

# Supporting Information

## Rapid Synthesis of Layered $K_xMnO_2$ Cathodes from Metal-Organic Frameworks for Potassium-Ion Batteries

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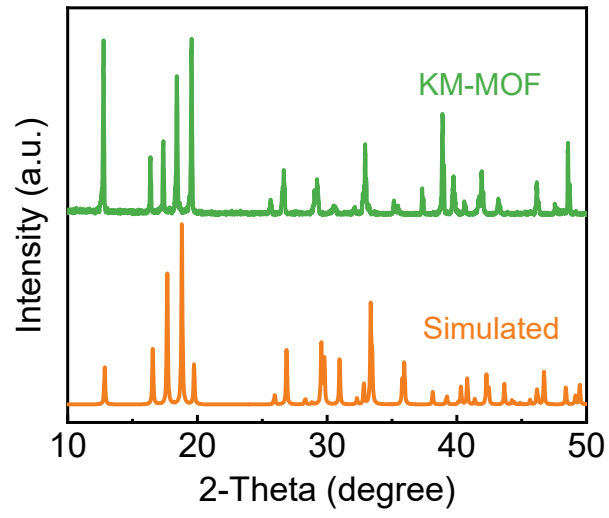
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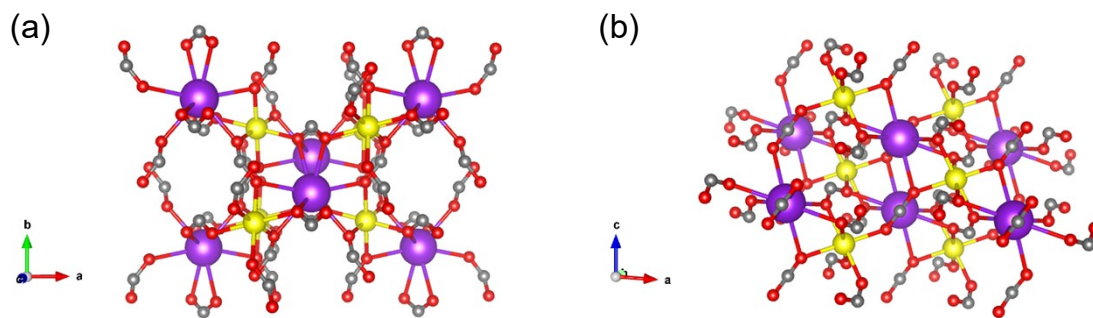
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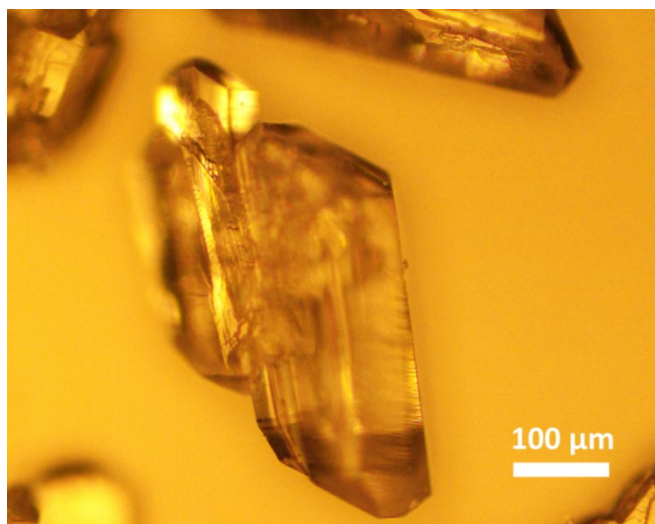
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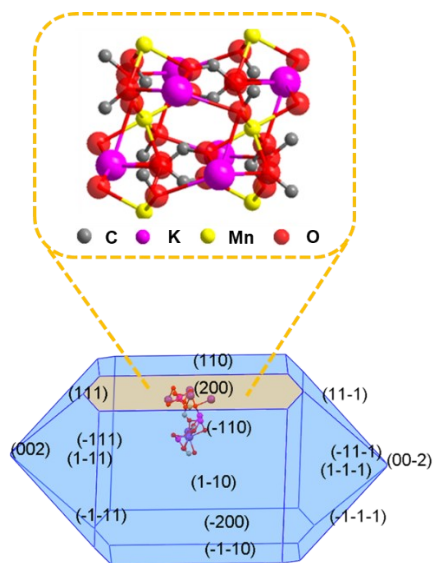
**Fig. S1** XRD pattern of KM-MOF.



**Fig. S2** 3D structures of KM-MOF along (a) c and (b) b directions. (Mn: yellow, K: purple, C: gray, and O: red).



**Fig. S3** Optical microscope photograph image of KM-MOF.



**Fig. S4** Crystal structure on the view of (200) plane of KM-MOF.

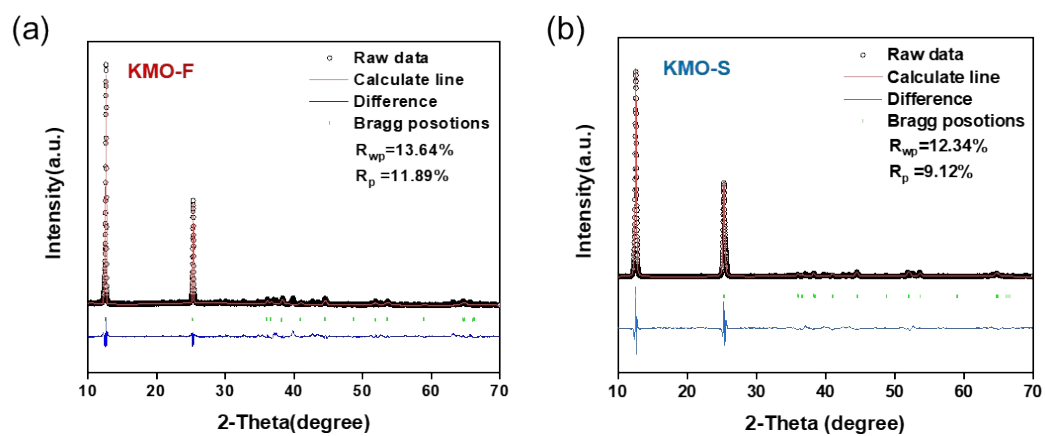
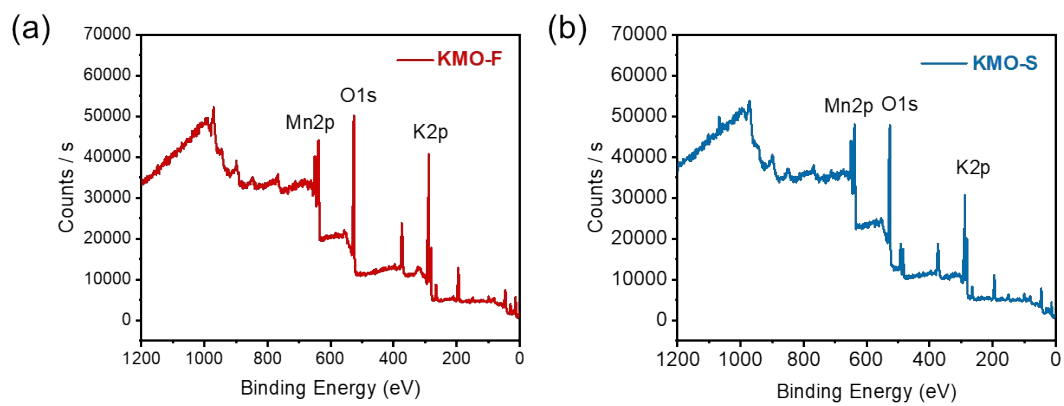


Fig. S5 XRD patterns and Rietveld refinement plots of (a) KMO-F and (b) KMO-S.



**Fig. S6** Full XPS survey scans of (a) KMO-F and (b) KMO-S.

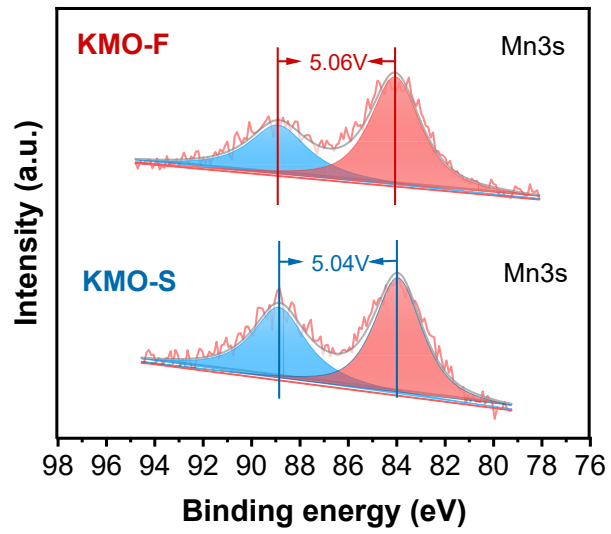
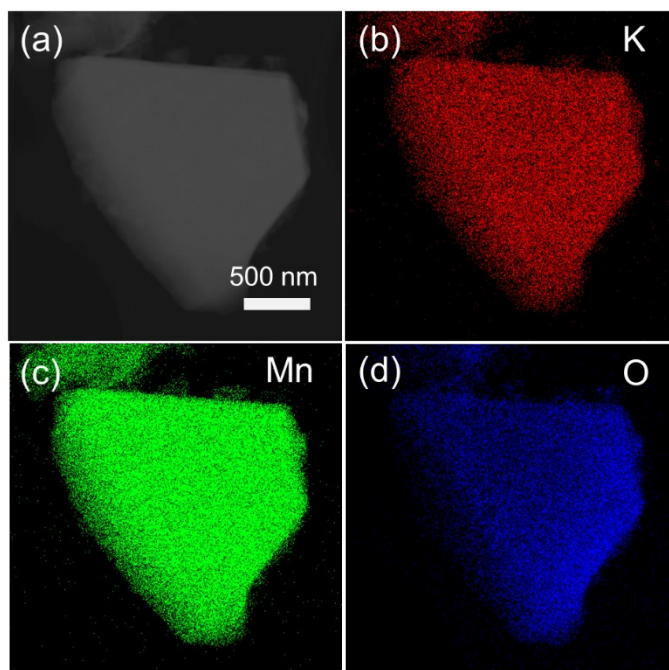


Fig. S7 XPS spectra of Mn 3s and compositional analyse for KMO-F and KMO-S.





**Fig. S8** STEM image of KMO-S and elemental mappings of K, Mn, and O.

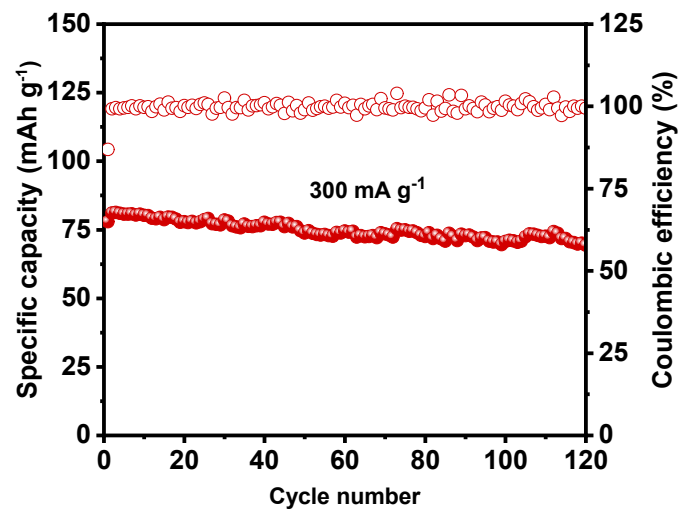


Fig. S9 Cycling performance of KMO-F at 300 mA g<sup>-1</sup> in the voltage range of 2.0-4.2V.

**Tab. S1** Comparison of reaction conditions for preparing layered  $K_xMnO_2$  in this work and the literature.

Layered Oxides	Synthesis methods	Calcination temperature and time	References
<b>KMO-F</b>	<b>Thermal decomposition of MOFs</b>	<b>1000 °C@8 min</b>	<b>This work</b>
P3-Type $K_{0.5}MnO_2$	Solid state	800 °C@12 h	1
$K_{0.45}Mn_{1-x}Fe_xO_2$	Solid state	850 °C@15 h	2
P2- $K_{0.44}Ni_{0.22}Mn_{0.78}O_2$	Solid state	1000 °C@30 h	3
P3- $K_{0.48}Mn_{0.4}Co_{0.6}O_2$	Solid state	850 °C@2 h	4
$K_{0.54}Mn_{0.78}Mg_{0.22}O_2$	Solid state	800 °C@10 h	5
$K_{0.6}Mn_{0.8}Ni_{0.1}Ti_{0.1}O_2$	Solid state	1000 °C@15 h	6
P2-KMO	Sol-gel method	950 °C@24h	7
$K_xMnO_2$	Co-precipitation	900 °C@15 h	8
P2- $K_{0.75}[Ni_{0.3}Mn_{0.7}]O_2$	Co-precipitation	900 °C@10 h	9
$K_xMn_{0.7}Ni_{0.3}O_2$	Co-precipitation	900 °C@10 h	10

**Tab. S2** Comparison of electrochemical performances of LTMOs in KIBs in this work and the literature.

Layered oxides	Discharge capacity (mAh g <sup>-1</sup> )	Cycle performance (capacity retention@cycles )	Rate performance (mAh g <sup>-1</sup> @mA g <sup>-1</sup> )	References
<b>KMO-F</b>	<b>126.6</b>	<b>80%@100</b>	<b>64@1000</b>	<b>This work</b>
<b>KMO-S</b>	<b>119.5</b>	<b>85%@100</b>	<b>72@1000</b>	<b>This work</b>
P3-K <sub>0.5</sub> MnO <sub>2</sub>	100	70%@50	38@100	1
P3- K <sub>0.45</sub> MnO <sub>2</sub>	129	70.8%@100	51@200	8
P2- K <sub>0.3</sub> MnO <sub>2</sub>	117	61.1%@100	48@200	8
P2- K <sub>0.67</sub> MnO <sub>2</sub>	78	90.5%@300	78@200	7
K <sub>0.77</sub> MnO <sub>2</sub> ·0.23H <sub>2</sub> O	125	93%@100	77@1000	11
P2-K <sub>0.44</sub> Ni <sub>0.22</sub> Mn <sub>0.78</sub> O <sub>2</sub>	82	67%@500	58@500	3
P2-K <sub>0.75</sub> Mn <sub>0.8</sub> Ni <sub>0.1</sub> Fe <sub>0.1</sub> O <sub>2</sub>	80	70%@200	62@1000	12
P3- K <sub>0.48</sub> Mn <sub>0.4</sub> Co <sub>0.6</sub> O <sub>2</sub>	48	82%@30	24@119	4
P'3- K <sub>0.3</sub> Mn <sub>0.9</sub> Cu <sub>0.1</sub> O <sub>2</sub>	124	82%@50	64@500	13

**Tab. S3** Summary of bond lengths in KM-MOF.

<b>Bonds</b>	<b>Bond Lengths (Å)</b>
Mn-O	2.190(1) *2, 2.177(1) *2, 2.173(1), 2.109(1) *2
K-O	2.834(1) *1, 2.859(1) *2, 2.834 (1) *2, 2.751(1) *1

**Tab. S4** ICP-AES test results of layered  $K_xMnO_2$ .

<b>Products</b>	<b>x values</b>	<b>Atomic ratios of K : Mn</b>
KMO-F	0.53	0.526 : 1
KMO-S	0.51	0.514 : 1

**Tab. S5** Compositional analyses from Mn3s XPS spectra of KMO-F and KMO-S.

<b>Products</b>	<b><math>\Delta E_{3s}</math> (eV)</b>	<b>Valences of Mn</b>
KMO-F	5.06	3.47
KMO-S	5.04	3.49

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