Electronic Supplementary Material (ESI) for Energy & Environmental Science.

Supporting Information

Al^{3+} intercalation/de-intercalation-enabled dual-band electrochromic smart windows with high optical modulation, quick response and long cycle life

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Supplementary Figures and Table

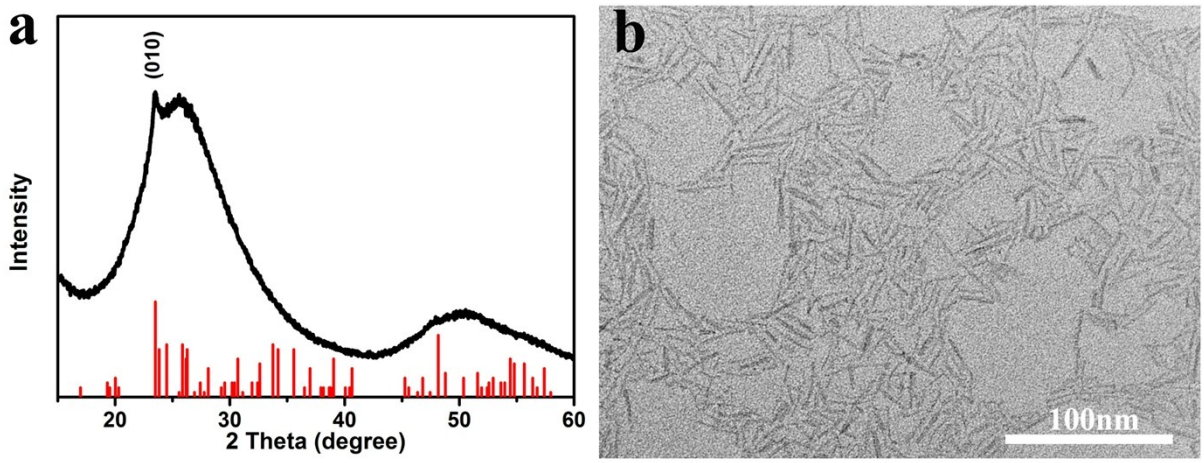

Fig. S1 (a) XRD patterns of $W_{18}O_{49}$ NWs and the monoclinic $W_{18}O_{49}$ reference (ICSD #05-0392). (b) TEM image of $W_{18}O_{49}$ NWs.

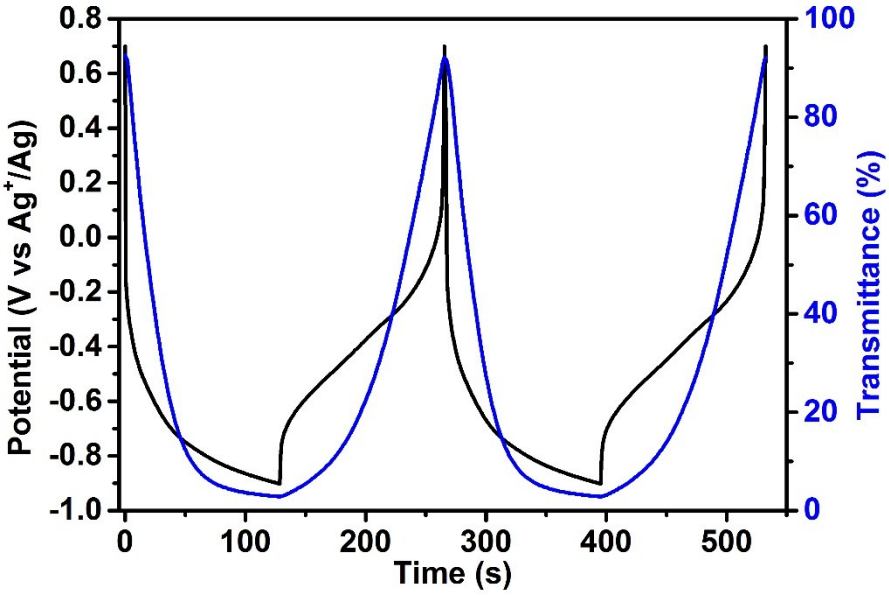

Fig. S2 Galvanostatic discharge/charge curves of the m-WO_{3-x} NW film at a current density of 0.5 mA cm^{-2} between 0.7 ~ -0.9 V (vs Ag^+/Ag) (black trace) and the corresponding changes of the transmittance at 633 nm measured in-situ (blue trace).

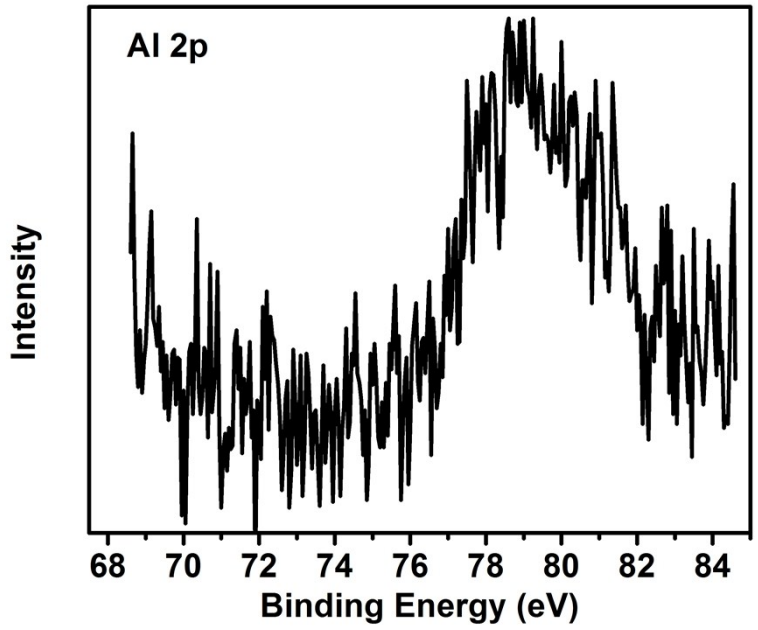

Fig. S3 The Al 2p XPS spectrum of c-Al_yWO_{3-x} NW film at -0.9 V.

Table S1. The detailed binding energy and ratio of W^{6+}, W^{5+} and W^{4+} in m-WO_{3-x} (pristine), t-Al_yWO_{3-x} (-0.5V) and c-Al_yWO_{3-x} (-0.9V).

Sample	**W^{6+}**		**W^{5+}**		**W^{4+}**		**W^{5+}/W^{6+}**	**$W^{4+}/W^{5+}/W^{6+}$**
	$W_{7/2}$ (eV)	$W_{5/2}$ (eV)	$W_{7/2}$ (eV)	$W_{5/2}$ (eV)	$W_{7/2}$ (eV)	$W_{5/2}$ (eV)		
m-WO_{3-x} (pristine)	36.0	38.15	35.1	37.25			0.2	
t-Al_yWO_{3-x} (-0.5V)	35.65	37.8	35.0	37.15			0.5	
c-Al_yWO_{3-x} (-0.9V)	35.58	37.73	34.9	37.05	33.40	35.55		0.43/0.81/1

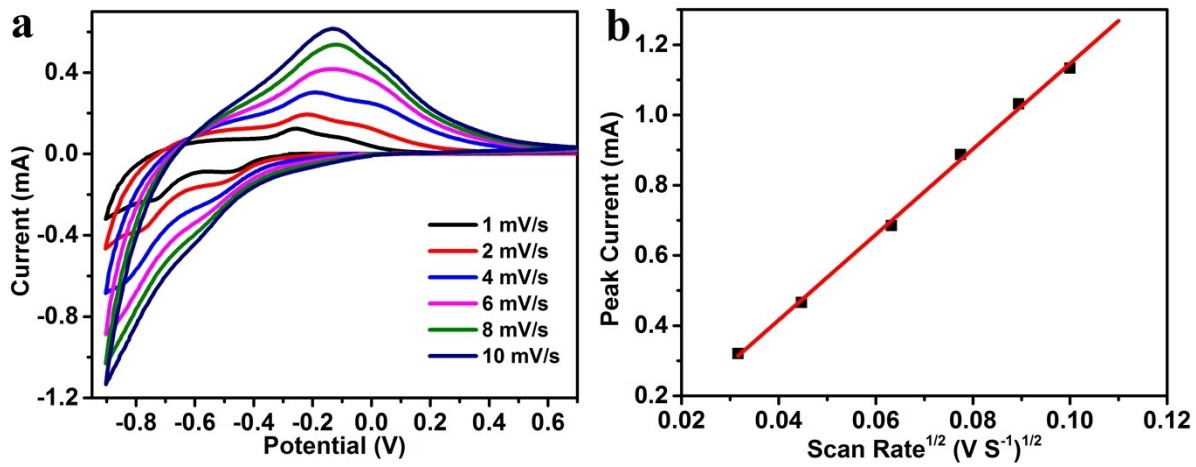

Fig. S4 (a) Cyclic voltammograms of Al^{3+} intercalation/de-intercalation of a m-WO_{3-x} NW film at different scan rates. (b) The cathodic peak current as a function of the square root of scaning rate.

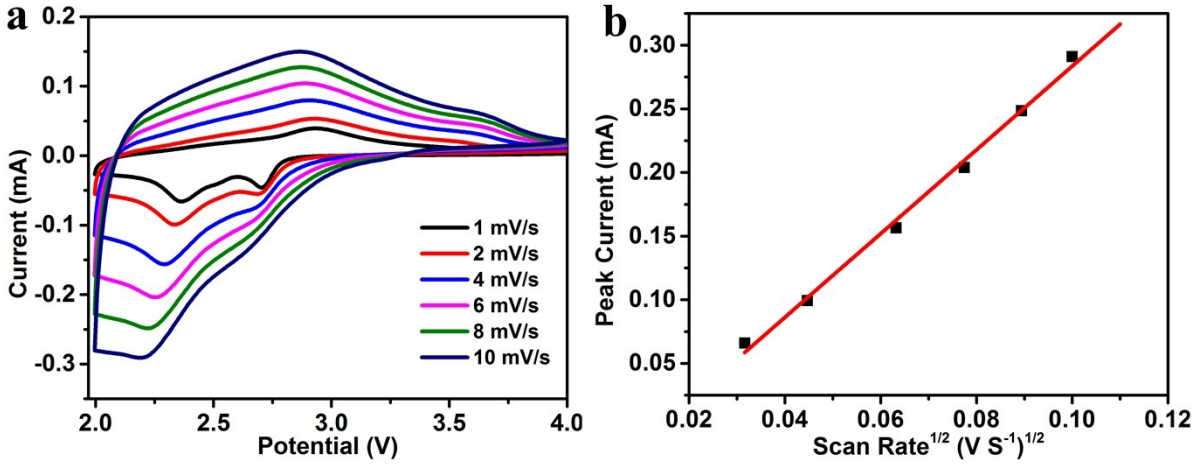

Fig. S5 (a) Cyclic voltammograms of of Li^{+} intercalation/de-intercalation of a m-WO_{3-x} NW film at different scan rates. (b) The cathodic peak current as a function of the square root of scaning rate.

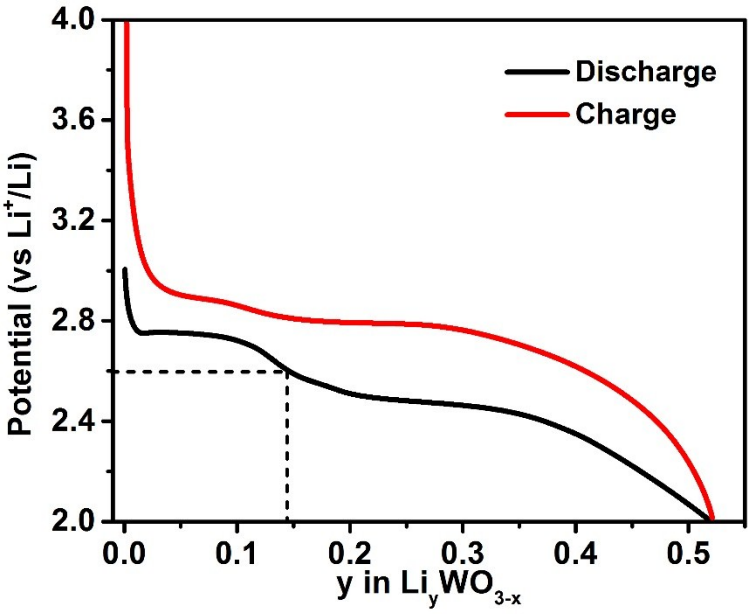

Fig. S6 Discharge/charge curves of m-WO_{3-x} NW film at a current density of 20 mA g^{-1} in the 4-2 V (vs Li^+/Li) window using Li metal as counter and reference electrodes, 0.5 M Li-TFSI/tetraglyme as electrolyte.

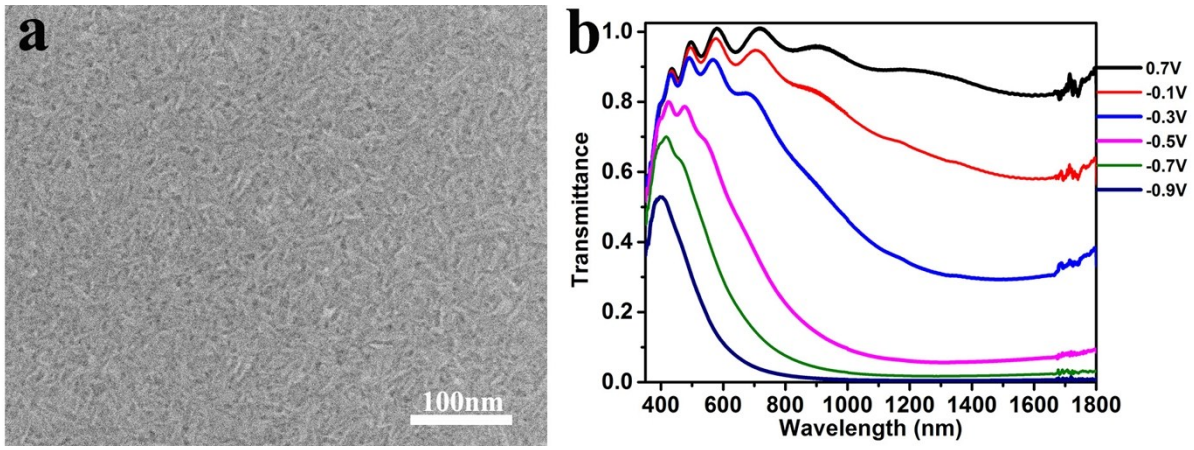

Fig. S7 (a) SEM image and (b) optical performance of m-WO_{3-x} NW film after 2000 voltammetric cycles.