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

Electronic Supplementary Information

Doped Polyaniline-Hybridized Tungsten Oxide Nanocrystals as Hole Injection Layers for Efficient Organic Light Emitting Diodes

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Figure S1-S5

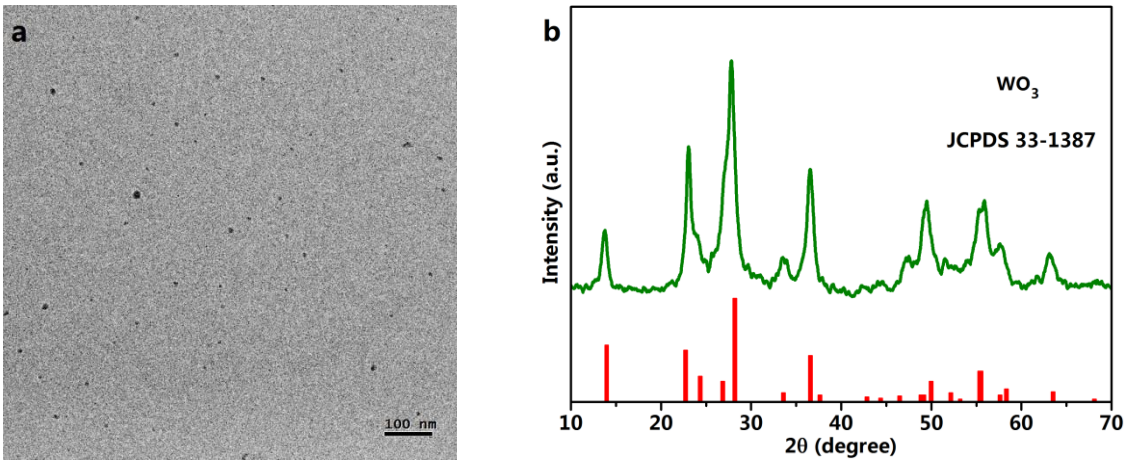

Figure S1. (a) TEM image and (b) XRD pattern of WO_3 NCs.

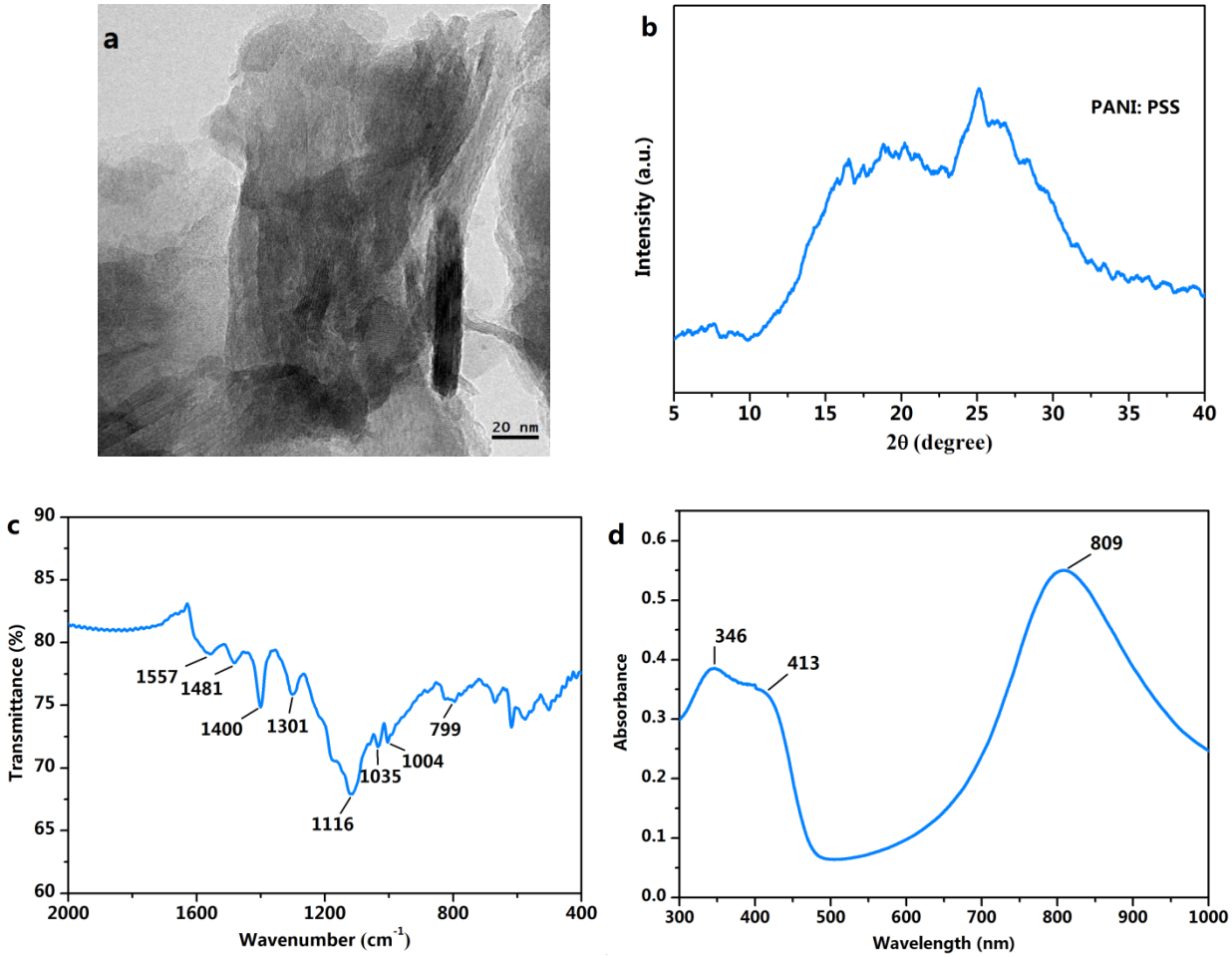

Figure S2. (a) TEM image, (b) XRD pattern, (c) FTIR spectra and (d) UV-vis absorption spectra of PANI: PSS.

Figure S2c is the FTIR spectroscopy of PANI: PSS. 1557 and 1481 cm^{-1} attributable to C=C stretching of quinoid rings and benzenoid rings, respectively. The 1400 and 1116 cm^{-1} is assigned to N=Q=N (Q is quinoid rings) characteristic vibrations, and 1301 cm^{-1} band can be interpreted as C-N stretching in a secondary aromatic amine. The S=O stretching vibration at 1035 cm^{-1} represents the effective doping of PSS. The 1004 cm^{-1} is the aromatic C-H in-plane bending vibration mode. Band near 799 cm^{-1} is the characteristic C-H out of plane bending on para-substitution of benzene rings, which indicate that the polymerization proceeds via a head-to-tail mechanism. All these above results indicate the successful preparation of PANI: PSS.

UV-vis spectroscopy (Figure S2d) showed main absorption bands for PANI: PSS at 346, 413 and 809 nm. The peak at around 346 and 413nm are assigned to the π→π* transition and the polaron band→π* transition in benzenoid rings, respectively. The π→localized polaron band transition near 809 nm is the result of charge transfer from benzenoid to quinoid rings of the protonated PANI, which confirms the efficient doping of PSS and the emeraldine state of PANI.

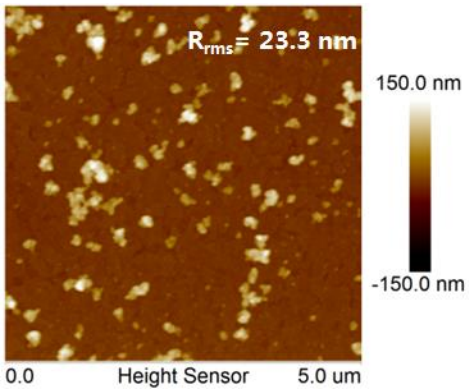

Figure S3. AFM height image of ITO/WO_3 layer.

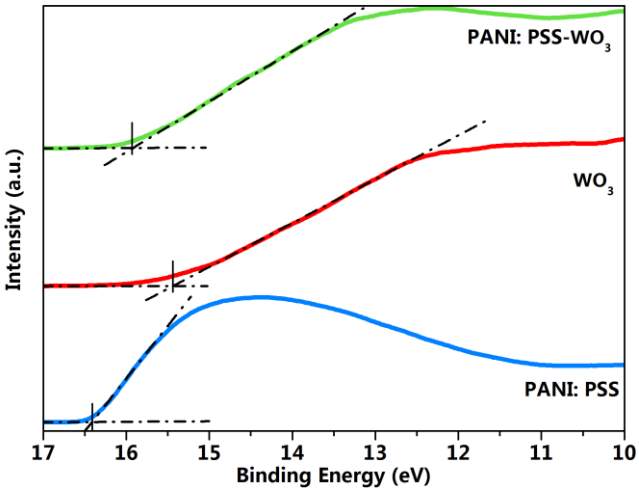

Figure S4. UPS spectra showing high-binding energy secondary electron cut off of WO_3, PANI: PSS, PANI: PSS-WO_3.

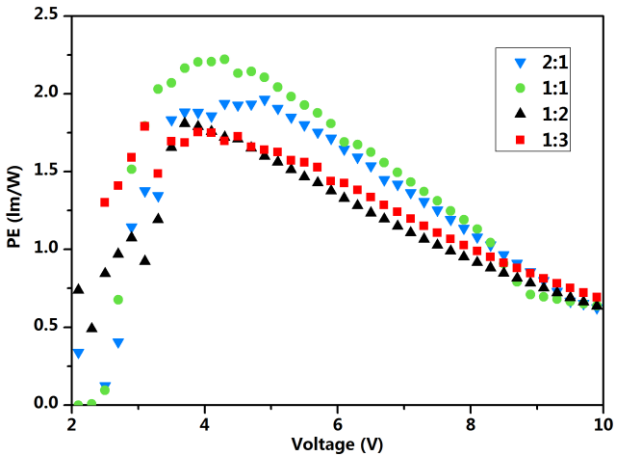

Figure S5. PE-voltage characteristics of OLEDs based on hybrid HILs with different volume ratios of WO_3 to PANI: PSS (2:1, 1:1, 1:2, 1:3).

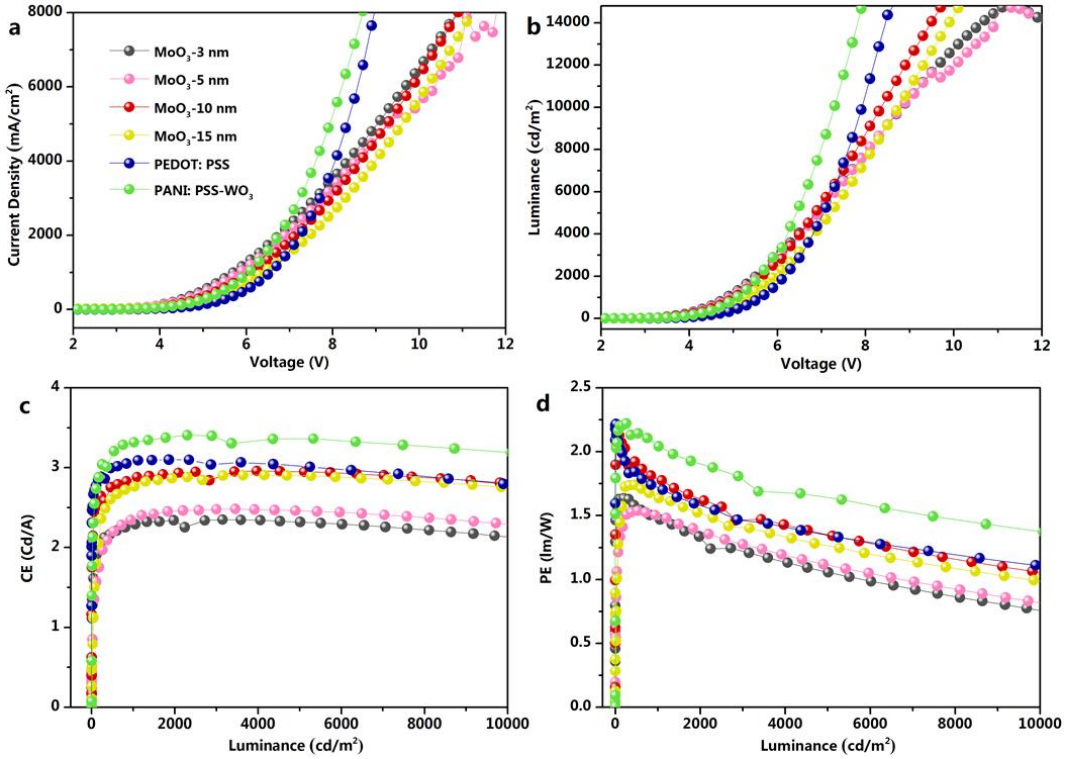

Figure S6. (a) Current density-voltage, (b) luminance-voltage, (c) CE-luminance and (d) PE-luminance characteristics of OLEDs with different HILs.