Electronic Supplementary Information

10 cm^2 nonfullerene solar cells with efficiency over 10% using H_xMoO_3-assisted growth of silver electrodes with a low threshold thickness of 4 nm

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Table S1. Summary of nonfullerene large-area (> 2 cm^2) device in previous reports.[1-6]

Area [cm^2]	PCE [%]	Year	Ref.
3.48	8.6	2018	[1]
8	6	2018	[2]
18	6.3	2018	[3]
60	5	2018	[4]
2	6	2019	[5]
3.2	8.1	2019	[6]

Table S2. Photovoltaic parameters of OSCs with MoO_3 and H_xMoO_3 as HTL. The device structure is glass/ITO/ZnO/PM6:IT-4F/HTL/Ag. All devices were measured under 100 mW cm^{-2} AM 1.5G illumination.

Area [cm^2]	HTL	J_{sc} [mA/cm^2]	V_{oc} [V]	FF	PCE [%]
0.1	MoO_3	20.37	0.86	0.76	13.34
0.1	H_xMoO_3	19.76	0.85	0.75	12.63

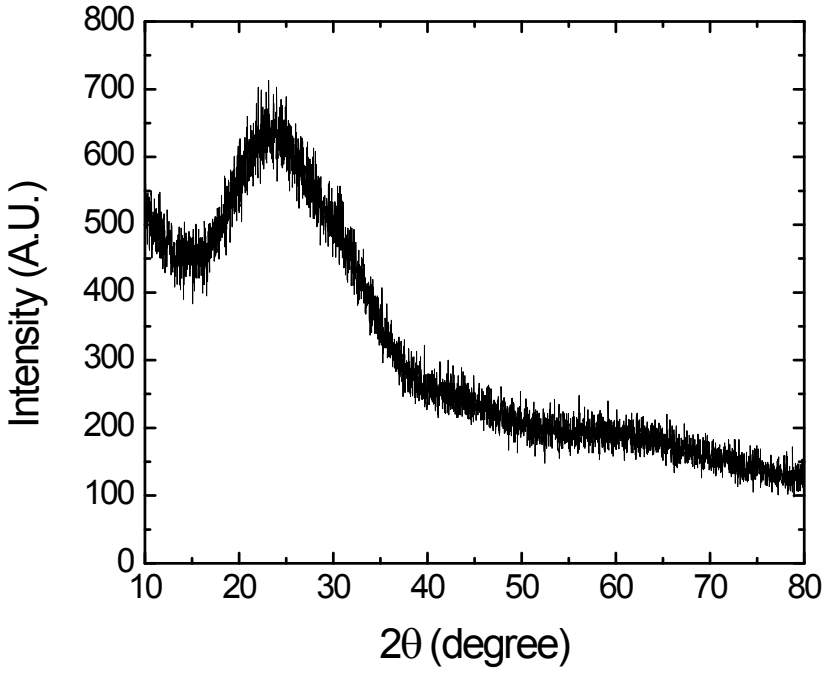

Figure S1. X-ray diffraction (XRD) pattern of H_xMoO_3.

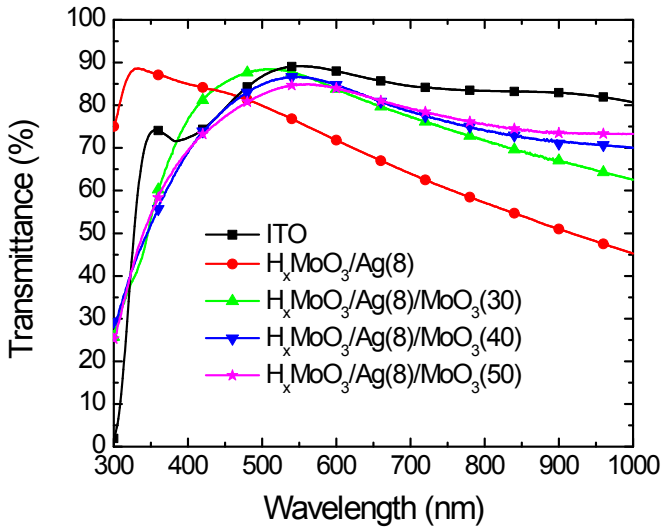

Figure S2. Optical transmittance of transparent electrode with different antireflective MoO_3 thickness when the thickness of Ag is fixed at 8 nm.

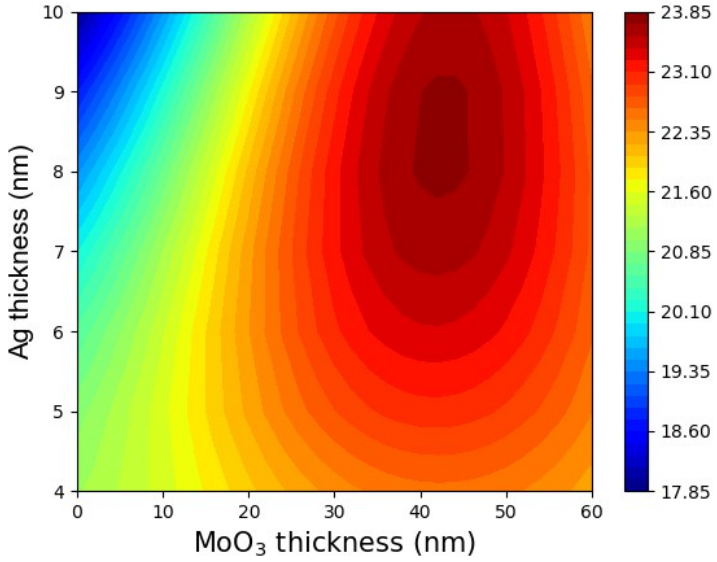

Figure S3. Optically simulated photocurrent, assuming the IQE=100%, of top-illuminated device as a function of thicknesses of ut-Ag and MoO_3 ARL.

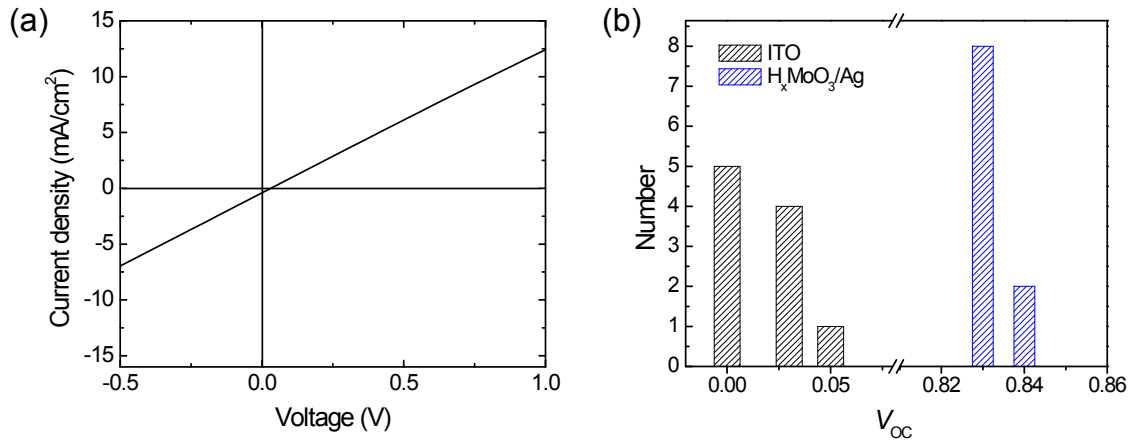

Figure S4. (a) Current density-voltage (*J-V*) characteristics under AM 1.5G illumination of 10 cm^2 solar cell on ITO. The device structure is ITO/ZnO/PM6:IT-4F/MoO_3/Ag. (b) Histogram distribution of open-circuit voltage for 10 cm^2 devices on ITO and thick opaque Ag on H_xMoO_3.

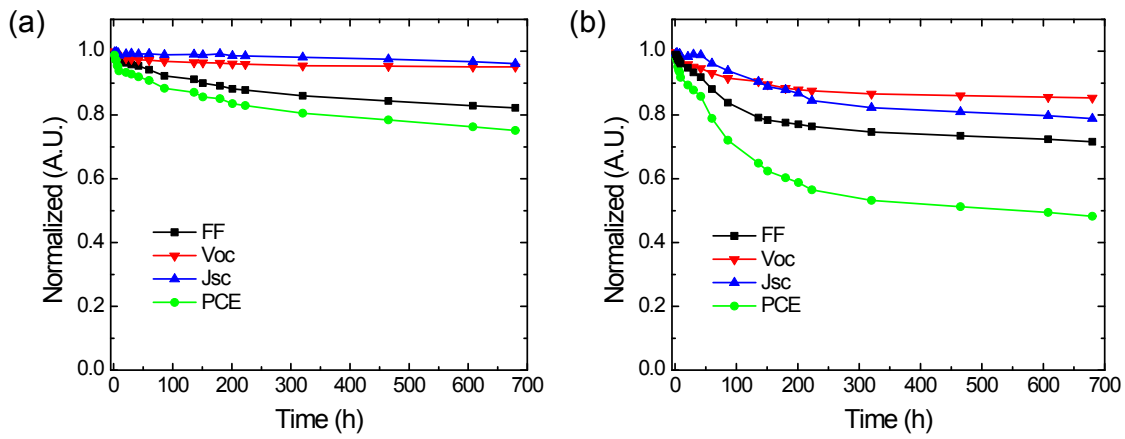

Figure S5. Normalized photovoltaic parameters of (a) ut-Ag cell (glass/H_xMoO_3/70-nm Ag/ZnO/PM6:IT-4F/H_xMoO_3/ut-Ag/MoO_3) and (b) reference cell (ITO/ZnO/PM6:IT-4F/MoO_3/Ag) under continuous a LED white light illumination up to 680 hours.

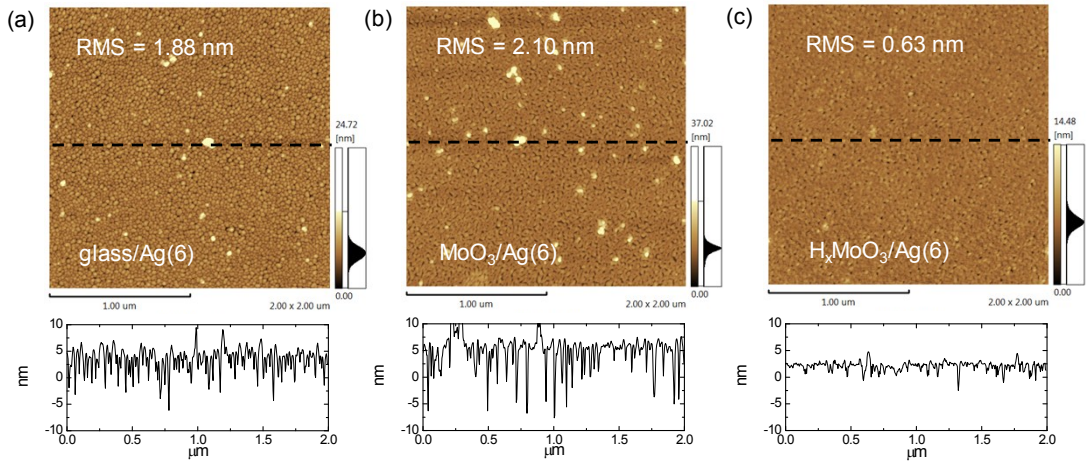

Figure S6. Atomic force microscope (AFM) images of 6-nm Ag on different surface: (a) glass; (b) MoO_3; (c) H_xMoO_3. The dash lines indicate the position of sectional height distribution shown underneath.

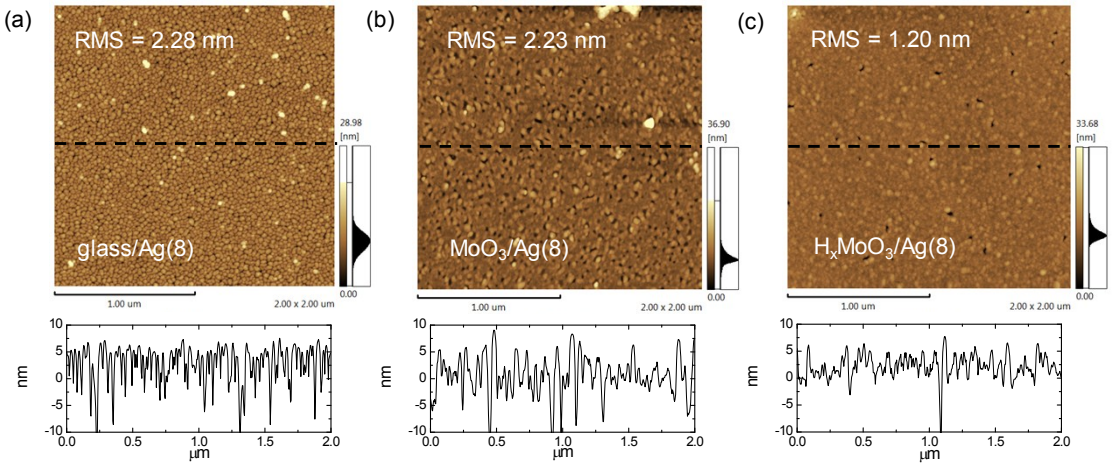

Figure S7. Atomic force microscope (AFM) images of 8-nm Ag on different surface: (a) glass; (b) MoO_3; (c) H_xMoO_3. The dash lines indicate the position of sectional height distribution shown underneath.

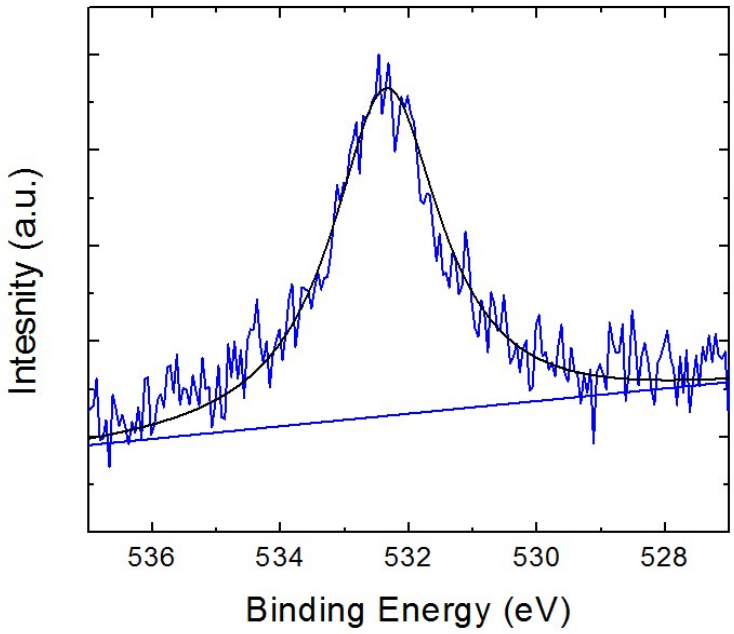

Figure S8. O 1s XPS spectrum of 70-nm Ag deposited on glass. The peak at 532 eV was assigned to the dissolved oxygen in silver bulk[7, 8].

References:

1. T. Zhang, G. Zeng, F. Ye, X. Zhao and X. Yang, *Advanced Energy Materials*, 2018, **8**, 1801387.
2. L. Mao, L. Sun, B. Luo, Y. Jiang and Y. Zhou, *Journal of Materials Chemistry A*, 2018, **6**, 5817-5824.
3. L. Mao, B. Luo, L. Sun, S. Xiong, J. Fan, F. Qin, L. Hu, Y. Jiang, Z. Li and Y. Zhou, *Materials Horizons*, 2018, **5**, 123-130.
4. S. Strohm, F. Machui, S. Langner, P. Kubis, N. Gasparini, M. Salvador, I. McCulloch, H. J. Egelhaaf and C. J. Brabec, *Energy & Environmental Science*, 2018, **11**, 2225-2234.
5. D. Corzo, K. Almasabi, E. Bihar, S. Macphee, D. Rosas-Villalva, N. Gasparini, S. Inal and D. Baran, *Advanced Materials Technologies*, 2019, **4**, 1900040.
6. L. Sun, X. Jiang and Y. Zhou, *Journal of Energy Chemistry*, 2019, **37**, 220-224.
7. A. I. Boronin, S. V. Koscheev and G. M. Zhidomirov, *Journal of Electron Spectroscopy and Related Phenomena*, 1998, **96**, 43-51.
8. X. Bao, M. Muhler, T. Schedel-Niedrig and R. Schlögl, *Physical Review B*, 1996, **54**, 2249-2262.