Electronic Supplementary Material (ESI) for Nanoscale.

Ultrathin and ultrasmooth Au films as transparent electrodes in ITO-free organic light-emitting devices

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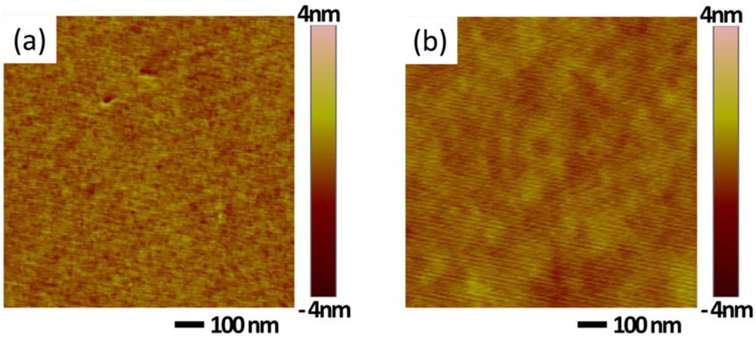

Figure S1. Atomic force microscopy (SEM) images of the glass substrate (a) and SU-8 film (b). The glass substrate and SU-8 film show quite smooth surface morphologies and similar roughness. The root-mean-square (RMS) roughness of the glass substrate and SU-8 film is about 0.35 nm and 0.32 nm, respectively.

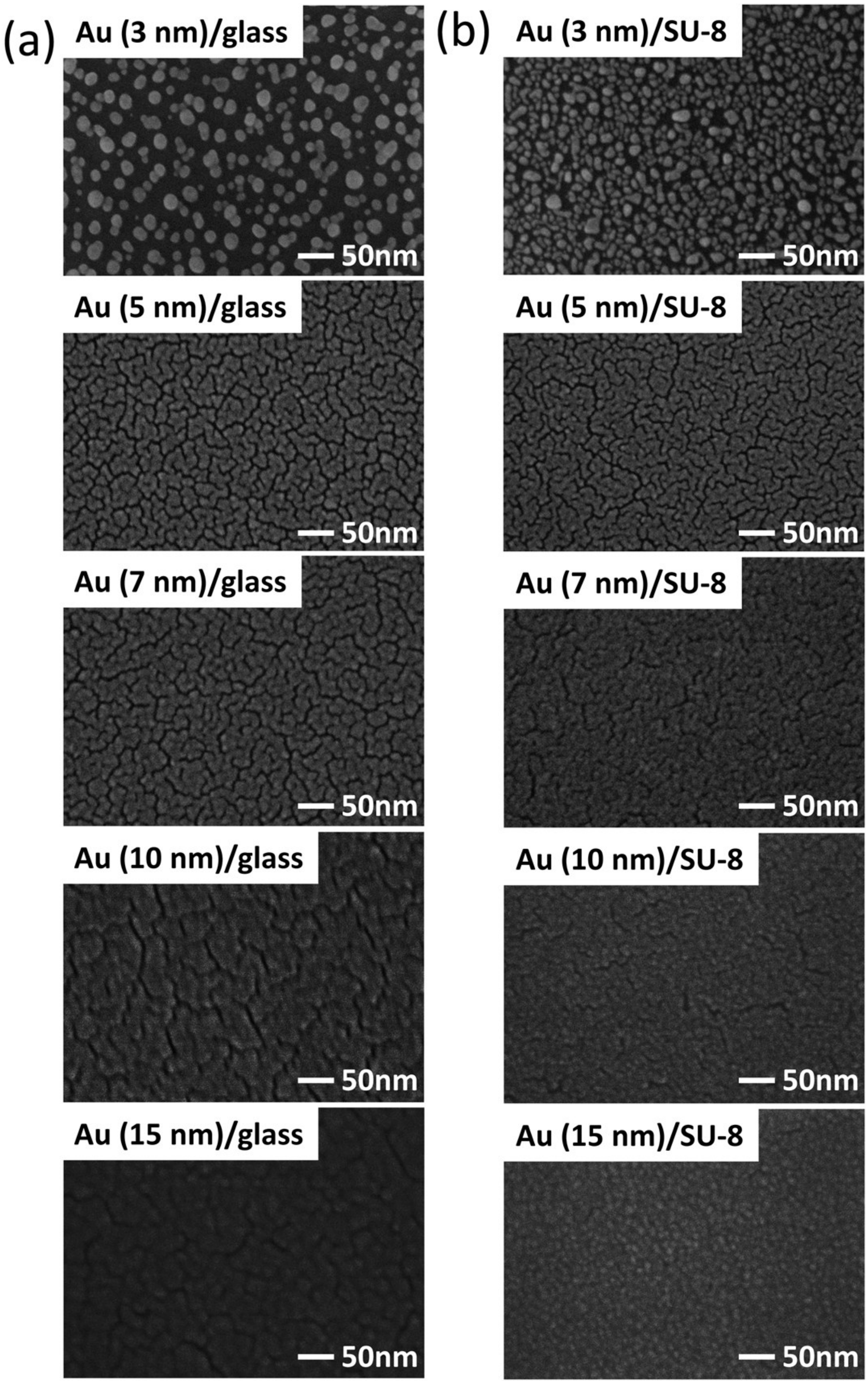

Figure S2. Scanning electron microscope (SEM) images of the deposited Au films. (a) 3 nm, 5 nm, 7 nm, 10 nm, and 15 nm Au films deposited directly on the glass substrates. (b) 3 nm, 5 nm, 7 nm, 10 nm, and 15 nm Au films deposited on the SU-8 modified glass substrates.

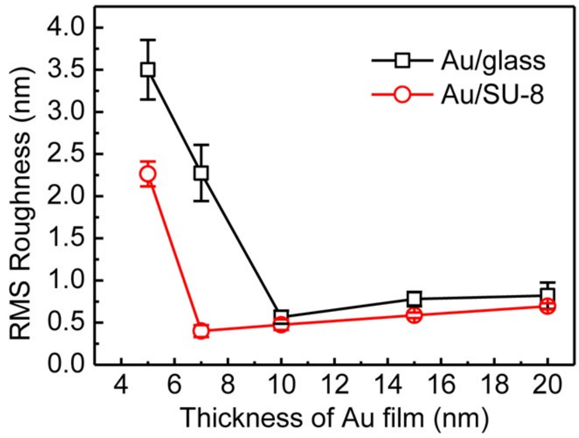

Figure S3. The RMS roughness of Au/glass and Au/SU-8 film as a function of the thickness of Au film.

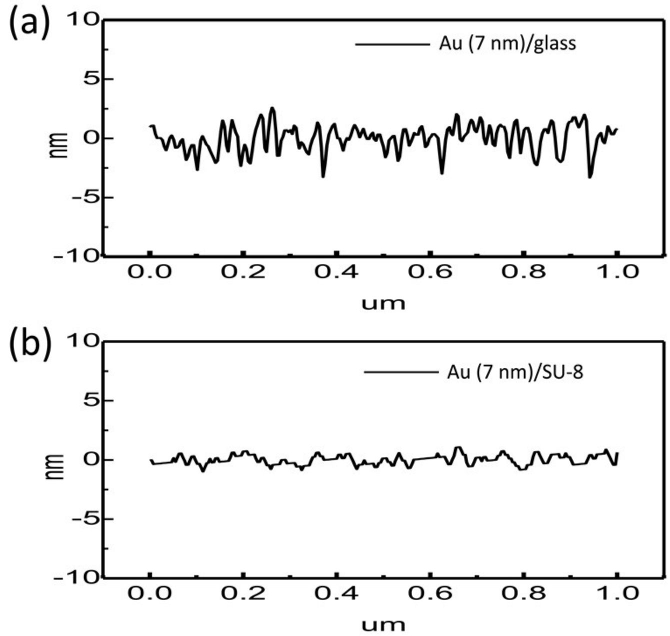

Figure S4. Atomic force microscopy (AFM) surface profiles of the 7nm Au film deposited on glass substrate (a) and on the SU-8 modified glass substrate (b).

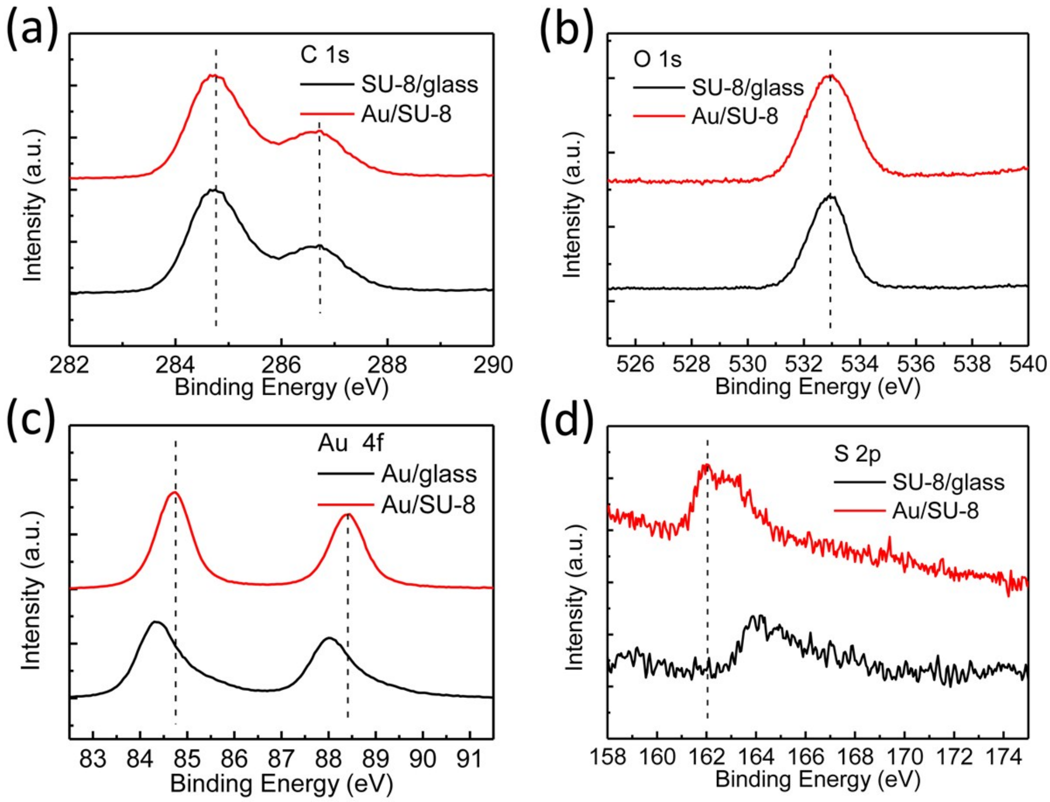

Figure S5. X-ray photoelectron spectroscopy (XPS) spectra of C 1s core level (a), O 1s core level (b), Au 4f core level (c), and S 2p core level (d) of the SU-8/glass, Au/glass, and Au/SU-8 samples.

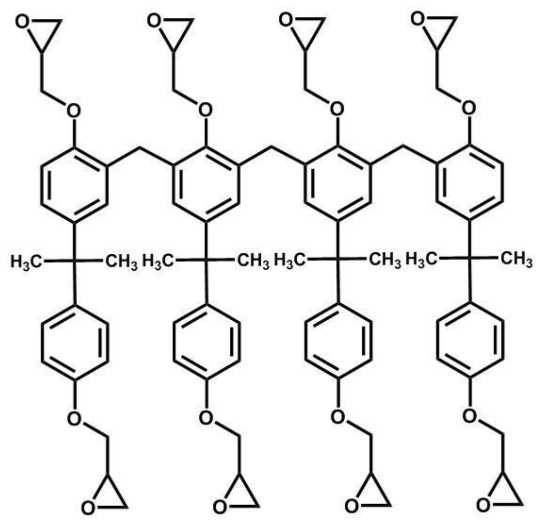

Figure S6. The chemical structure of the SU-8 2025 epoxy. There are eight epoxy groups in each molecule on average, so it is named 'SU-8'.

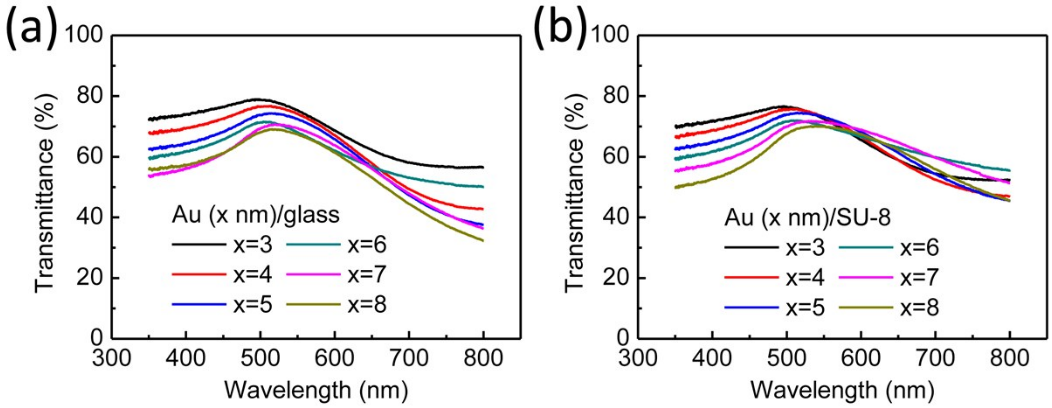

Figure S7. Optical transmittance of Au/glass (a) and Au/SU-8 (b) films with various film thicknesses on the glass substrates.

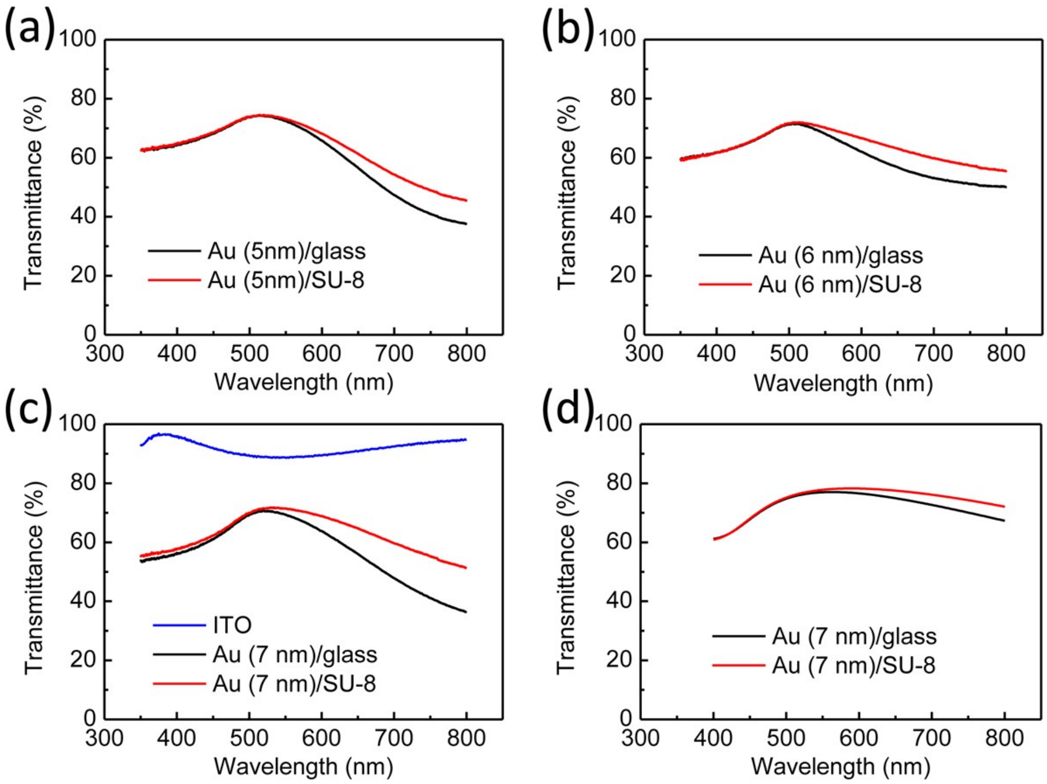

Figure S8. Transmission spectra of 5 nm (a), 6 nm (b), and 7 nm (c) Au/glass and Au/SU-8 film. Transmission spectra of ITO is also shown in (c). (d) Simulated transmission spectra of 7 nm Au/glass and Au/SU-8 film. There is an excellent agreement between the numerically calculated and experimentally measured transmission spectra, and the enhanced light transmittance at longer wavelength can be observed in both simulated and measured results.

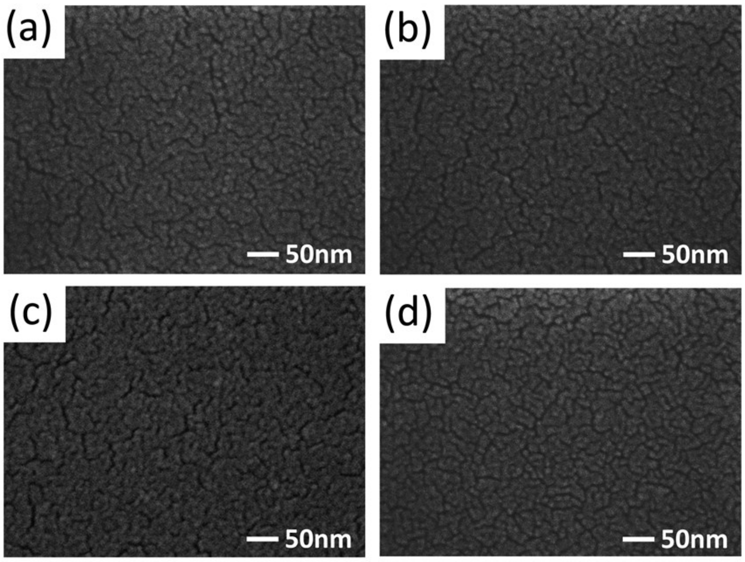

Figure S9. SEM images of the deposited 7 nm Au films on different thickness of SU-8 film. The thickness of SU-8 film is about 1000 nm (a), 500 nm (b), 100 nm (c), and 50 nm (d). The SEM images show no direct relationship between the SU-8 thickness and the surface morphology of the deposited Au films.

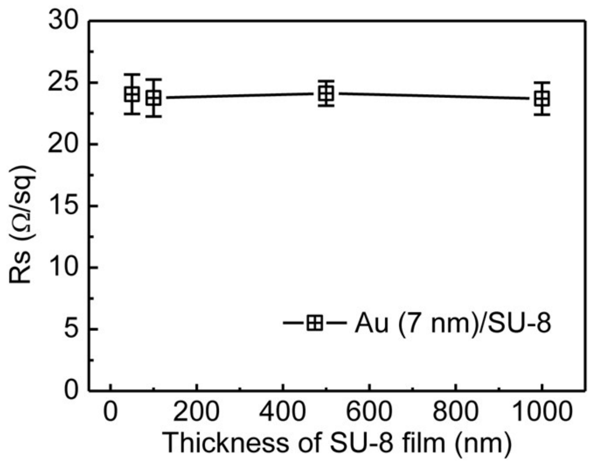

Figure S10. Sheet resistance (Rs) of the 7 nm Au/SU-8 films as the function of the SU-8 thickness. The electronic characteristics of the Au/SU-8 films keep consistent.

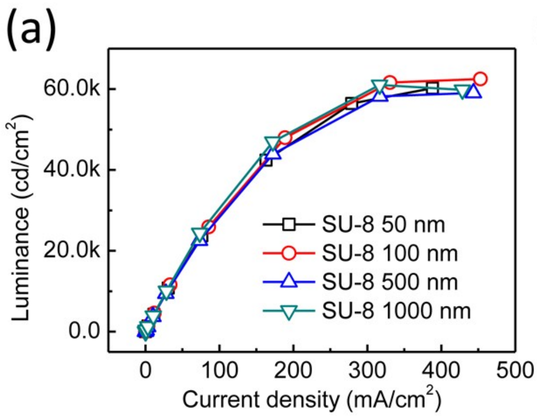

Figure S11. The electroluminescence (EL) performance of the OLEDs based on the Au/SU-8 anodes with various thicknesses of SU-8 films. Current density-luminance (a), and current density-current efficiency (b) characteristics of the OLEDs. We can conclude from the EL performance that there is not any relationship between the thickness of SU-8 films and corresponding OLEDs performance.

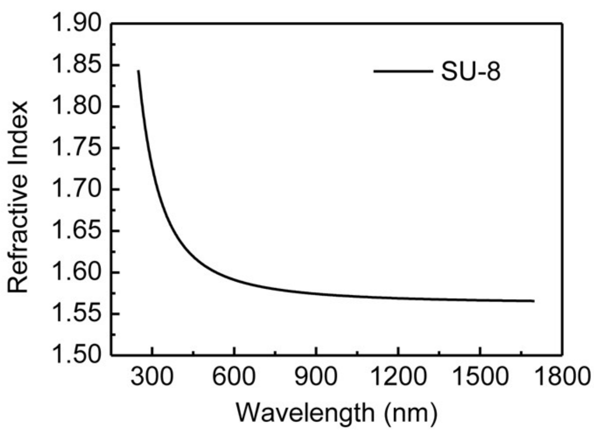

Figure S12. Refractive index of SU-8 film as the function of wavelength obtained from ellipsometer measurement.

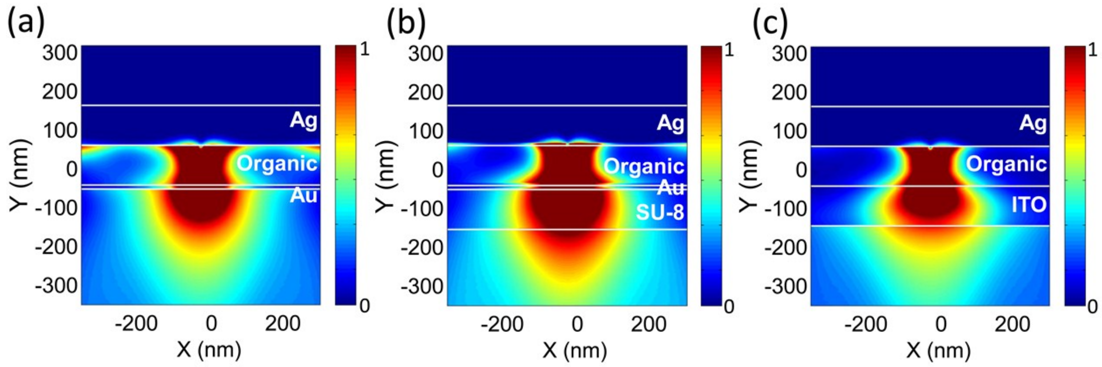

Figure S13. Normalized cross-section intensity field distributions (at 510 nm) of OLEDs based on ultrathin Au (a), Au/SU-8 (b), and ITO (c) anode simulated using in-house generated Finite-Difference Time-Domain (FDTD) codes. The refractive indices of the materials used for optical modeling are based on the experimentally determined parameters obtained from ellipsometer measurements. The thickness of SU-8 film is 100 nm. The simulated cross-section views of the energy flux density are induced by an emitting dipole at 510 nm centered in the organic emitter. The theoretically calculated intensity field distributions of OLEDs based on ultrathin Au with (a) and without (b) SU-8 film qualitatively reveal the influence of SU-8 film on light manipulation in OLEDs, and more fraction of emitted light is extracted by engaging the SU-8 film. By comparing the energy flux density of the Au/SU-8 based OLEDs and ITO based OLEDs, the devices based on ultrathin Au/SU-8 anodes show higher light extraction efficiency as shown in (b) and (c).