

# Supporting information

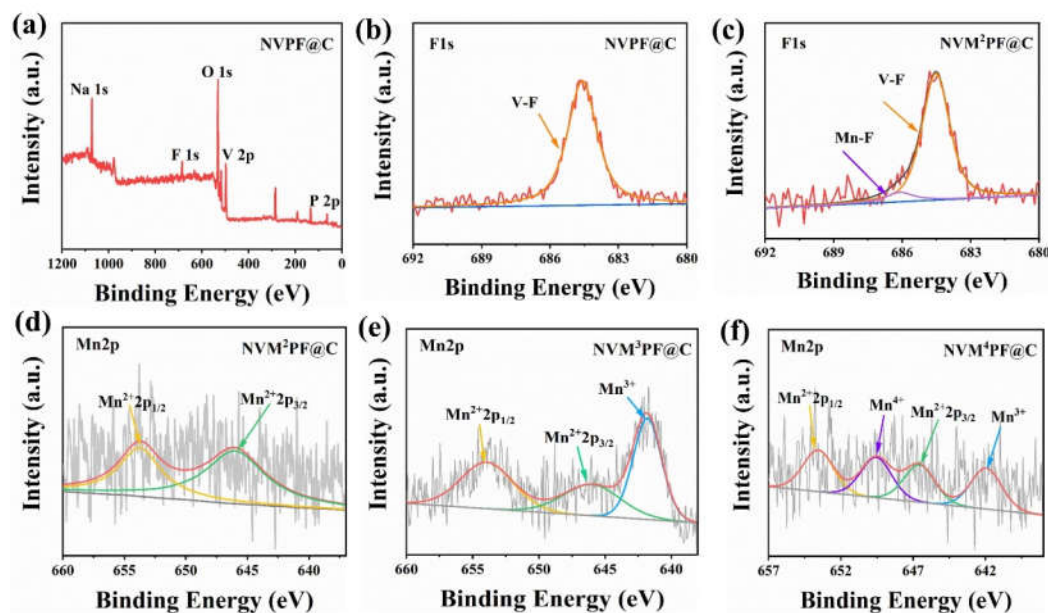
## Mn<sup>x+</sup> Substitution to Improve Na<sub>3</sub>V<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>F<sub>3</sub>-Based Electrodes for Sodium-Ion Battery Cathode

Renyuan Su, Weikai Zhu, Kang Liang, Peng Wei \*, Jianbin Li, Wenjun Liu and Yurong Ren \*

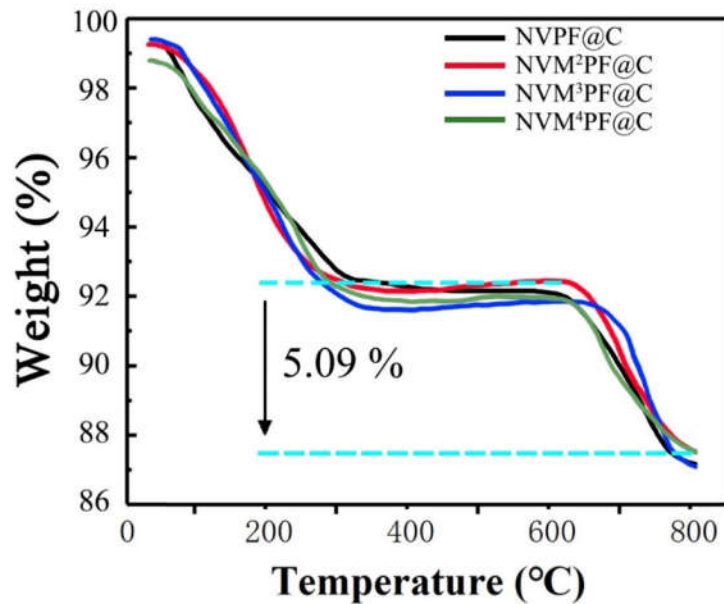
School of Materials Science and Engineering, Jiangsu Province Engineering Research Center of Intelligent Manufacturing Technology for the New Energy Vehicle Power Battery, Changzhou Key Laboratory of Intelligent Manufacturing and Advanced Technology for Power Battery, Changzhou University, Changzhou 213164, China; surenyuan1021@163.com (R.S.); 18862489151@163.com (W.Z.); isliangkang@163.com (K.L.); jianbinchem@cczu.edu.cn (J.L.); 00003203@cczu.edu.cn (W.L.)

\* Correspondence: weipeng@cczu.edu.cn (P.W.); ryrchem@cczu.edu.cn (Y.R.)

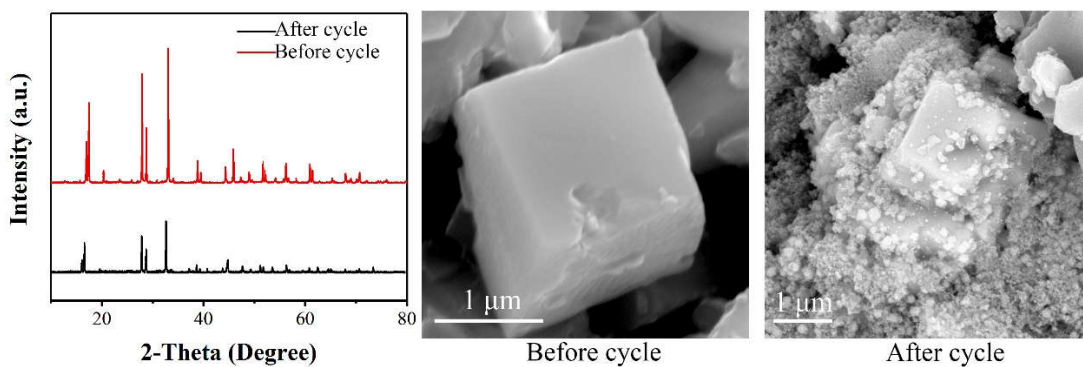
### Figures and Tables



**Figure S1.** (a) Full XPS spectrum of NVPF@C; (b) high-resolution XPS spectra for F 1s of NVPF@C; (c) high-resolution XPS spectra for F 1s of NVM<sup>2</sup>PF@C; (d) high-resolution XPS spectra for Mn 2p of NVM<sup>2</sup>PF@C; (e) high resolution XPS spectra for Mn 2p of NVM<sup>3</sup>PF@C; (f) high-resolution XPS spectra for Mn 2p of NVM<sup>4</sup>PF@C



**Figure S2.** The TG curves of NVPF@C and NVMPF@C



**Figure S3.** XRD and SEM images of NVM<sup>2</sup>PF@C before and after the cycles

**Table S1.** Cell parameters of NVPF@C and NVMPF@C

Samples	a(Å)	b(Å)	c(Å)	V(Å <sup>3</sup> )
NVPF	9.047	9.047	10.705	876.185
NVM <sup>2</sup> PF	9.093	9.093	10.861	898.016
NVM <sup>3</sup> PF	9.085	9.085	10.799	891.319
NVM <sup>4</sup> PF	9.064	9.064	10.735	881.946

**Table S2.** Carbon content of NVPF@C and NVMPF@C

Samples	Carbon content %
NVPF@C	4.77%
NVM <sup>2</sup> PF@C	5.09%
NVM <sup>3</sup> PF@C	4.63%
NVM <sup>4</sup> PF@C	4.23%

**Table S3.** Potential difference of NVPF@C and NVMPF@C

Samples	Potential difference (mv)	
NVPF@C	221	245
NVM <sup>2</sup> PF@C	162	235
NVM <sup>3</sup> PF@C	228	203
NVM <sup>4</sup> PF@C	214	299

**Table S4.** Long-term cycling performance of NVPF@C and NVMPF@C

Samples	1 st cycle	100 th cycle	Retention (100%)
	Discharge capacity (mAh g <sup>-1</sup> )	Discharge capacity (mAh g <sup>-1</sup> )	
NVPF@C	106.8	83.1	77.8
NVM <sup>2</sup> PF@C	116.2	93.2	80.2
NVM <sup>3</sup> PF@C	108.1	85.7	79.3
NVM <sup>4</sup> PF@C	94.5	69.9	73.9

**Table S5.** The impedance parameters from the simulated equivalent circuit and sodium diffusion coefficients of NVPF@C and NVMPF@C

Samples	R <sub>f</sub> (Ω)	R <sub>ct</sub> (Ω)	σ (Ω cm <sup>2</sup> s <sup>-1/2</sup> )	D <sub>Na<sup>+</sup></sub> (cm <sup>2</sup> s <sup>-1</sup> )
NVPF@C	395	110.0	231.9	6.61 × 10 <sup>-14</sup>
NVM <sup>2</sup> PF@C	317	82.5	74.2	1.03 × 10 <sup>-13</sup>
NVM <sup>3</sup> PF@C	345	91.7	157.7	8.23 × 10 <sup>-14</sup>
NVM <sup>4</sup> PF@C	441	136.9	346.9	3.27 × 10 <sup>-14</sup>