Supporting Information

In-Situ Facile Bubble-Templated Fabrication of New-Type Urchin-Like (Li, Mo)-Doped $Li_x(Mo_{0.3}V_{0.7})_2O_5$ for Zn^{2+} Storage

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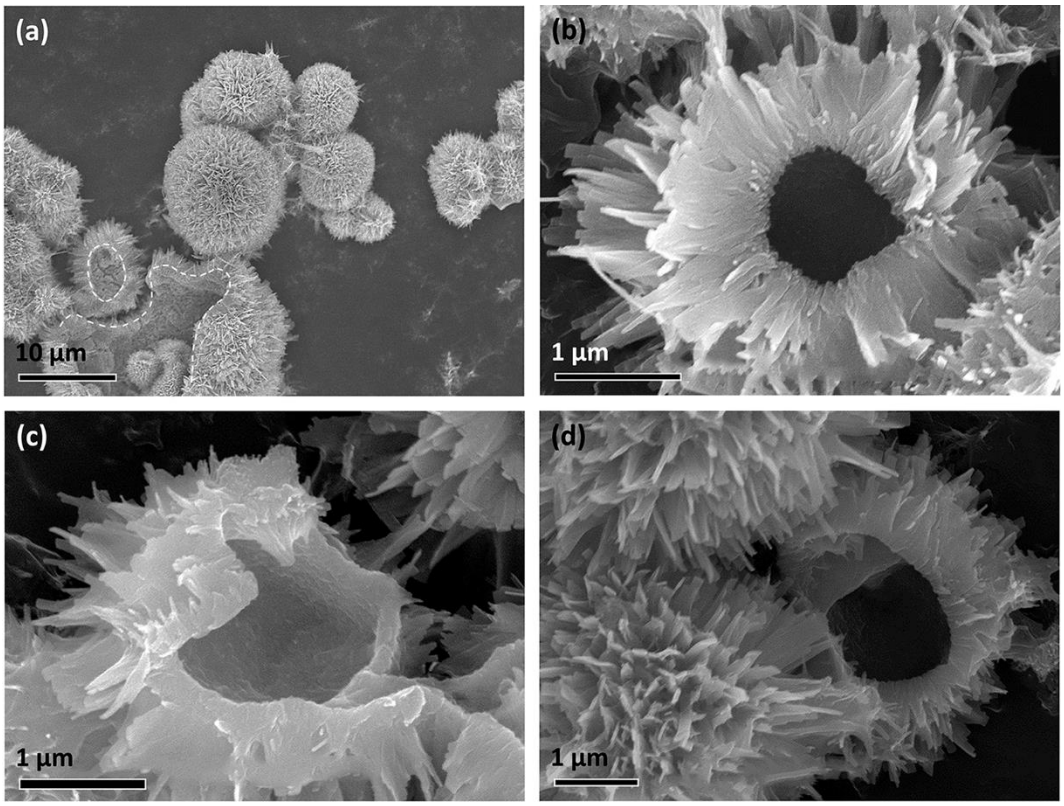

Fig. S1 (a–d) SEM images of the cracked LMVO.

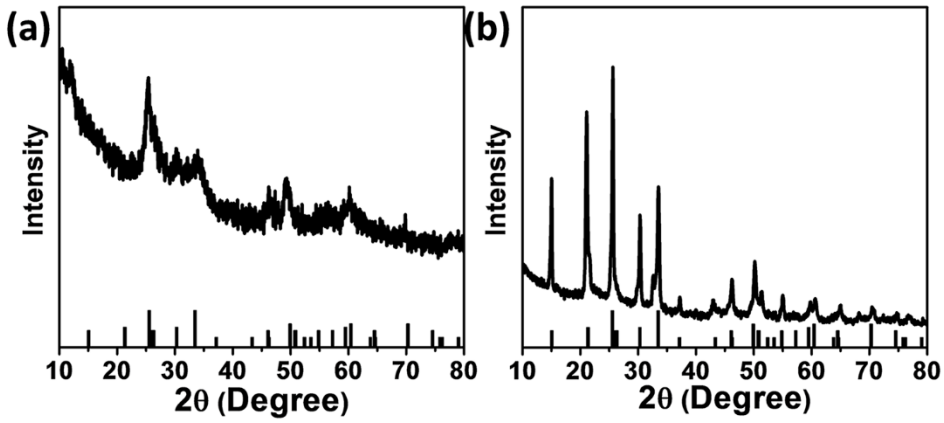

Fig. S2 XRD patterns of the raw and annealed LMVO.

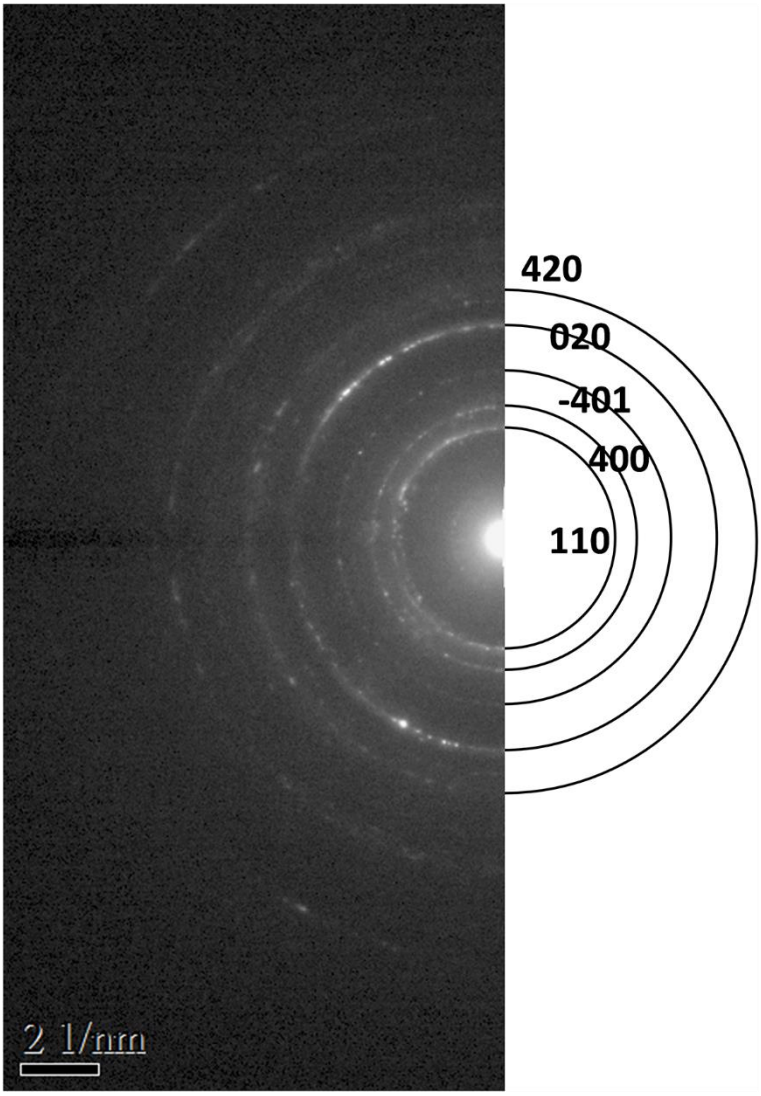

Fig. S3 SAED pattern of LMVO.

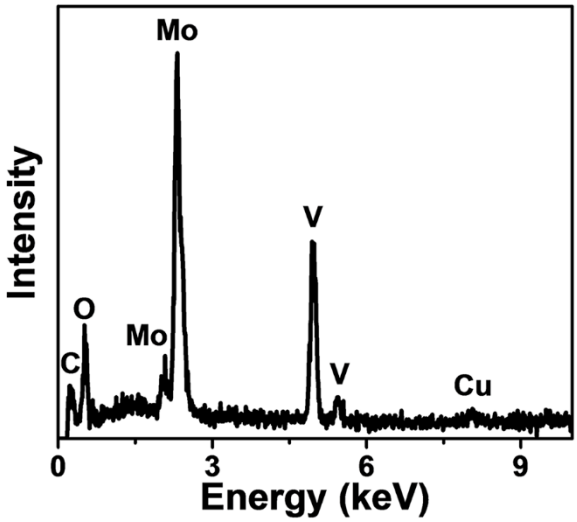

Fig. S4 EDS spectrum of LMVO.

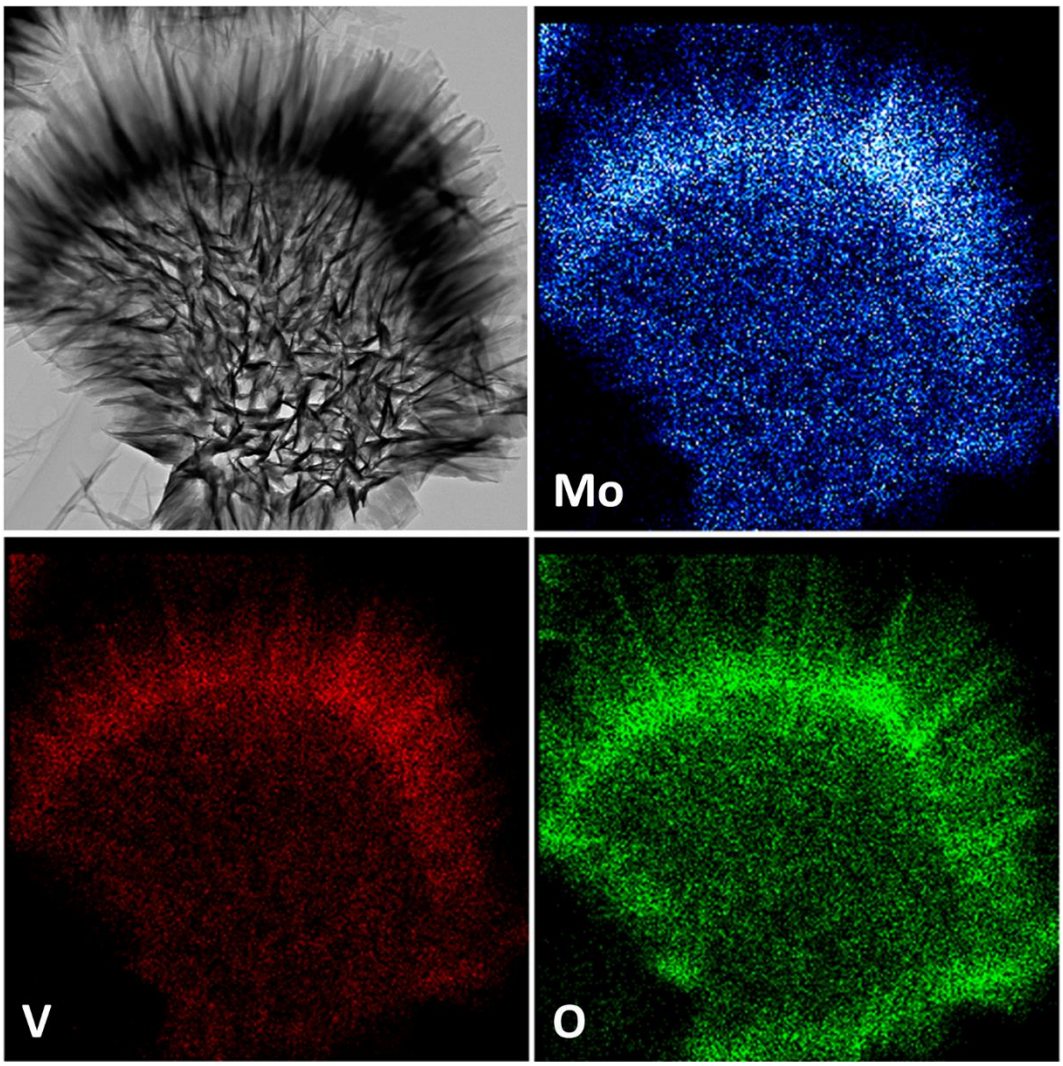

Fig. S5 SEM image and mapping images of Mo, V and O for LMVO.

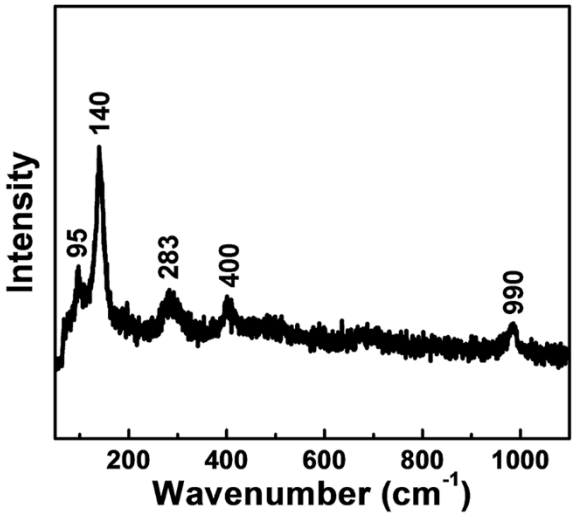

Fig. S6 Raman spectrum of LMVO.

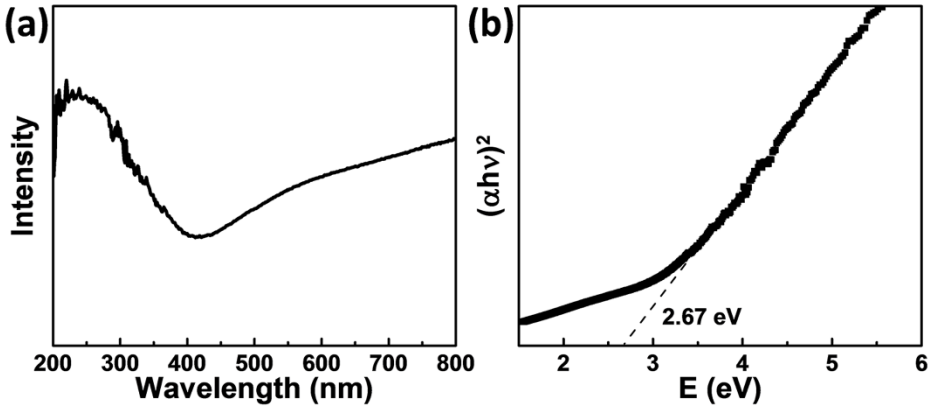

Fig. S7 UV-vis diffuse reflectance spectrum and Tauc plot of LMVO.

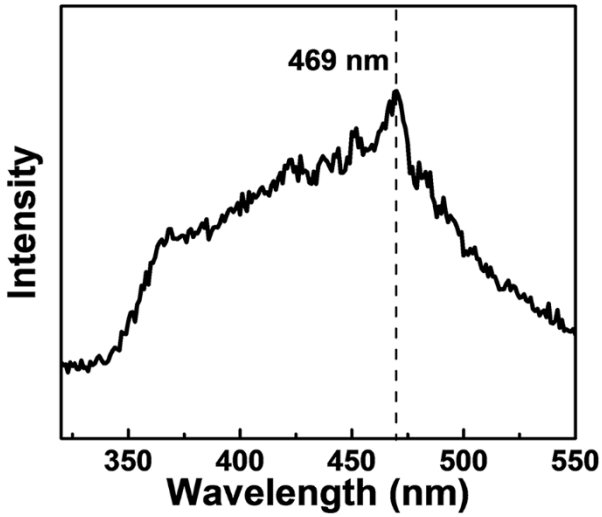

Fig. S8 Photoluminescence spectroscopy of LMVO with an excitation wavelength of 320 nm at room temperature.

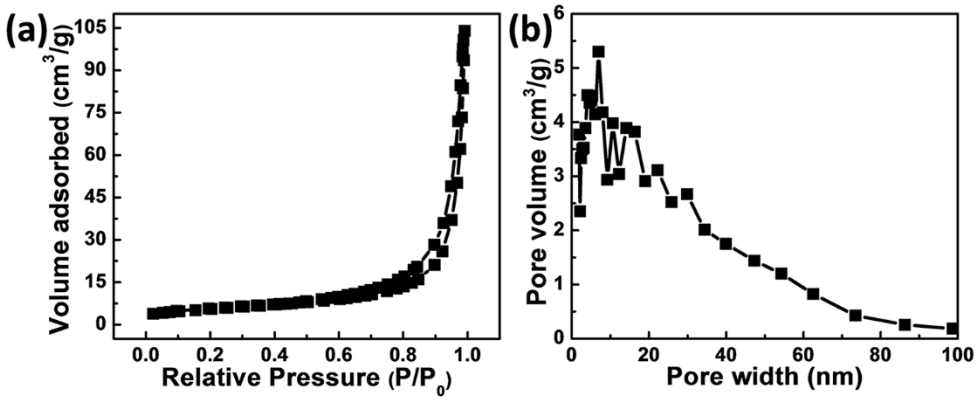

Fig. S9 (a) Nitrogen adsorption and desorption isotherms and (b) pore size distribution curve of LMVO.

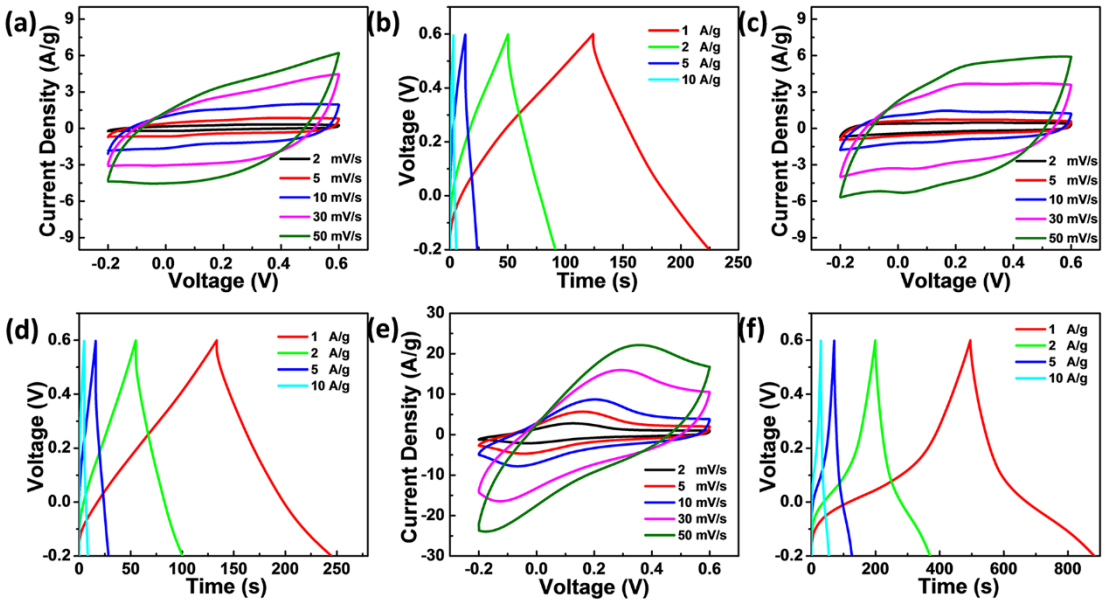

Fig. S10 (a, c, e) CV curves at different sweep rates and (b, d, f) GCD curves at different current densities of LMVO in $LiNO_3$, $Mg(NO_3)_2$ and $Zn(NO_3)_2$ electrolytes respectively.

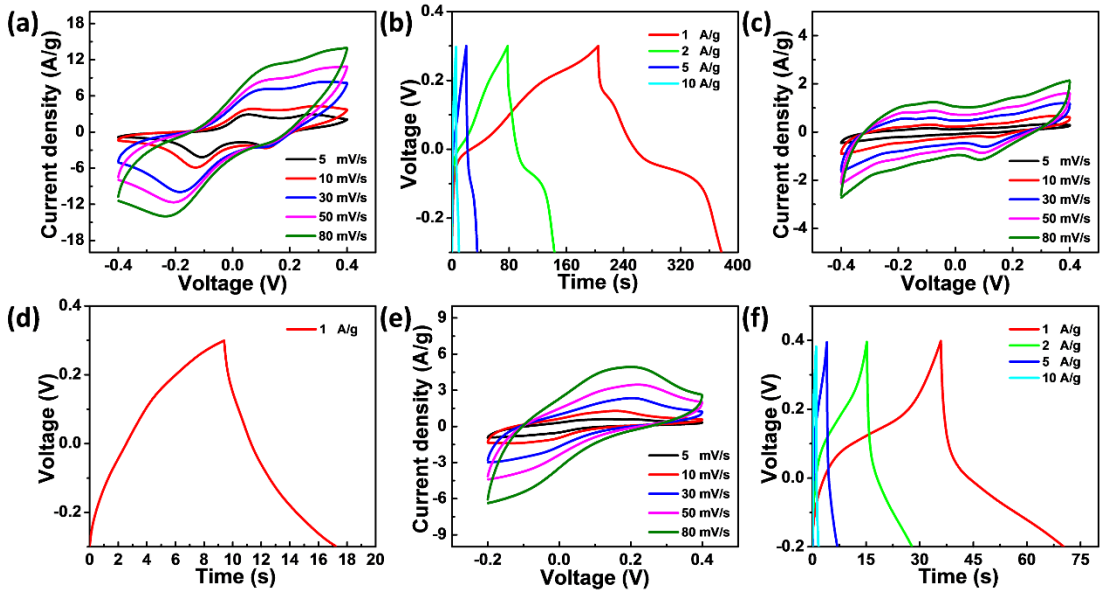

Fig. S11 (a, c, e) CV curves at different sweep rates and (b, d, f) GCD curves at different current densities of V_2O_5 in $LiNO_3$, $Mg(NO_3)_2$ and $Zn(NO_3)_2$ electrolytes respectively.

Table S1. Comparison of the synthesis, compositions, morphology and electrochemical performance of V-based materials.

Materials	Compositions	Synthesis Conditions	Morphology	Specific Capacitance	Ref.
LMVO	Li, Mo, V and O	Free energy, 1 min	Urchin-like	484 F/g at 1 A/g	This work
$Li_xV_2O_5$	Li, V and O	120 °C, > 31 h	Nanowire	57.3 F/g at 0.5 A/g	[1]
$Mn_xV_2O_5$	Mn, V and O	250 °C, > 27 h	Film	536 F/g at 0.068 A/g	[2]
V_2O_5	V and O	300 °C, > 27 h	Film	331.2 F/g at 0.2 A/g	[3]
V_3O_7	V and O	160 °C, > 12 h	Nanowire	236 mF/cm^2 at 0.2 mA/cm^2	[4]
$Na_xV_2O_5$	Na, V and O	400 °C, > 1.5 h	Nanosheet	389 F/g at 0.4 A/g	[5]
V_2O_5	V and O	70 °C, > 3.5 h	Nanobelt	312 F/g at 0.1 A/g	[6]
VO_x	V and O	160 °C, > 6 h	Nanorod	356.8 mF/cm^2 at 0.5 mA/cm^2	[7]
VO_2@PANI	V and O	160 °C, > 24 h	Nanobelt	246 F/g at 0.5 A/g	[8]
VO_2	V and O	180 °C, > 12 h	Starfruit	225 F/g at 0.25 A/g	[9]
V_2O_5	V and O	800 °C, > 48 h	Nanowire	460 mF/cm^3 at 5 mV/s	[10]
V_2O_5@PPy	V and O	120 °C, > 12 h	Nanoribbon	308 F/g at 0.1 A/g	[11]
$V_2O_5 \cdot 0.76H_2O$	H, V and O	200 °C, > 12 h	Nanosheet	219 F/g at 1 A/g	[12]
RGO/V_2O_5	V and O	180 °C, > 12 h	Nanobelt	320 F/g at 1 A/g	[13]
V-PPy/RGO	V and O	90 °C, > 18 h	Nanowire	434.7 F/g at 1 A/g	[14]
CNT/V_2O_5	V and O	120 °C, > 24 h	Nanowire	226 F/g at 1 mV/s	[15]
CNT-V_2O_5	V and O	120 °C, > 24 h	Nanowire	440 F/g at 0.25 A/g	[16]
V_2O_5	V and O	300 °C, > 1 h	Particle	262 F/g at 5 mV/s	[17]

V_2O_5	V and O	180 °C, > 48 h	Nanosheet	195.4 F/g at 1 A/g	[18]
V_2O_5	V and O	180 °C, > 10 h	Nanobelt	205 F/g at 1 A/g	[19]
V_2O_5	V and O	190 °C, > 5 h	Nanosheet	451 F/g at 0.5 A/g	[20]
V_2O_3@C	V and O	800 °C, > 7 h	Nanoflake	207 F/g at 0.05 A/g	[21]

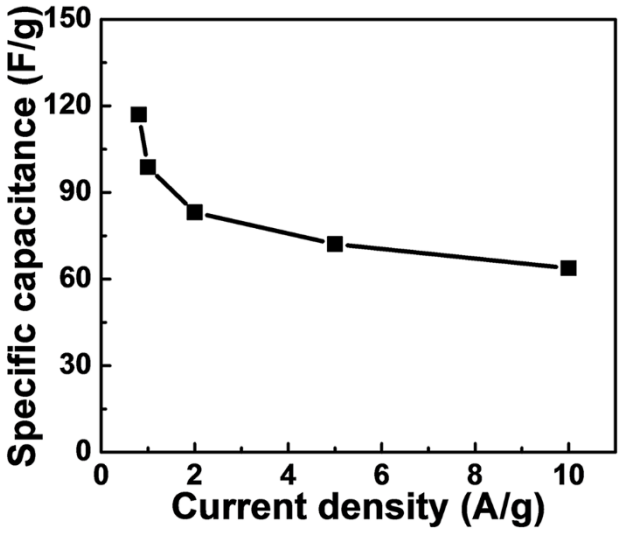

Fig. S12 Rate capability plot of LMVO//LMVO device in $Zn(NO_3)_2$ electrolyte.

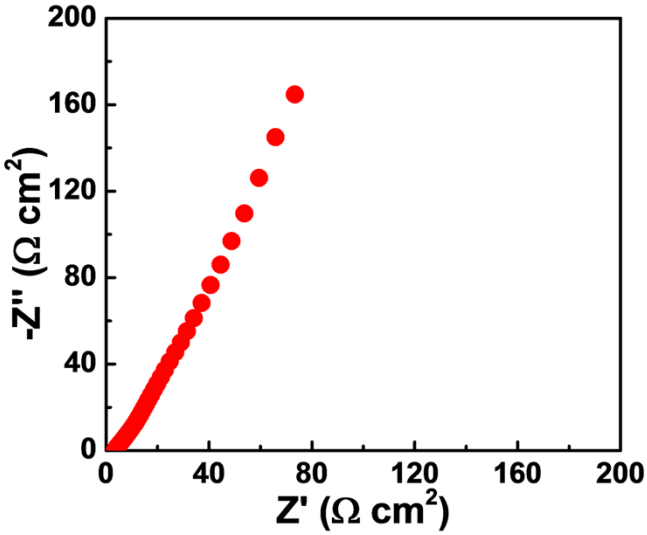

Fig. S13 Nyquist plot of LMVO//LMVO device at open circuit potential in $Zn(NO_3)_2$ electrolyte.

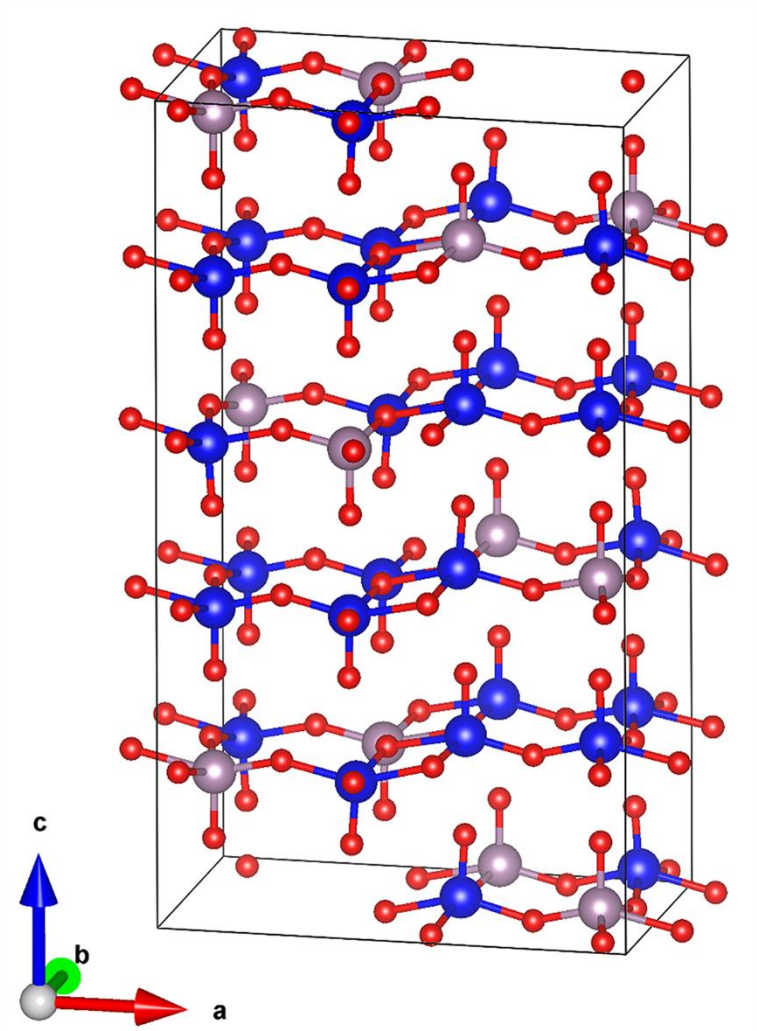

Fig. S14 Distribution of Mo atoms in $(Mo_{0.3}V_{0.7})_2O_5$. (blue ball: vanadium atom, grey ball: molybdenum atom, red ball: oxygen atom).

Tab. S2 Calculated Lattice Parameters and Volumes of Unit Cells for V_2O_5 and MVO.

	A (Å)	B (Å)	C (Å)	Volume (Å^3)
V_2O_5	11.56	3.58	4.33	179.17
MVO	12.30	3.64	4.00	179.09

MVO：$\alpha = 89.97$， $\beta = 90.00$， $\gamma = 90.00$

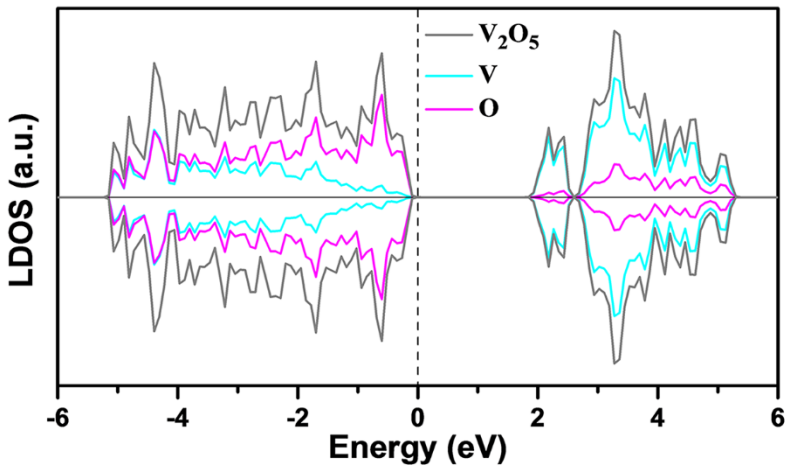

Fig. S15 Total and local DOS for V_2O_5. The positive values represent spin-up states, and the negative values are spin-down states. The Fermi levels indicated by dashed lines are set at 0 eV.

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