Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Flash-evaporated small molecule films toward low-cost and flexible organic light-emitting diodes

Bo Wang, Zhao-Kui Wang, Jian Liang, Meng Li, Yun Hu, and Liang-Sheng Liao**

B. Wang, Dr. Z. K. Wang, J. Liang, M. Li, Y. Hu, Prof. L.S. Liao
Jiangsu Key Laboratory for Carbon-Based Functional Materials & Devices
Institute of Functional Nano & Soft Materials (FUNSOM)
Soochow University
Suzhou, Jiangsu 215123, P. R. China

E-mail: lsliao@suda.edu.cn; zkwang@suda.edu.cn;

Contents

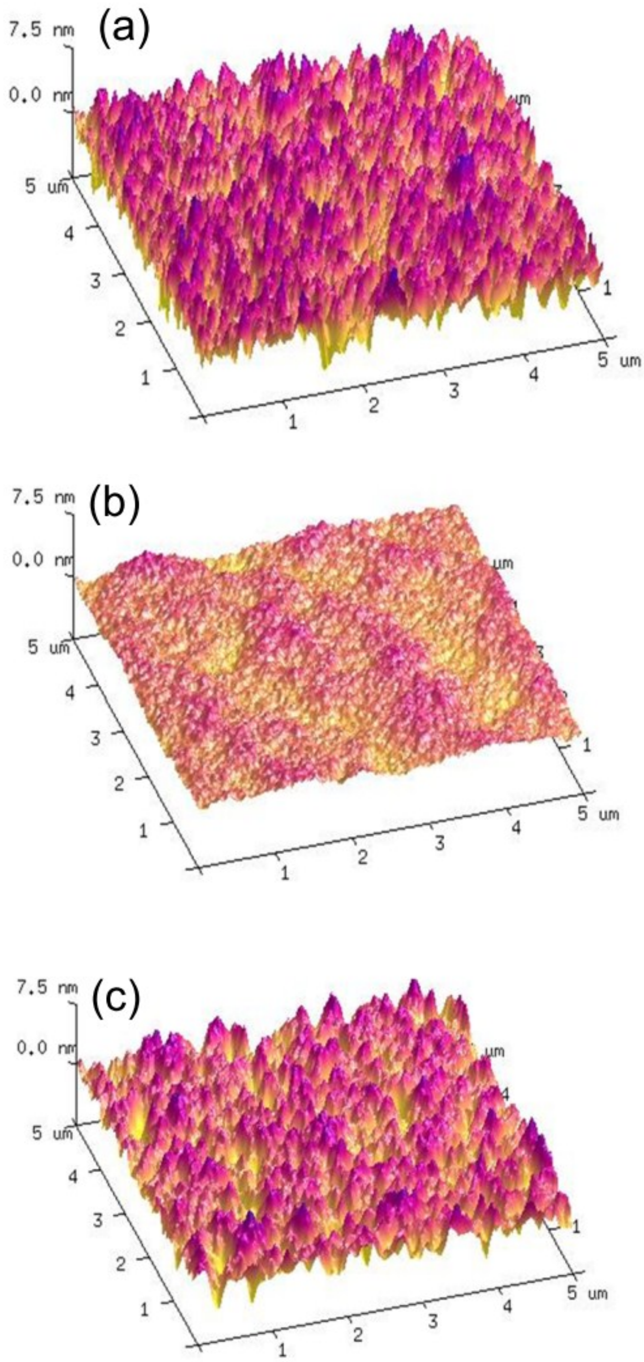


Figure S1. 3D AFM images of (a) vacuum-evaporated, (b) spin-coated and (c) flash-evaporated (10^{-1} Pa) TCTA films.

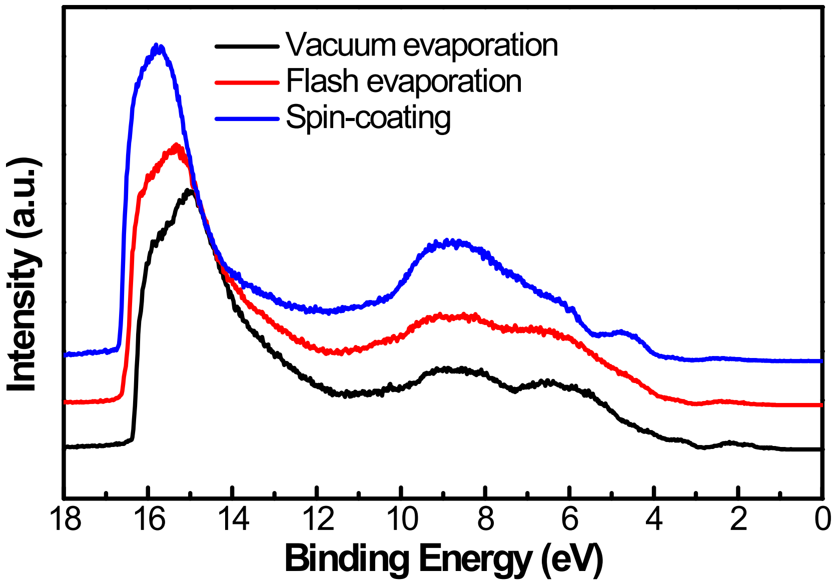


Figure S2. UPS spectra of vacuum-evaporated, spin-coated and flash-evaporated (10^{-1} Pa) TCTA films.

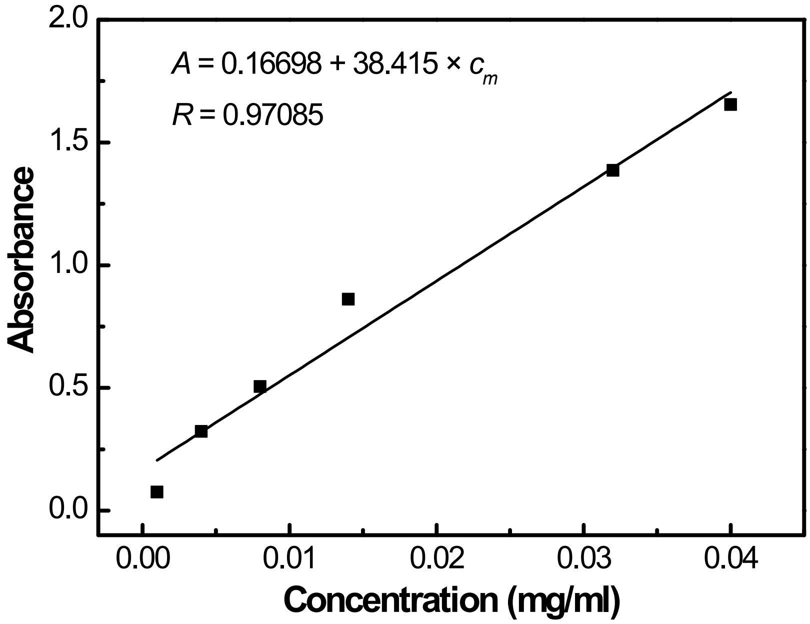


Figure S3. Fitted curve of relationship between the concentration and absorbance intensity.

Hole Mobility Evaluation in TCTA Films

Hole-Dominated Device:

ITO/PEDOT:PSS (40 nm)/TCTA (50 nm)/MoO_3 (10 nm)/Al (120 nm)

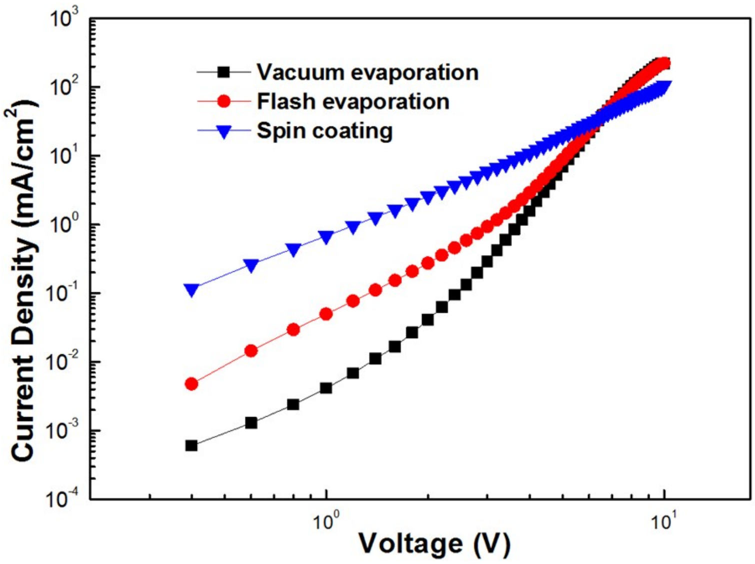


Figure S4. *J-V* curves of hole-dominated devices based on TCTA films deposited by vacuum evaporation, flash evaporation (10^{-1} Pa) and spin-coating methods.

The hole mobilities (μ) were extrapolated from the *J-V* curves of TCTA based hole-dominated devices by using space charge limited current (SCLC) method with an equation as follow:

$$J = \frac{9}{8}\varepsilon_0\varepsilon_r\mu\frac{V^2}{d^3},$$

where ε_0 (= 8.8542 × 10^{-14} F/cm) is permittivity of free space, ε_r = 3, is the dielectric constant of the TCTA organic film, d (= 50×10^{-7} cm) is the film thickness of the TCTA film. The calculated hole mobilities were 7.77 × 10^{-7} $cm^2\ V^{-1}\ s^{-1}$, 1.33 × 10^{-7} $cm^2\ V^{-1}\ s^{-1}$ and 4.59 × 10^{-8} $cm^2V^{-1}s^{-1}$ for vacuum-evaporated, flash-evaporated and spin-coated TCTA films, respectively

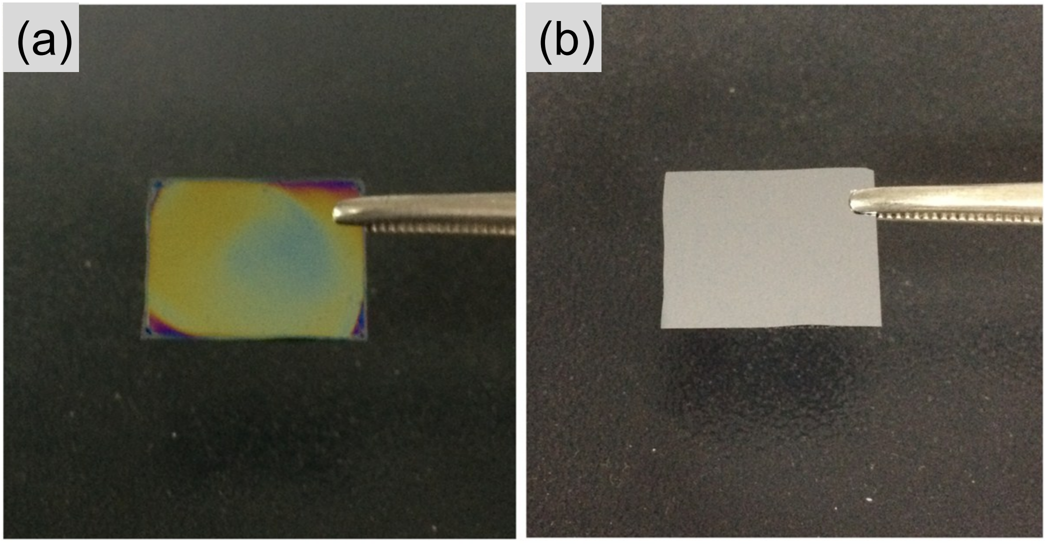


Figure S5. Photo images of the TCTA-coated silicon wafer (a) before and (b) after flash evaporation.

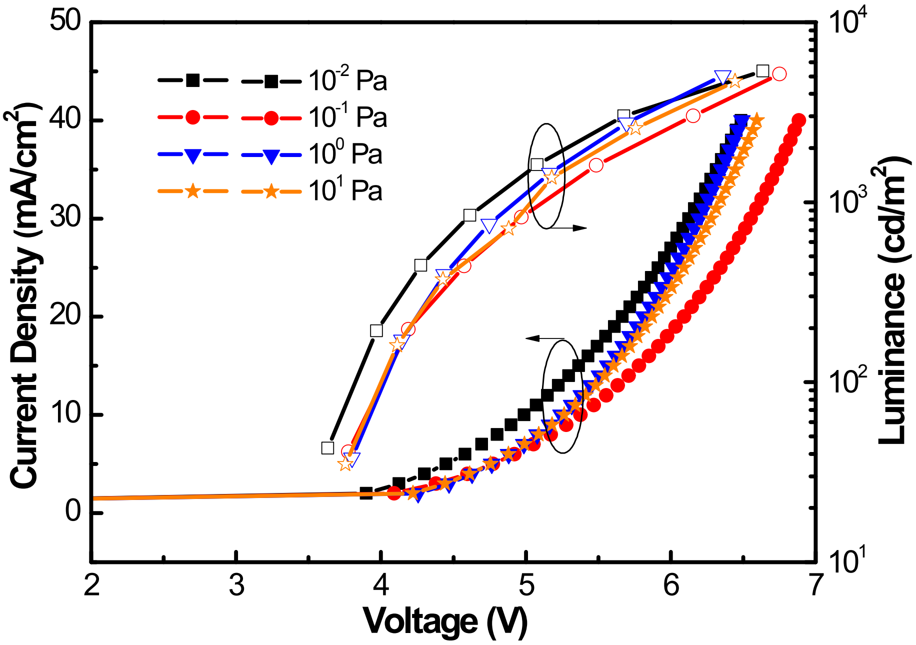
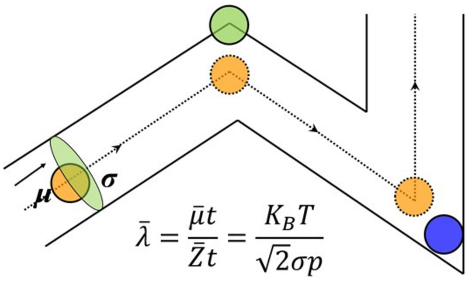


Figure S6. Pressure-dependent *J-V* curves of flash-evaporated OLEDs.

Appendix A: Derivation Process of the Mean Free Path Equation



The collision cross section can be obtained by

$$\sigma = \pi d^2,$$

where d is distance between the center of two molecules. The mean collision frequency can be calculated by

$$\bar{Z} = n\sigma\mu_{rel},$$

where n is the number of molecules per unit volume, and μ_{rel} is the mean relative speed. According to the Maxwell velocity distribution law, we can get the average speed $\bar{\mu}$ of molecule from the mean relative speed

$$\mu_{rel} = \sqrt{2}\bar{\mu}.$$

As we all know, the state equation of ideal gas can be expressed by

$$p = nK_B T,$$

where p is the pressure, K_B is the Boltzmann constant and T is the temperature. According to the above equations, we can get the mean free path

$$\bar{\lambda} = \frac{\bar{\mu}t}{\bar{Z}t} = \frac{1}{\sqrt{2}n\sigma} = \frac{K_B T}{\sqrt{2}\sigma p}.$$

Therein $K_B = 1.38 \times 10^{-23}$ J/K, $T = 500$ K when current was applied. If we took the atmosphere as an example, then $d = 3.5 \times 10^{-10}$ m. Eventually we can calculate the mean free path: $\bar{\lambda} = \frac{1.27}{p}\,cm$.