

ADVANCED OPTICAL MATERIALS

Supporting Information

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Smart Window Structures Based on Highly Conductive,
Transparent Metal Nanomeshes and Thermo-chromic
Perovskite Films

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Frances Camille M. Wu, and Edward T. Yu**

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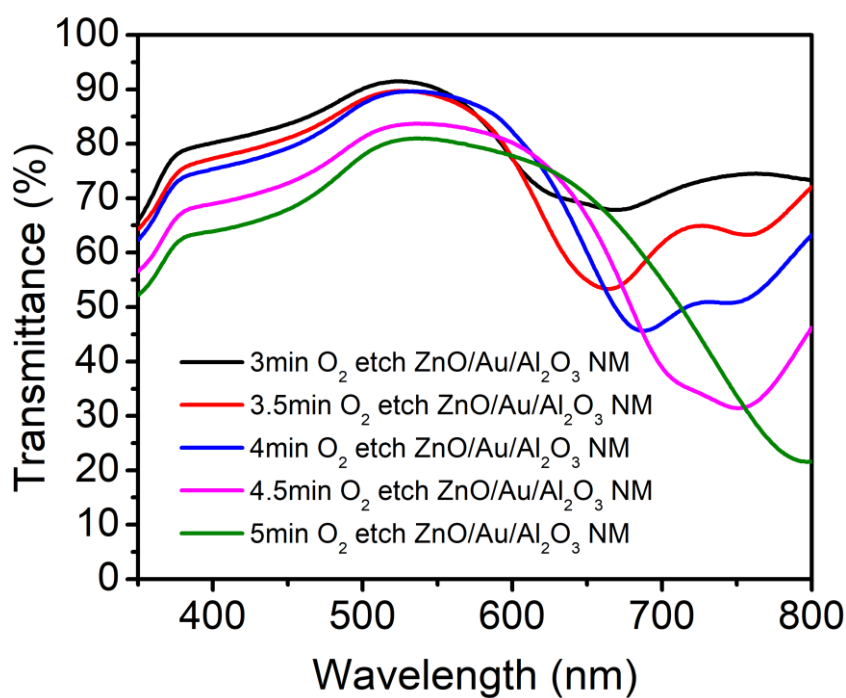


Figure S1. Transmittance spectra of different O₂ etching time for 370-nm based ZnO/Au/Al₂O₃ nanomesh (NM) film.

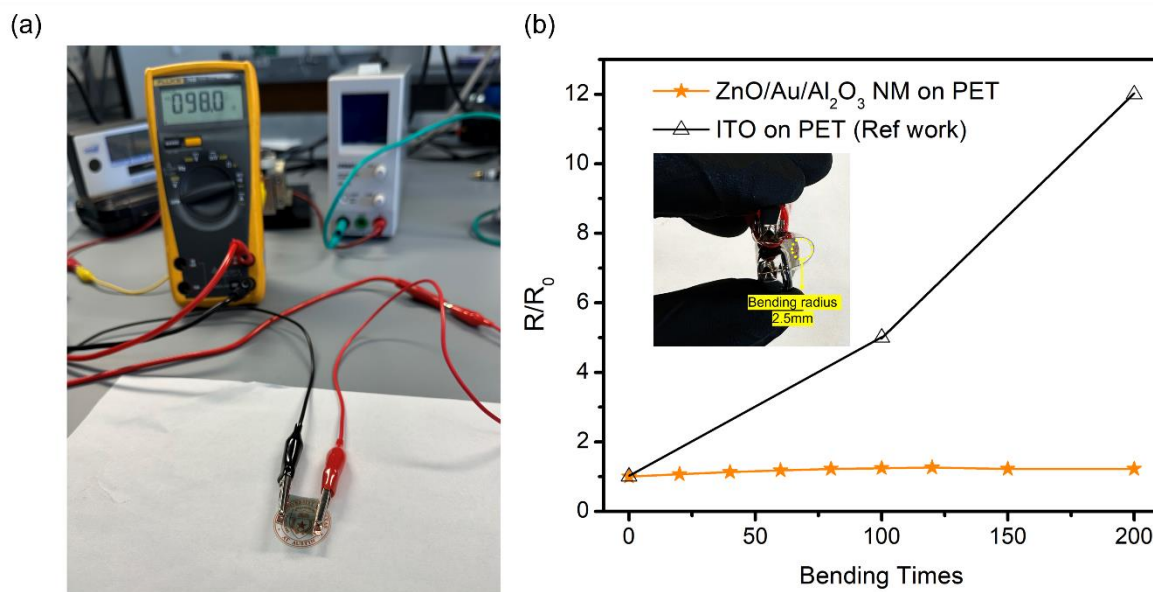


Figure S2. (a) Photograph of resistance measurement setup for ZnO/Au/Al₂O₃ NM on PET samples. (b) Resistance changes versus number of bending cycles for ZnO/Au/Al₂O₃ NM on PET and ITO on PET samples, at a bending radius of 2.5 mm (right side figure). Bending test result for ITO on PET was extracted from Qiu et al. for comparison.^[3]

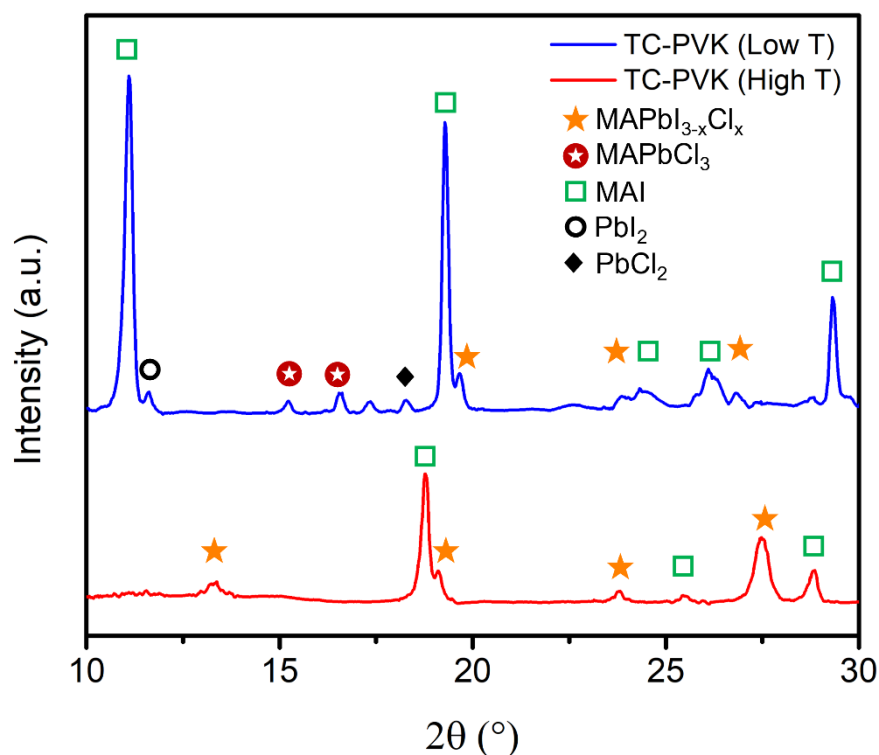


Figure S3. X-ray diffraction patterns of thermochromic perovskite (TC-PVK) layer at low T (blue) and high T (red) states.

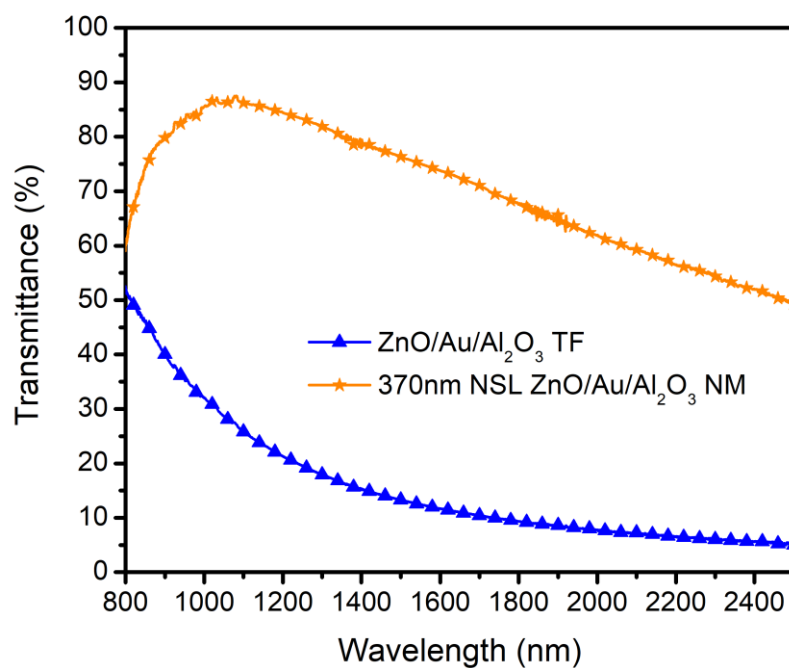


Figure S4. Transmittance spectra in NIR range of ZnO/Au/Al₂O₃ thin film (TF) and ZnO/Au/Al₂O₃ NM.

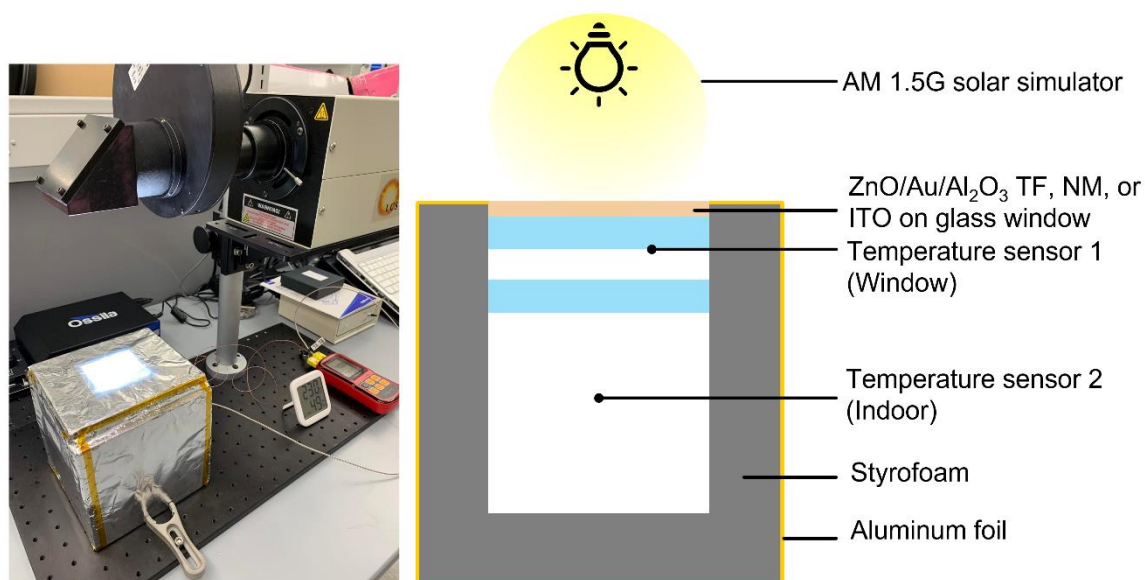


Figure S5. The experimental setup for the temperature response of different window layers (bare glass, ZnO/Au/Al₂O₃ TF, ZnO/Au/Al₂O₃ NM, and ITO glass) under AM 1.5G illumination.

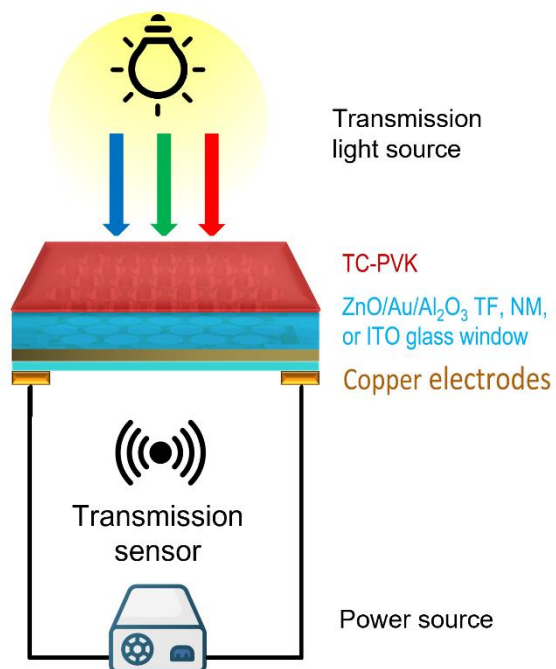


Figure S6. Experimental setup for transmittance-time response to the TC-PVK smart windows integrated with ZnO/Au/Al₂O₃ TF, ZnO/Au/Al₂O₃ NM and ITO glass.

Table S1. List of sheet resistance, transmittance and figure of merit (FOM) of metal mesh films from reference works.

Ref. Work	Pattern Method	Periodicity (nm)	Layer Configuration	Au thickness (nm)	Transmittance @550nm (%)	Sheet Resistance (Ω /sq)	FOM
[1]	NSL	430	Au/Ti	15	77.1	85	15.97
		380		15	74.9	44.7	27.12
		230	Au	15	74.1	73	15.97
		380		15	74.9	44.7	21.12
		230		15	74.1	73	15.97
[2]	NSL	202	Au/Cr	50	50	15.7	28.99
		375		50	43	10	35.91
[3]	NSL	600	TiO ₂ /Au/ TiO ₂	15	86.4	34	73.11
		650		15	86.8	40	64.25
		680		15	88	50	57.12
		650		16	88.4	30	98.81
		650		18	88.5	36	83.13

Table S2. List of etching conditions, sheet resistance, transmittance and figure of merit (FOM) of ZnO/Au/Al₂O₃ NM films based on 200-nm and 370-nm NSL from this work.

Sample	Periodicity (nm)	O ₂ etch time	Layer Configuration	Au thickness (nm)	Transmittance @550nm (%)	Sheet Resistance (Ω /sq)	FOM
1	200	2min15s	ZnO/Au/Al ₂ O ₃	15	67.37	10.20	84.64
2	200	2min	ZnO/Au/Al ₂ O ₃	15	72.18	15.33	69.45
3	200	1min45s	ZnO/Au/Al ₂ O ₃	15	73.91	14.71	78.53
4	200	1min30s	ZnO/Au/Al ₂ O ₃	15	77.81	21.23	66.43
5	200	1min15s	ZnO/Au/Al ₂ O ₃	15	80.91	36.43	46.31
6	370	5min	ZnO/Au/Al ₂ O ₃	15	80.78	10.77	155.41
7	370	4min30s	ZnO/Au/Al ₂ O ₃	15	83.55	13.58	147.63
8	370	4min	ZnO/Au/Al ₂ O ₃	15	89.24	16.92	190.20
9	370	3min30s	ZnO/Au/Al ₂ O ₃	15	88.79	21.20	145.17
10	370	3min	ZnO/Au/Al ₂ O ₃	15	90.10	23.14	152.24

References

- [1] K. Bley, J. Semmler, M. Rey, C. Zhao, N. Martić, R. N. Klupp Taylor, M. Stingl, N. Vogel, *Advanced Functional Materials* **2018**, 28, 1706965.
- [2] C. Stelling, C. R. Singh, M. Karg, T. A. F. König, M. Thelakkat, M. Retsch, *Scientific Reports* **2017**, 7, 42530.
- [3] T. Qiu, B. Luo, E. M. Akinoglu, J.-H. Yun, I. R. Gentle, L. Wang, *Advanced Functional Materials* **2020**, 30, 2002556.