Electronic Supplementary Information

High-Performance Flexible Inverted Organic Light-Emitting Diodes by Exploiting MoS_2 Nanopillar Arrays as Electron-injecting and Light-coupling Layer

Kunping Guo,‡[ab] Changfeng Si,‡[b] Ceng Han,[c] Saihu Pan,[ab] Guo Chen,[b] Yanqiong Zheng,[b] Wenqing Zhu,[b] Jianhua Zhang,*[ab] Chang Sun[d] and Bin Wei*[ab]

[a] *School of Mechatronic Engineering and Automation, Shanghai University, 149 Yanchang Road, Shanghai, 200072, P. R. China.*

[b] *Key Laboratory of Advanced Display and System Applications, Ministry of Education, Shanghai University, 149 Yanchang Road, Shanghai, 200072, P. R. China.*
**E-mail: jhzhang@shu.edu.cn; bwei@shu.edu.cn.*

[c] *Key Laboratory of Optoelectronic Technology & Systems (Ministry of Education) College of Optoelectronic Engineering, Chongqing University, Chongqing, 400044, P. R. China.*

[d] *Department of Electrical Engineering, Iowa State University, 4565 Union Dr, Ames, IA 50011 USA*

‡K. Guo and C. Si contributed equally to this work.

Discussion of Cs_2CO_3-based cell

Cs_2CO_3-based electron-only cell was fabricated to compare the electron-injection ability of Cs_2CO_3 with that of MoS_2. As shown in Supplementary Fig. S1, the Cs_2CO_3-based cell exhibited slightly higher current density than that of MoS_2-based one under both forward bias and reverse bias. Besides, the *J-V* characteristic of the Cs_2CO_3-based cell is dominated by trap-limited electron transport through Bphen. Here, the charge trapping was induced by the Cs_2CO_3 as an *n*-type dopant diffuses into the Bphen layer. However, the number of the diffused Cs-atoms decreases with increasing penetration depth in the organic layer, which leads to nonuniform doping distribution. Thus, the electron trapping instability occurs, giving rise to the unsmoothed curve of the Cs_2CO_3-based cell.

In addition, we have also performed AFM measurement to investigate the surface features of Cs_2CO_3 thin film deposit on ITO-coated PET substrate. The deposition of Cs_2CO_3 with 2 nm on the ITO-coated PET surface yielded a nearly homogeneous film with root mean square (RMS) roughness of 2.83 nm as illustrated in Supplementary Fig. S2. The results provide the evidence that the Cs_2CO_3 surface does not produce an effective nano-structure as MoS_2 nanopillar arrays, which is advantageous for light outcoupling in IOLEDs.

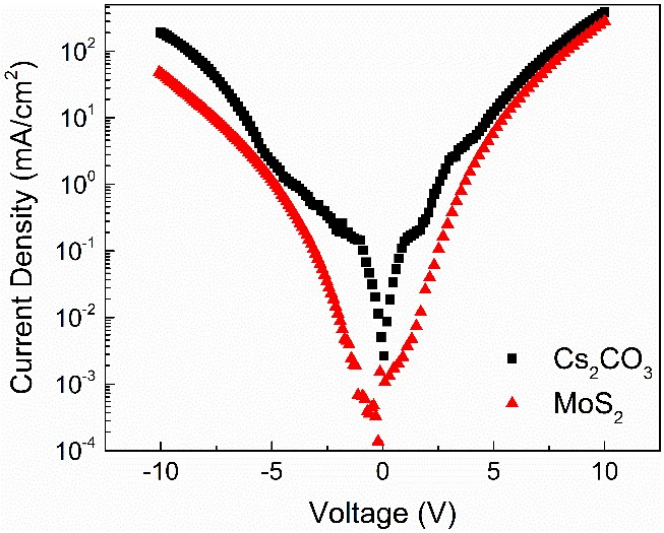

Fig. S1 The current density-voltage characteristics of electron only devices as a function of the electron injection material. The device structure: ITO/EIL (2 nm)/Bphen (120 nm)/Liq (1 nm)/Al.

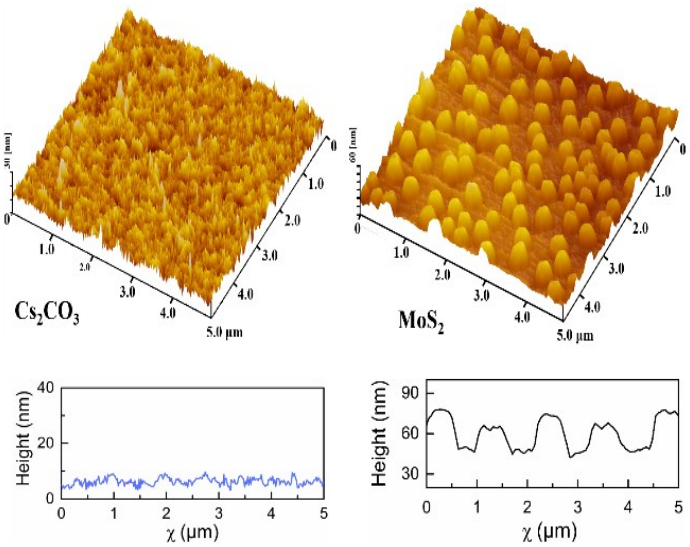

Fig. S2 Atomic force microscope images of Cs_2CO_3 and MoS_2 thin films deposit on ITO-coated PET substrate and corresponding line profiles.

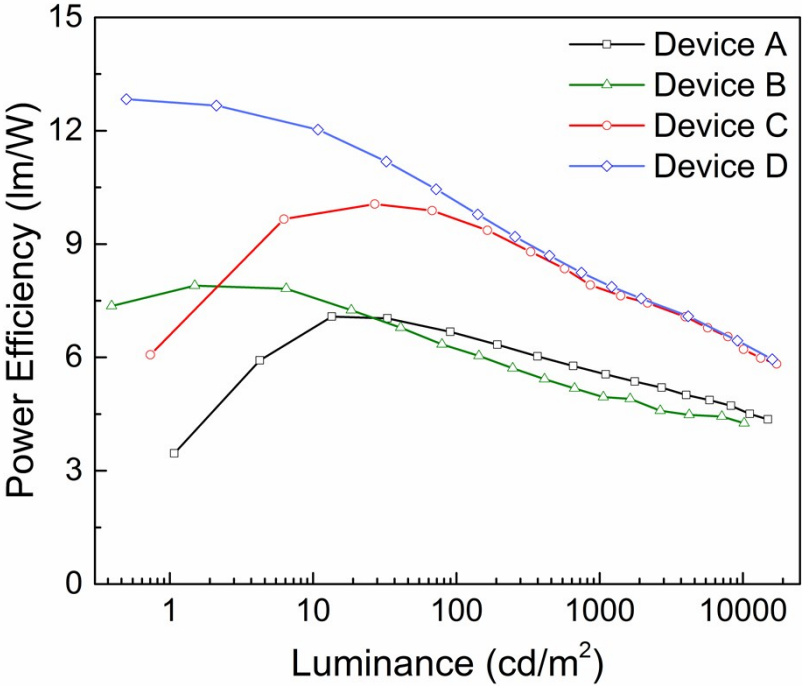

Fig. S3 Power efficiency plotted luminance of Devices A, B, C and D.

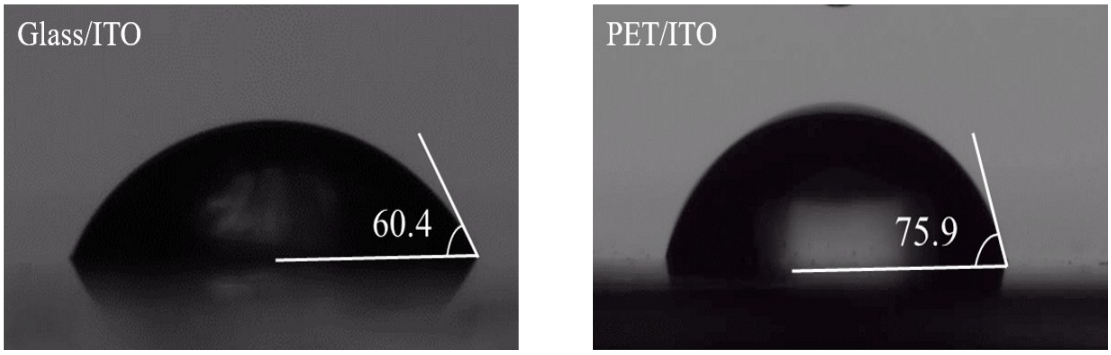

Fig. S4 Water contact angle of ITO-coated glass and PET substrates.

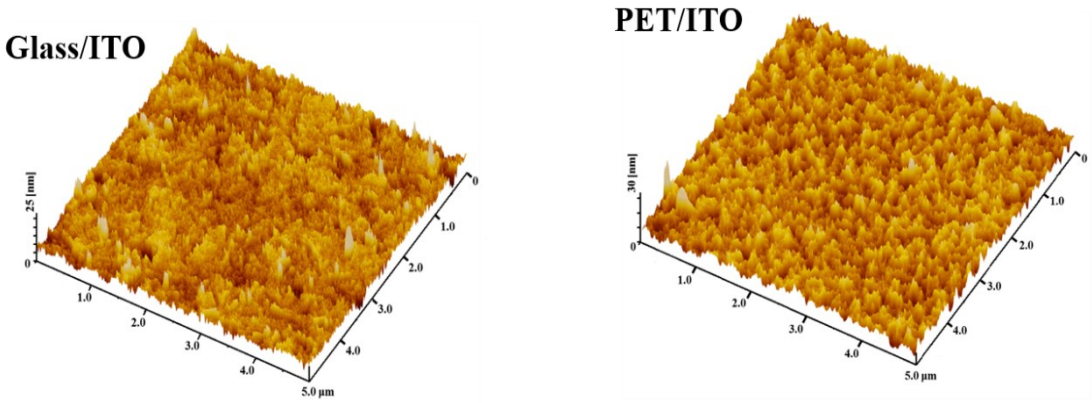

Fig. S5 Atomic force microscope images of ITO-coated glass and PET substrates.

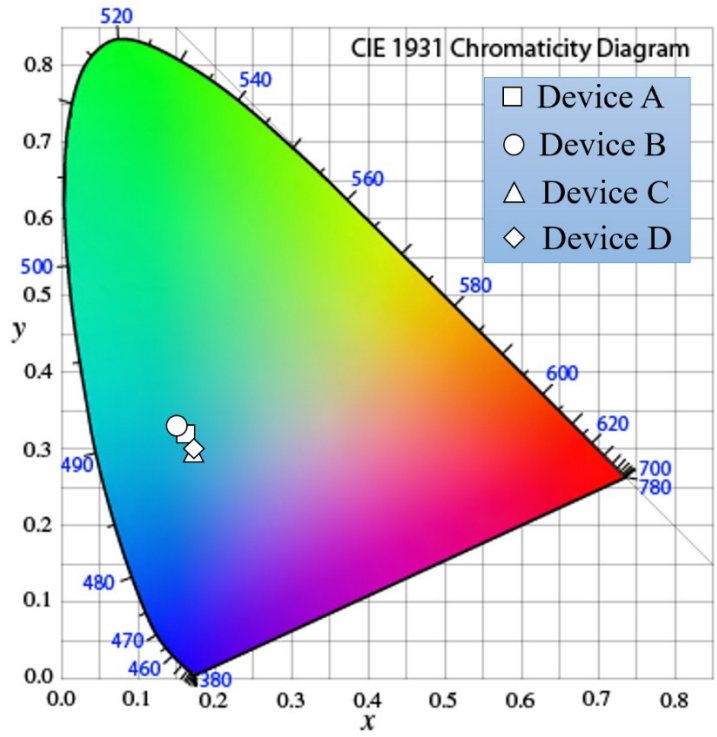

Fig. S6 The CIE 1931 chromaticity coordinates of Devices A, B, C and D.

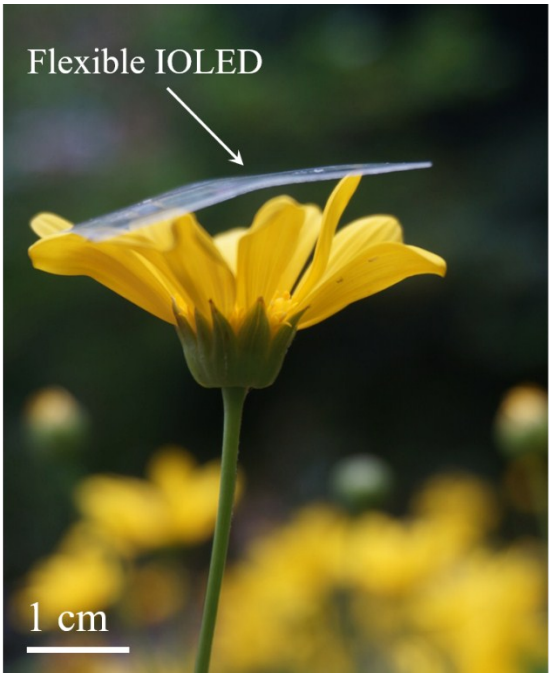

Fig. S7 Photograph of a flexible IOLED being lifted up by a tender flower.