Frontiers of Materials Science

Electronic Supplementary Material

Vanadium oxide cathode pillared by Al^{3+} and H_2O for high-performance aqueous zinc-ion batteries

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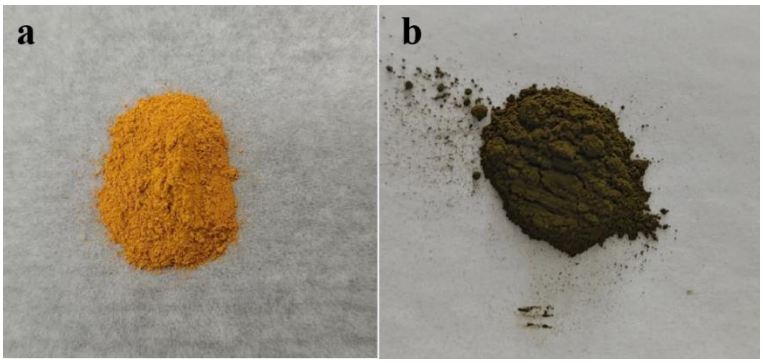

Fig. S1 Optical photographs: **(a)** c-V_2O_5; **(b)** AlVO.

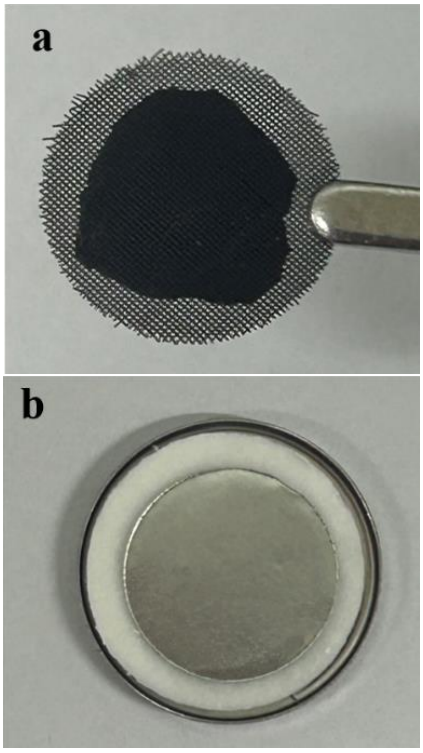

Fig. S2 Optical photographs: **(a)** cathode; **(b)** Waterman glass fiber separator and Zn metal anode.

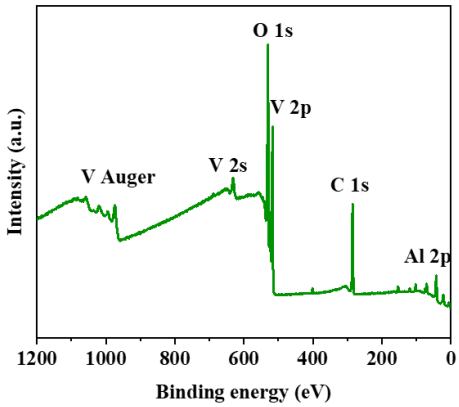

Fig. S3 Full XPS survey spectrum of PPy-V_2O_5.

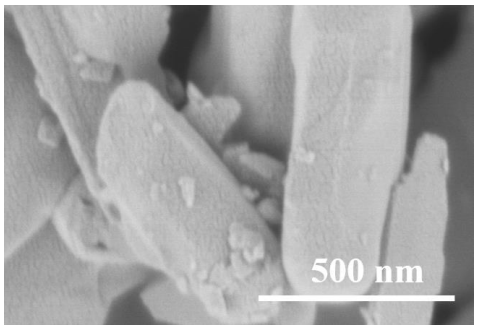

Fig. S4 SEM image of c-V_2O_5.

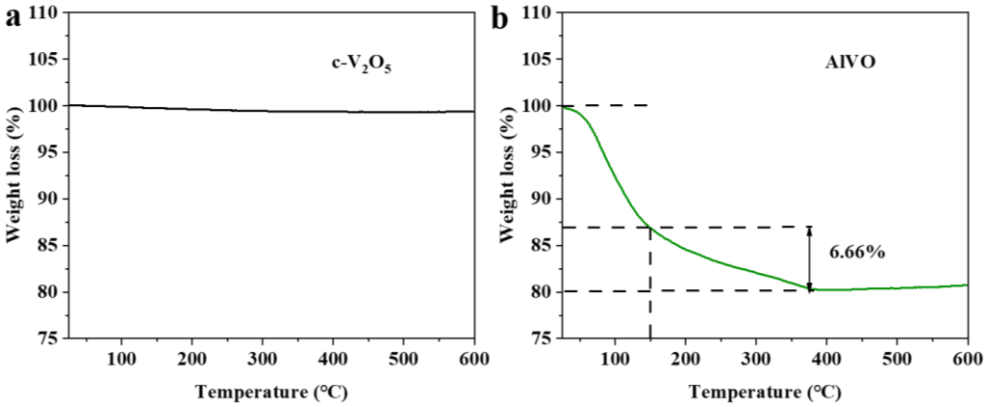

Fig. S5 TG curves of **(a)** c-V_2O_5 and **(b)** AlVO.

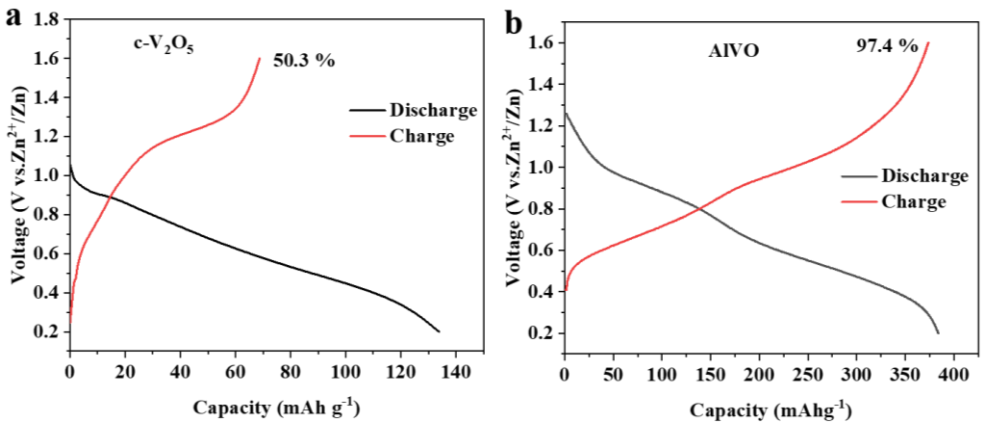

Fig. S6 The first discharge/charge profiles of two batteries at 0.5 $A \cdot g^{-1}$: **(a)** Zn//c-V_2O_5; **(b)** Zn//AlVO.

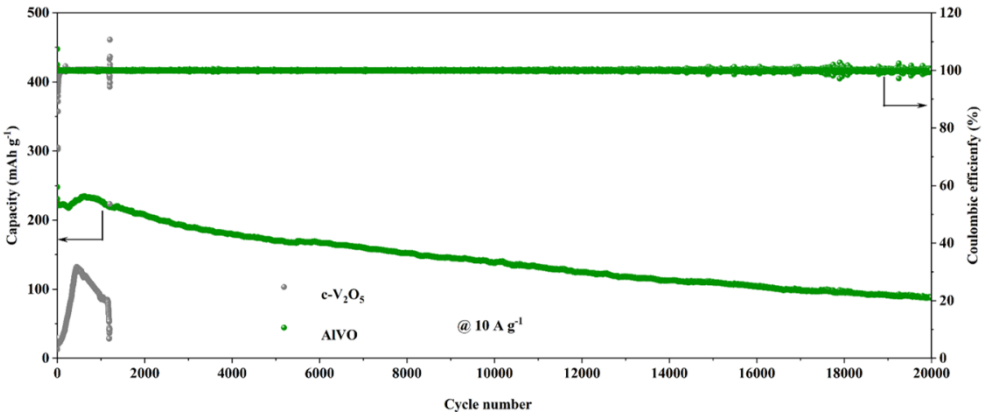

Fig. S7 Cycle performance of AlVO and c-V_2O_5 cathodes 10 A·g^{-1}.

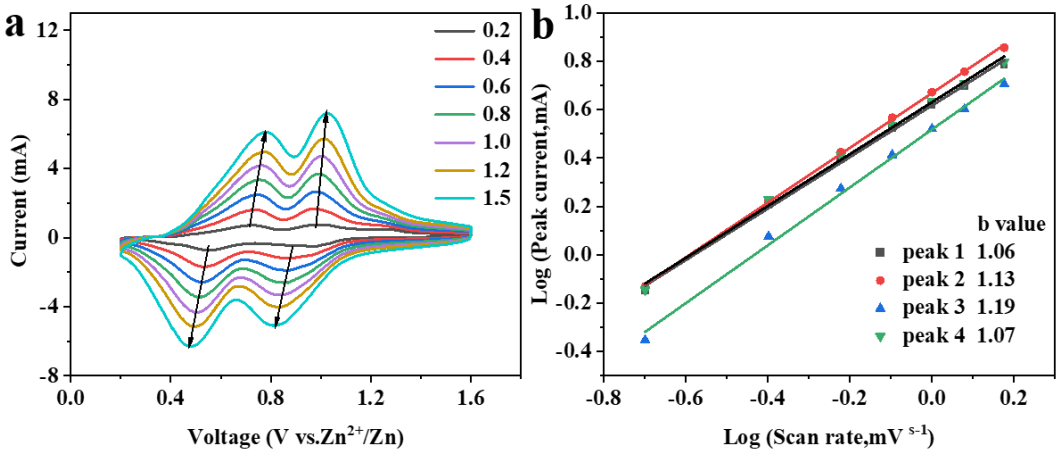

Fig. S8 (a) CV curves at different scan rates for the Zn//AlVO battery. **(b)** Relationships between the peak current and the scan rate.

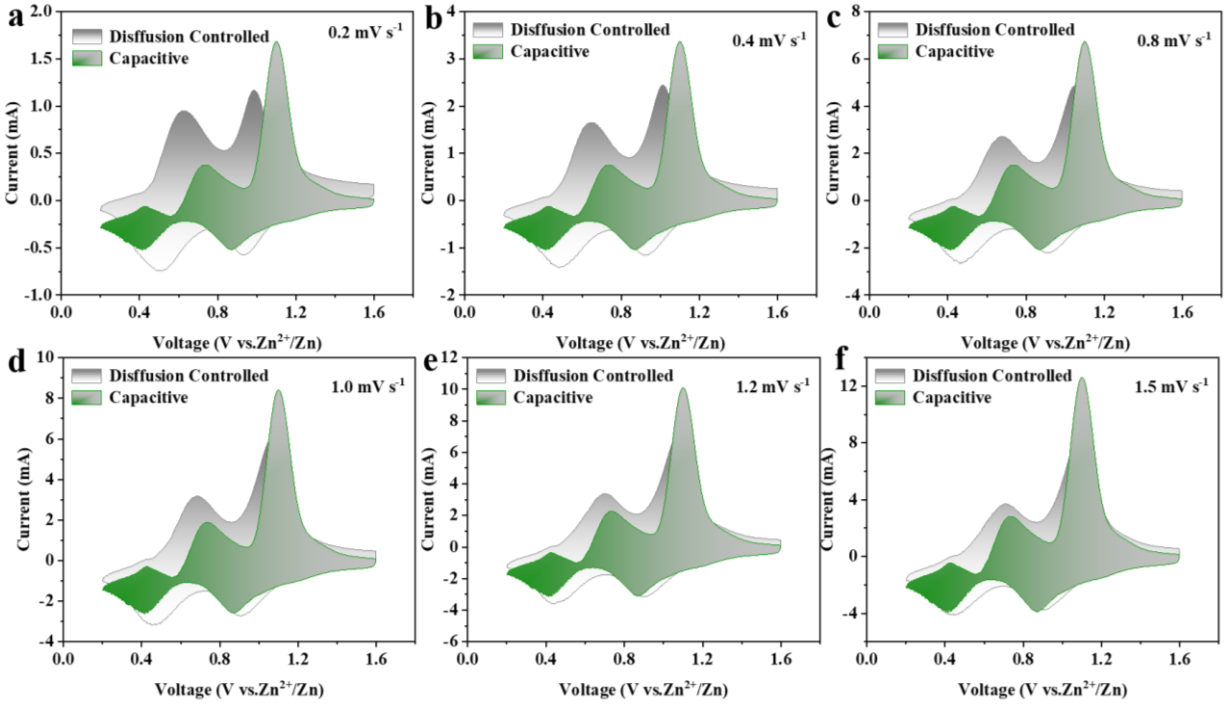

Fig. S9 Capacitance-controlled (green) and diffusion-controlled (gray) behaviors of the Zn//AlVO battery at **(a)** 0.2 mV·s^{-1}, **(b)** 0.4 mV·s^{-1}, **(c)** 0.8 mV·s^{-1}, **(d)** 1.0 mV·s^{-1}, **(e)** 1.2 mV·s^{-1}, and **(f)** 1.5 mV·s^{-1}.

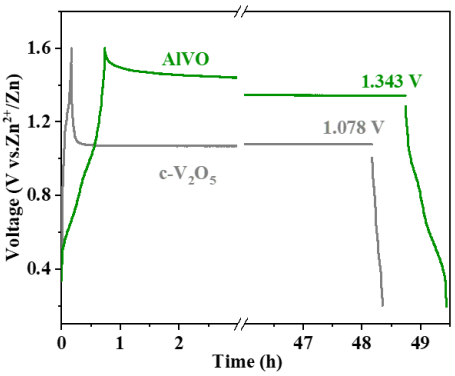

Fig. S10 Self-discharge performance of AlVO and c-V_2O_5 cathodes.

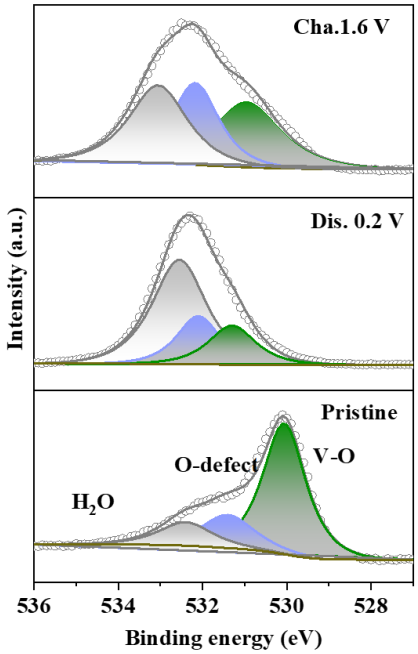

Fig. S11 *Ex-situ* high-resolution XPS spectra of O 2p at fully discharge/charge state in the first cycle at 0.5 A·g^{-1}.

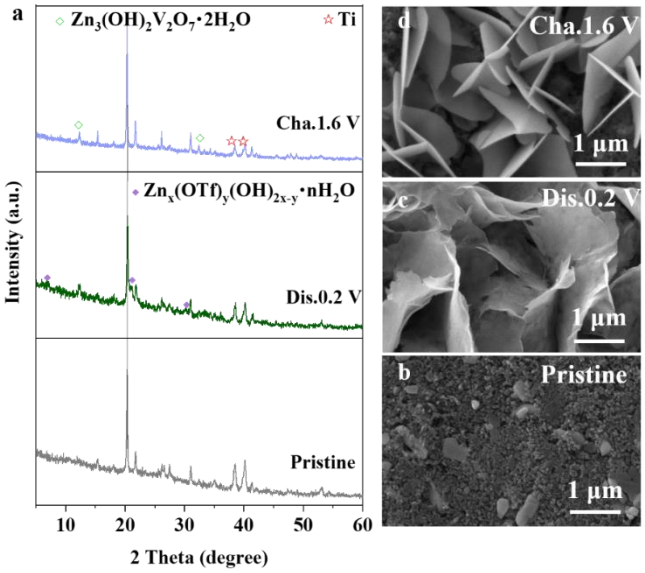

Fig. S12 (a) *Ex-situ* XRD patterns of the c-V_2O_5 cathode at different discharge/charge stages in the first cycle at 0.5 A·g^{-1}. *Ex-situ* SEM images of the c-V_2O_5 cathodes: **(b)** pristine, **(c)** the 1st discharge to 0.2 V, and **(d)** the 1st charge to 1.6 V.

Table S1 Comparison of cycle performance of vanadium-based cathodes for AZBs

Cathode	Electrolyte	C/(mAh·g^{-1}) (at i/(A·g^{-1}))	Cycle performance (N (i/(A·g^{-1}))	C_f/(mAh·g^{-1})	Ref.
$Sn_{1.5}V_2O_7(OH)_2·3.3H_2O$	–	300 at (0.1)	500 (10)	125	[S1]
MnVO	3 mol·L^{-1} $Zn(CF_3SO_3)_2$	415 (0.05)	2000 (4)	264	[S2]
PEDOT-$NH_4V_3O_8$	3 mol·L^{-1} $Zn(CF_3SO_3)_2$	356.8 (0.05)	5000 (10)	160.6	[S3]
VCN	–	256 (1)	1000 (5)	106	[S4]
$NaVPO_4F$	15 mol·L^{-1} $NaClO_4$ + 1 mol·L^{-1} $Zn(CF_3SO_3)_2$	87.4 (0.1)	4000 (1)	66.7	[S5]
$Mg_xV_2O_5·nH_2O$	1 mol·L^{-1} $ZnSO_4$ + 1 mol·L^{-1} $MgSO_4$	374 (0.1)	200 (1)	180	[S6]
V_2O_5	30 m $ZnCl_2$	341 (0.05)	1000 (1)	138	[S7]
$FeVO_4$	–	250 (0.1)	2500 (5)	70	[S8]
V_2O_5	21 mol·kg^{-1} LiTFSI + 1 mol·kg^{-1} $Zn(CF_3SO_3)_2$	238 (0.05)	2000 (2)	110	[S9]
$K_2V_8O_{21}$	–	230 (0.5)	300 (6)	128	[S10]
$Mn_{0.15}V_2O_5·nH_2O$	1 mol·L^{-1} $Zn(ClO_4)_2$/PC	367 (0.1)	8000 (10)	153	[S11]
AlVO	3 mol·kg^{-1} $Zn(CF_3SO_3)_2$	390.7 (0.5)	10000 (10)	138.2	This work
			20000 (10)	89	

Notes: C, capacity; i, current density; N, cycle number; C_f, final capacity.

References

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