supplementary Information

Ultra-Sensitive Mercury Sensor Based on Thin Film Transistor using Flavin Self-Assembly on Monochiral Carbon Nanotubes

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Note S1: Conductance calculation of FC12/(8,6)-SWCNT TFT devices

The electrical conductance (G) of the FC12/(8,6)-SWCNT TFT devices was extracted from the low-bias linear regime of the I_D–V_D characteristics. To minimize the influence of contact nonlinearity and high-field effects, the conductance was determined from the slope of the I_D–V_D curve within the range of $V_D = -0.2$ to 0.2 V at $V_G = 0$ V. The conductance is defined as:

$$G = dI_D/dV_D \tag{S1}$$

where I_D is the drain current and V_D is the drain voltage. The slope was obtained by linear fitting of the I_D–V_D curve within the specified low-voltage window. For the PEGulated device, the measured current change in the linear regime yielded:

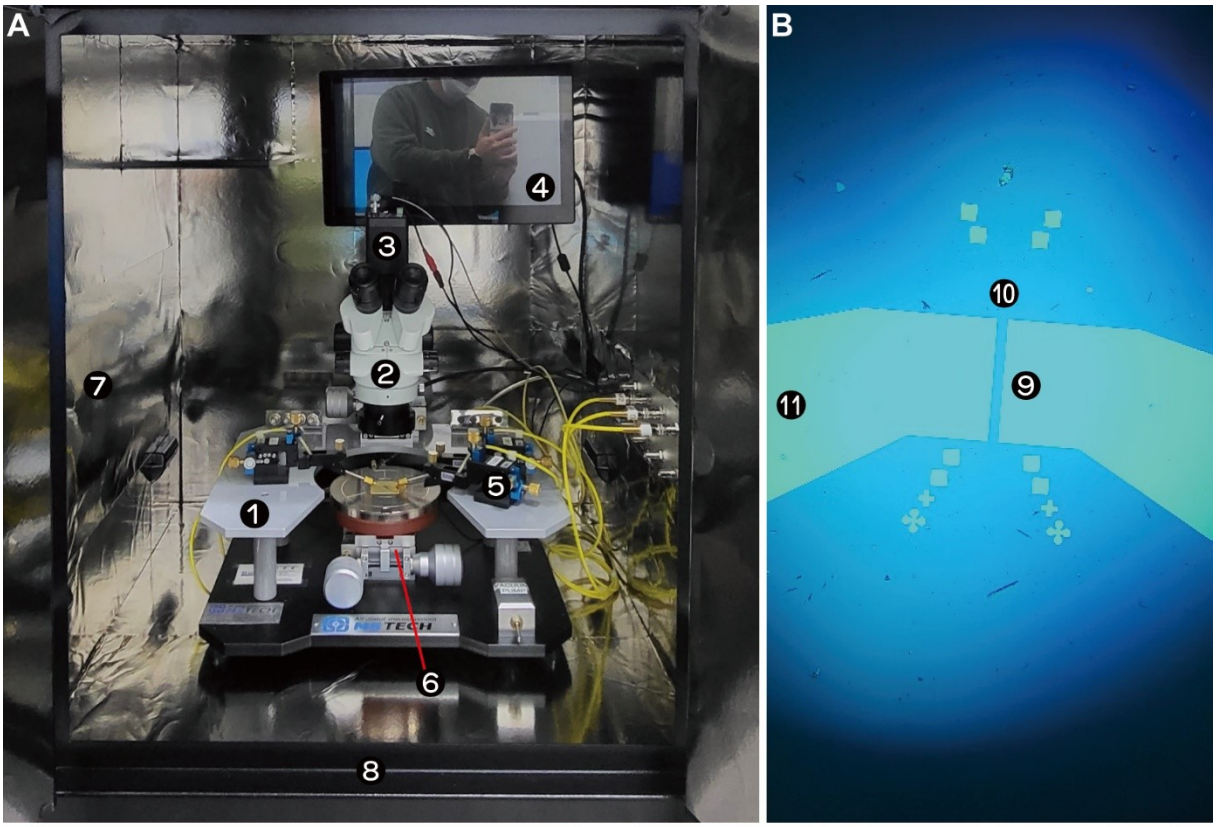
$$G_{PEG} = 8.3 \times 10^{-10}\ \text{S}$$

In contrast, the untreated device exhibited:

$$G_{untreated} = 1.0 \times 10^{-12}\ \text{S}$$

These results indicate an approximately two-order-of-magnitude enhancement in conductance upon PEG treatment. Because the conductance was extracted in the low-bias regime, the calculated G primarily reflects channel-dominated transport behavior.

Fig. S1 Photographs of probe station and TFT device.



A) Entire probe station

1. Probe station
2. Microscope
3. Camera
4. Monitor
5. Probe
6. Vaccum stage
7. Mu-metal
8. Dark shield box

B) Device

9. 230 μm channel width
10. 20 μm channel length
11. 50 nm thick Au/Ti electrode on a 285 nm-thick SiO_2/Si substrate

Fig. S2 PLE contour map of FC12/(8,6)-SWCNT film assembled on TFT device after photolithography including lift-off process.

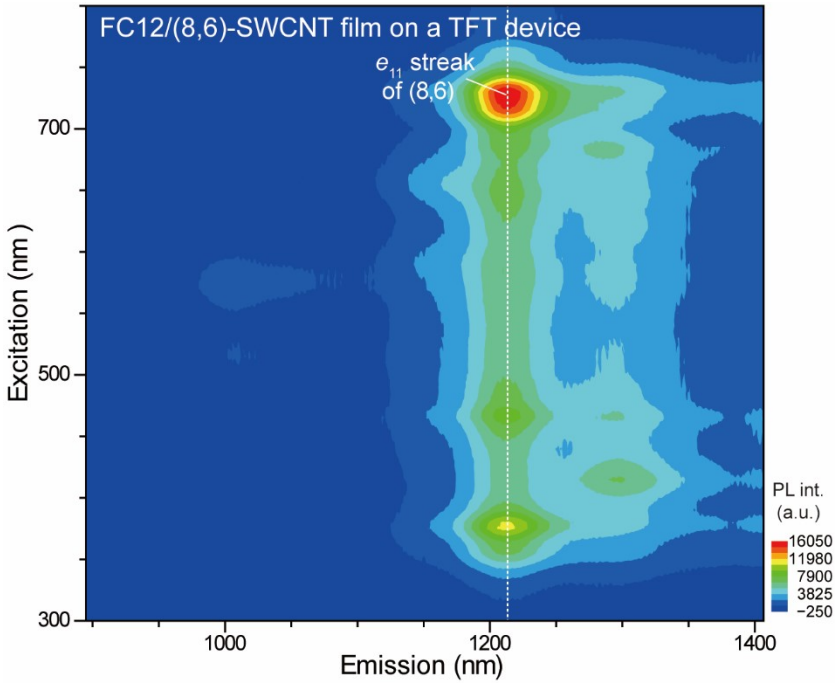


Fig. S3 (A−K) AFM height topographies of SAM with varying ratio of chloro(dimethyl)ethylsilane, choloro(dimethyl)octylsilane. Scale bars: 1 μm throughout figures.

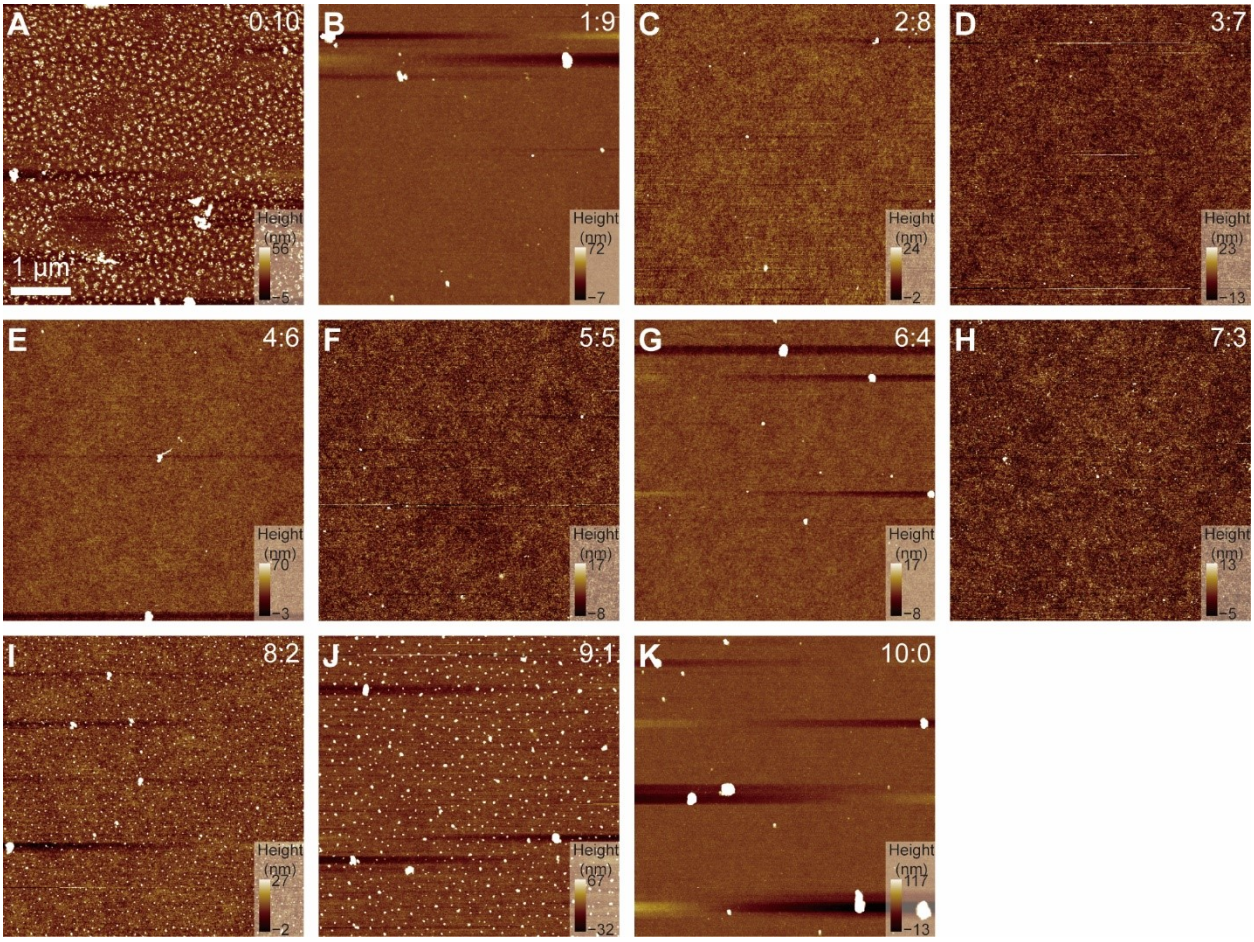


Fig. S4 Water contact angle change on the tandem alkyl SAM with varying precursor ratio of chloro(dimethyl)ethylsilane/choloro(dimethyl)octylsilane.

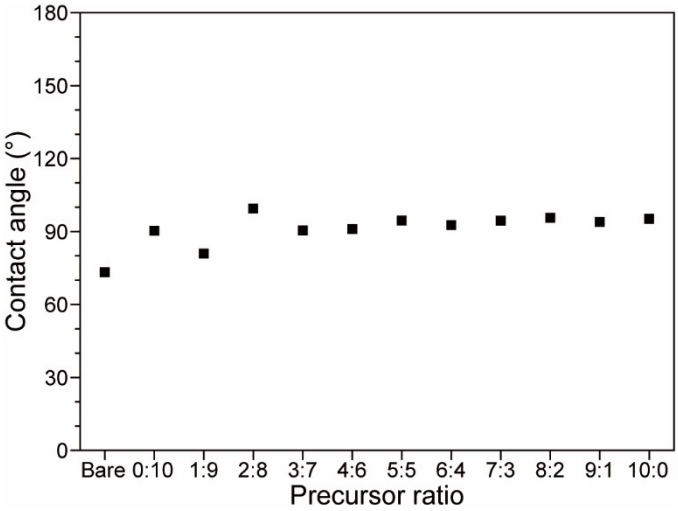


Fig. S5 Transfer characteristics (I_D–V_G) of FC12/(8,6)-SWCNT TFT devices measured at V_D = 1 V (A) before and (B) after PEGylation of Au electrodes.

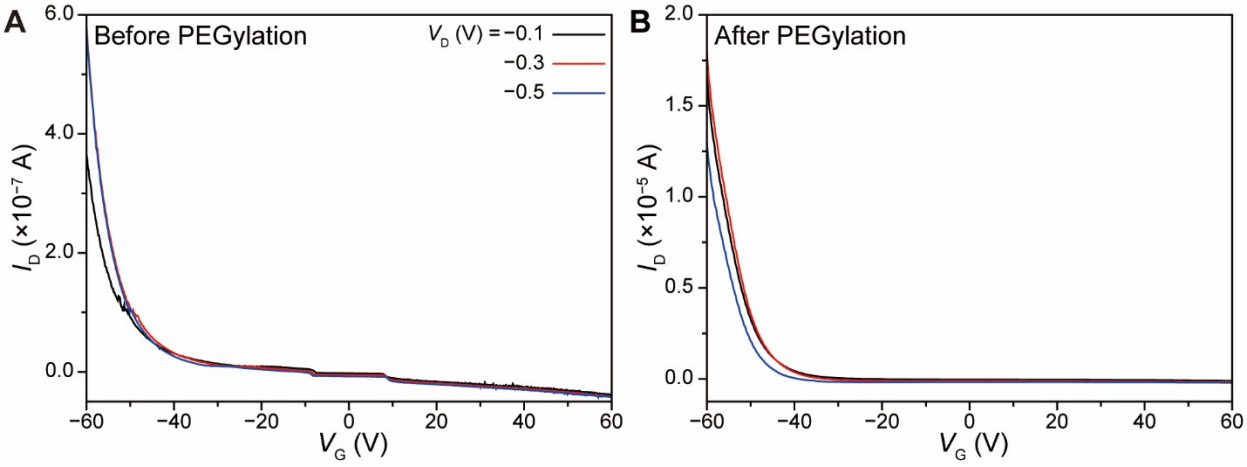


Fig. S6 Net effect of I_D levels of the Hg-sensing characteristics of FC12/(8,6)-SWCNT device with PEGylation.