Supporting Information

Reversible Zn^{2+}/Al^{3+} intercalation in niobium-substituted polyoxometalates and demonstration of energy storage smart window

Tong Feng [a, b], Huili Guo [a], Xiaoxiao Xing [a], Yan Bai [a, *], Dongbin Dang [a, *], Weizhen Zhao [b, *]

[a] *Henan Key Laboratory of Polyoxometalate Chemistry, College of Chemistry and Chemical Engineering, Henan University, Kaifeng, Henan 475004, PR China*

[b] *Beijing Key Laboratory of Ionic Liquids Clean Process, CAS Key Laboratory of Green Process and Engineering, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, PR China*

* *Corresponding author: E-mail address:* baiyan@henu.edu.cn (Y. Bai), dangdb@henu.edu.cn (D.-B. Dang), wzzhao@ipe.ac.cn (W.-Z. Zhao).

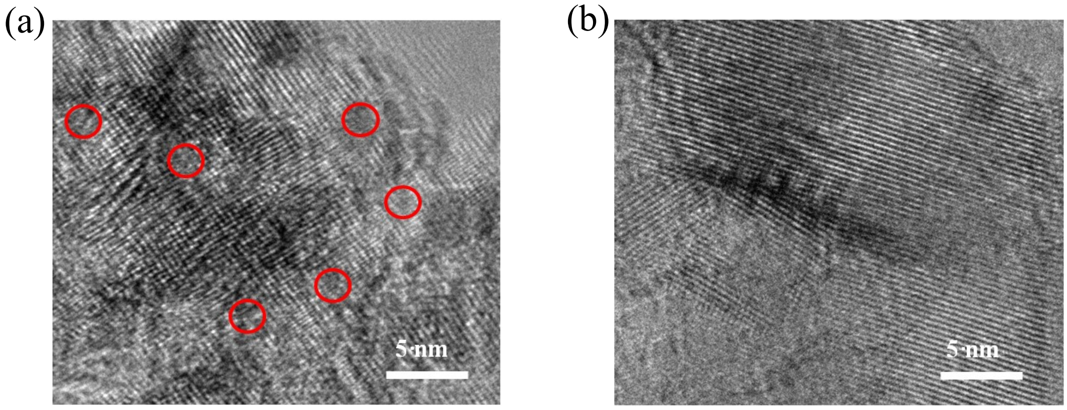

Fig. S1 Transmission electron microscopy (TEM) image of (a) $P_2W_{15}Nb_3$-TiO_2 composite film and (b) TiO_2 film.

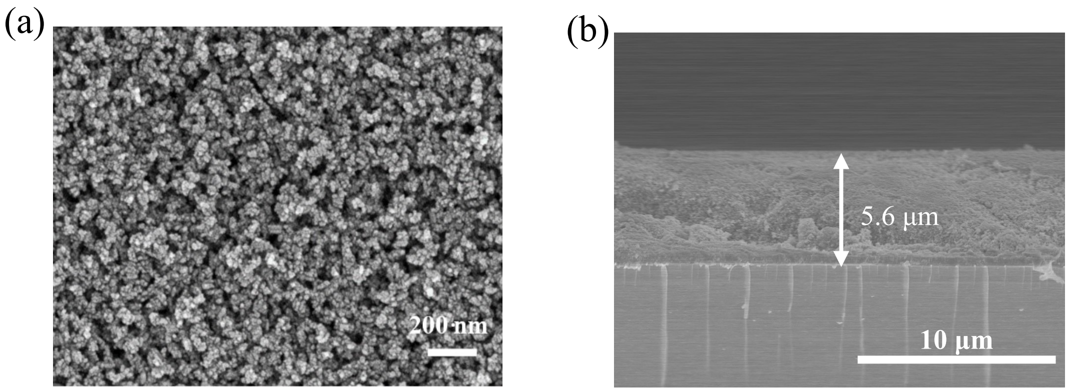

Fig. S2 (a) Top-view SEM images of TiO_2 film. (b) Cross-sectional SEM image of $P_2W_{15}Nb_3$-TiO_2 composite film.

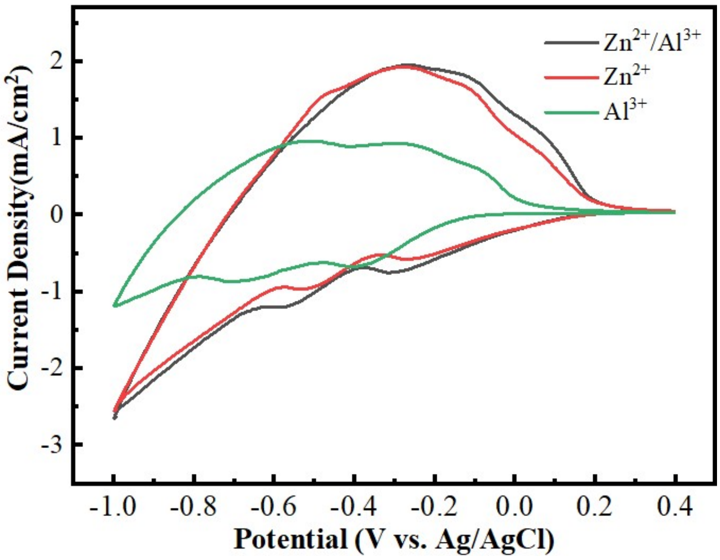

Fig. S3 CV curves of the $P_2W_{15}Nb_3$-TiO_2 composite film in 1 M $Zn(ClO_4)_2$-$Al(ClO_4)_3$, $Zn(ClO_4)_2$, $Al(ClO_4)_3$.

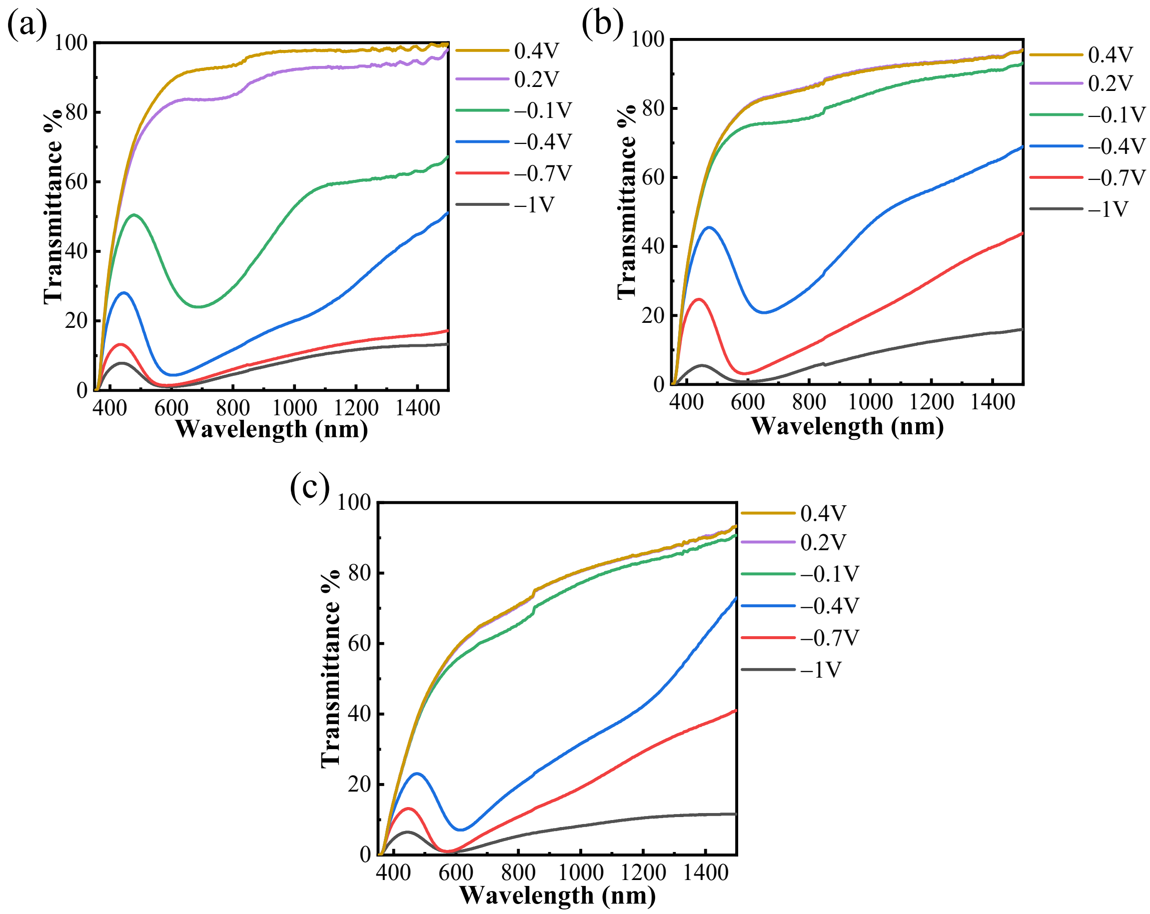

Fig. S4 Visible near-infrared transmittance spectra of $P_2W_{15}Nb_3$-TiO_2 composite film measured from -1 to 0.4 V in (a) 1 M $Zn(ClO_4)_2$-$Al(ClO_4)_3$, (b) $Zn(ClO_4)_2$, (c) $Al(ClO_4)_3$, respectively.

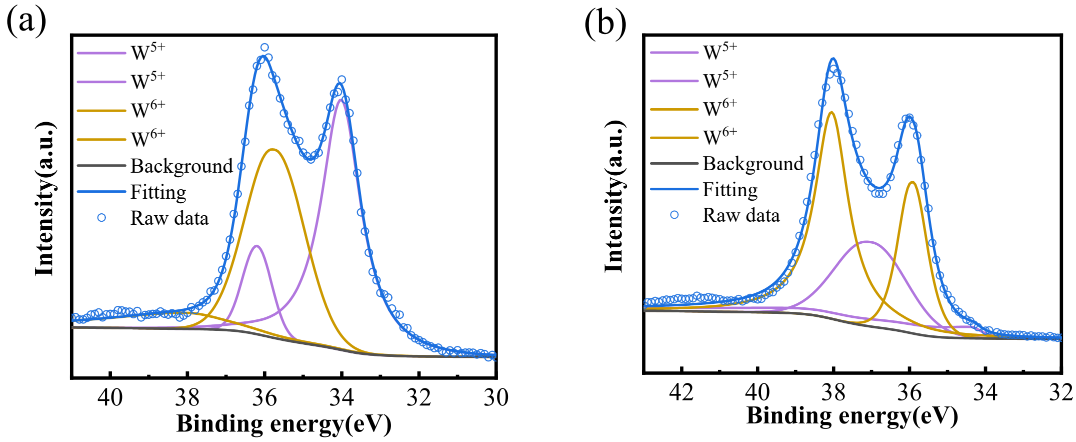

Fig. S5 W 4f XPS spectra of self-colored $P_2W_{15}Nb_3$-TiO_2 composite film in 1 M (a) $Zn(ClO_4)_2$, (b) $Al(ClO_4)_3$ electrolyte.

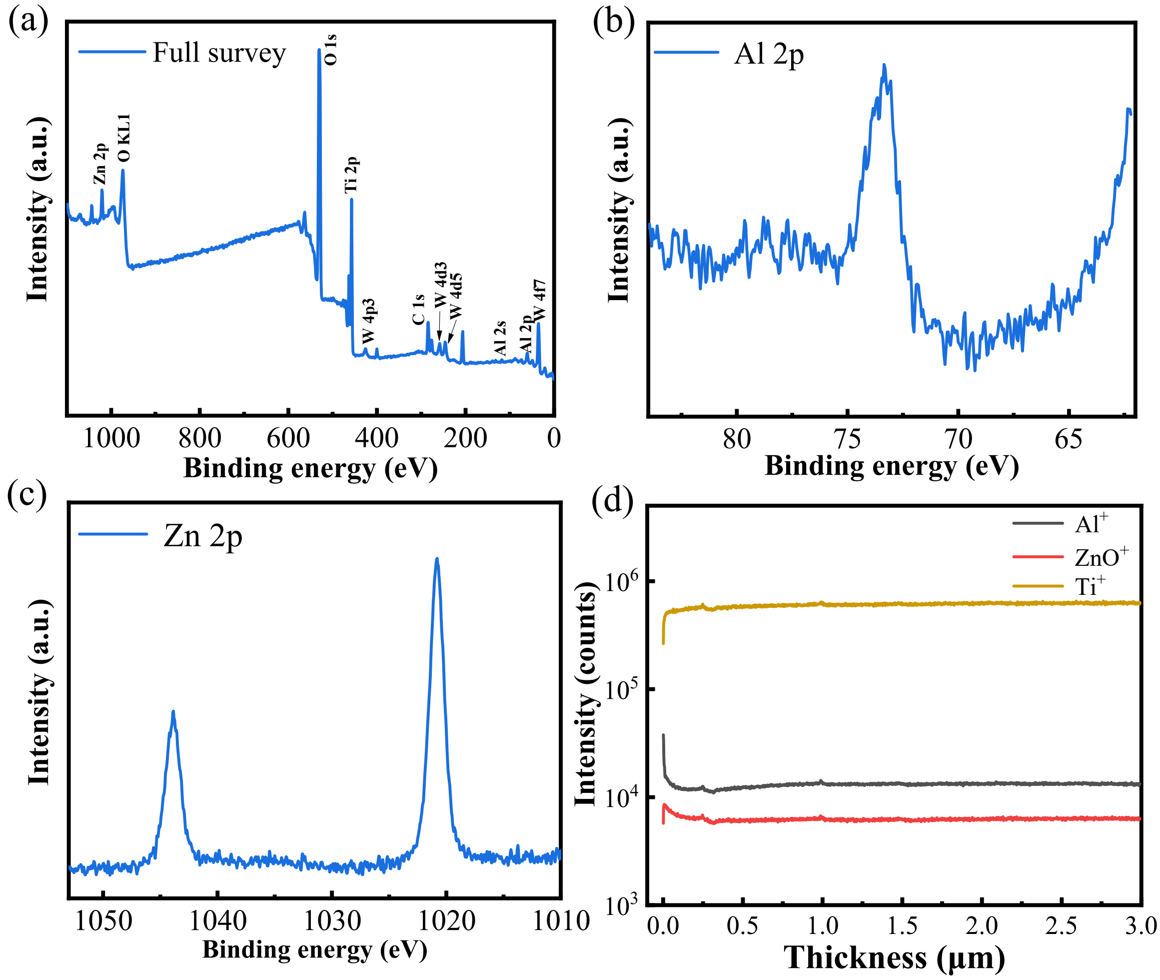

Fig. S6 (a) XPS full survey of $P_2W_{15}Nb_3$-TiO_2 composite film. (b) Al 2p and (c) Zn 2p XPS spectra of colored $P_2W_{15}Nb_3$-TiO_2 composite film in 1 M $Zn(ClO_4)_2$-$Al(ClO_4)_3$ electrolyte. (d) TOF-SIMS depth profiles of $P_2W_{15}Nb_3$-TiO_2 composite film that measure at -1 V in 1 M $Zn(ClO_4)_2$-$Al(ClO_4)_3$ electrolyte.

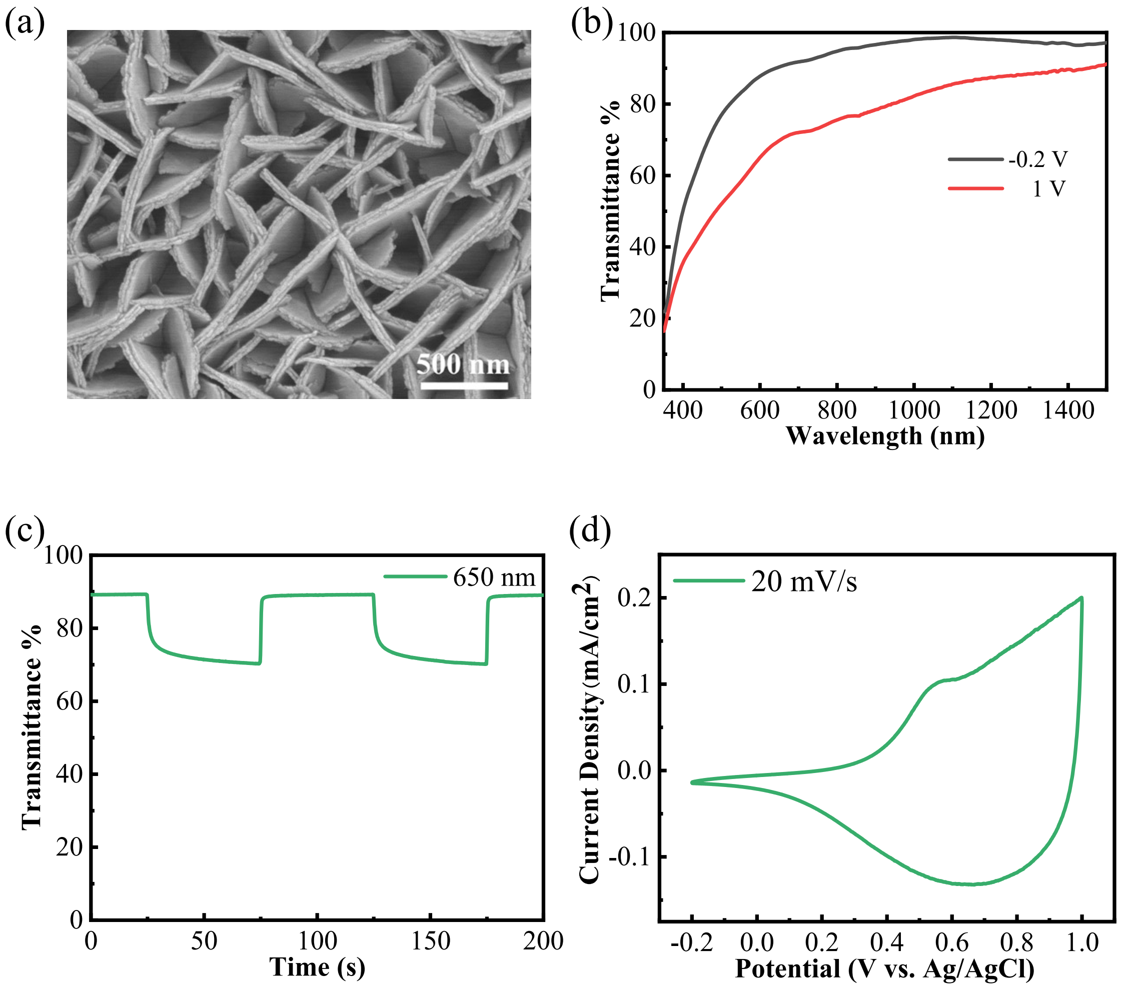

Fig. S7 (a) SEM image of NiO nanosheets. (b,c) Visible near-infrared transmittance spectra and dynamic optical transmittance measurements of the NiO film measured at −0.2 and 1 V in 1 M $Zn(ClO_4)_2$-$Al(ClO_4)_3$ electrolyte. (d) CV curves of the NiO film in 1 M $Zn(ClO_4)_2$-$Al(ClO_4)_3$ electrolyte.

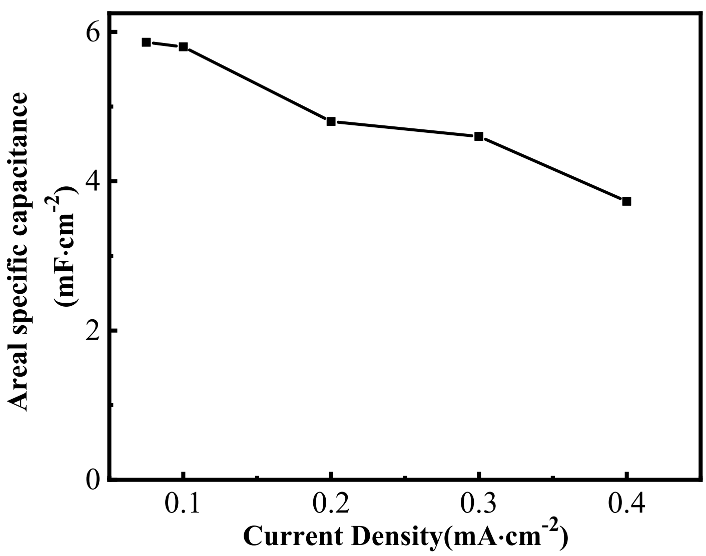

Fig. S8 Areal capacitances of EESD at different current densities.

Table S1 Comparison of Current State-of-the-Art Electrochromic Films and Devices

Materials	Film or Device	△T	Response Time T_b/T_c(s)	CE (cm^2 C^{-1})	Areal Capability (mF cm^{-2})	Spectal selectivity	Reference
$P_2W_{15}Nb_3$-TiO_2	Film	～90% 650 nm	18/8	136	52	350-1500 nm	**This work**
	Device	～64% 650 nm	14/4	88	5.86		
Polyoxometalates-$W_{18}O_{49}$	Film	～30% 500 nm	86/26	–	–	350-1400 nm	Gu et al[1]
WO_{3-x}	Film	～93% 633 nm	13/16	–	–	350-1800 nm	Zhang et al[2]
	Device	～73% 650 nm	–	–	–		
NiO-PB	Film	～60% 630 nm	3.8/1.6	45.3	–	350-1000 nm	Pan et al [3]
	Device	～67% 630 nm	7.9/2.8	109	11.5		
WO_3	Device	～62% 650 nm	1.95/1.84	139	5.12	350-800 nm	Bi et al4
PICA	Film	～43% 490 nm	0.7/1.7	142	16.2	350-1000 nm	Li et al[5]
	Device		–	–	4.3		
NW-P_2W_{17}-Cu(phen)$_2$	Film	～44% 490 nm	9.5/2.9	50.4	–	400-800 nm	Chu et al[6]

Reference

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