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Supporting Information

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Sodium Rich Vanadium Oxy-Fluorophosphate – $Na_{3.2}Ni_{0.2}V_{1.8}(PO_4)_2F_2O$ – as Advanced Cathode for Sodium Ion Batteries

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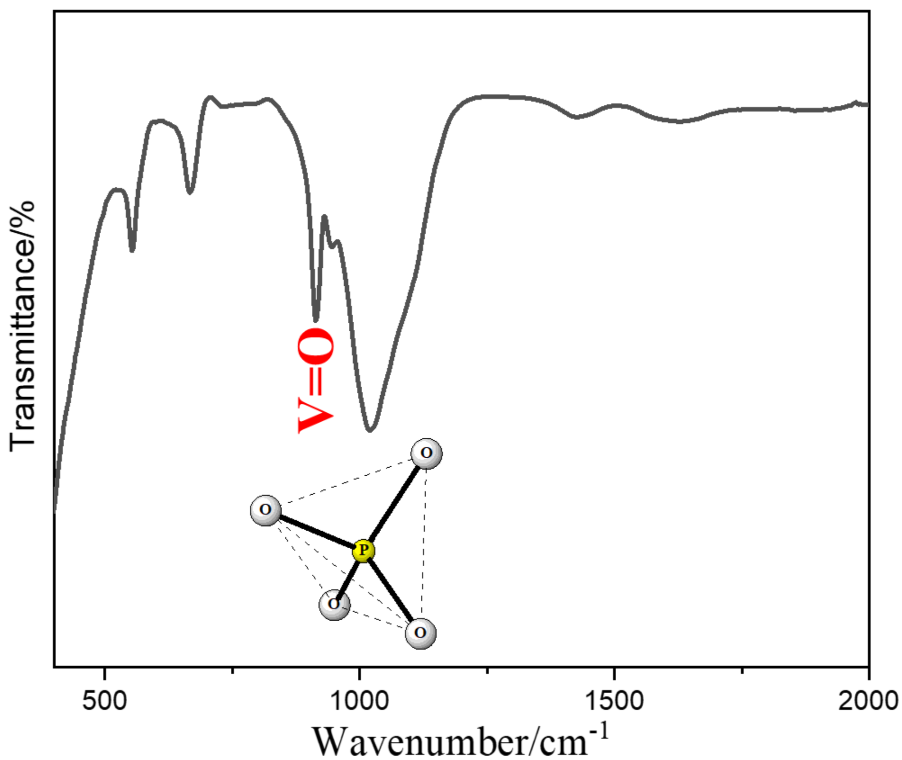

Figure S1. The Fourier transform infrared spectroscopy spectrum of $Na_{3.2}Ni_{0.2}V_{1.8}(PO_4)_2F_2O$ composite in the range of 400–2,000 wavenumbers.

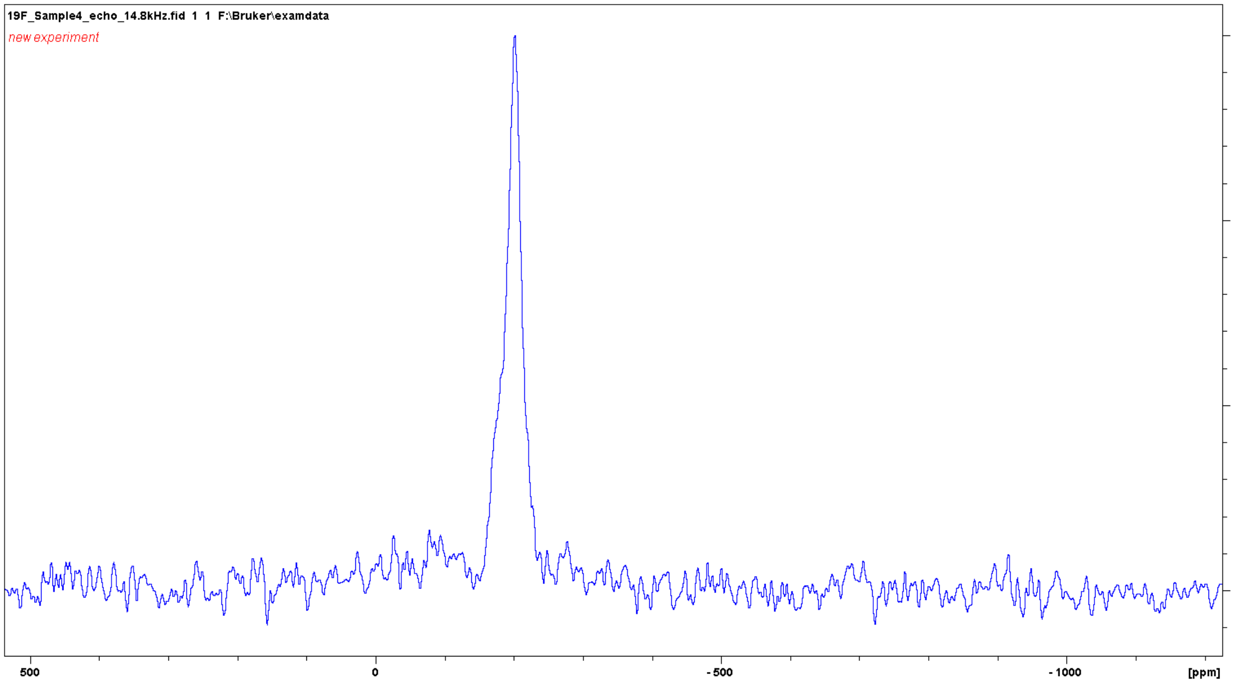

Figure S2. Nuclear Magnetic Resonance spin echo spectrum of ^{19}F in $Na_{3.2}Ni_{0.2}V_{1.8}(PO_4)_2F_2O$.

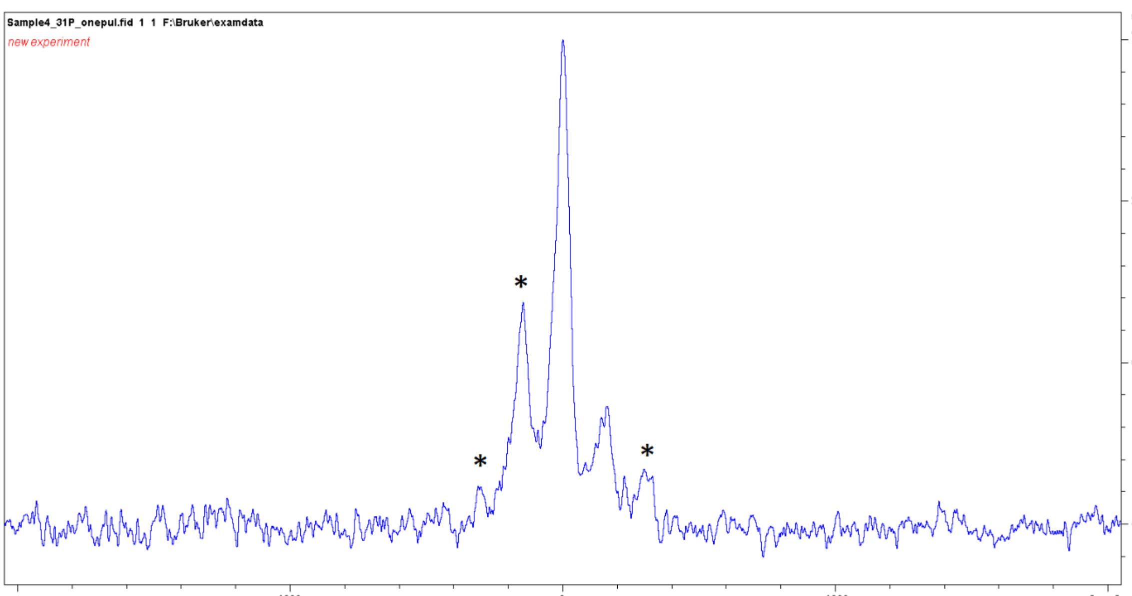

Figure S3. Nuclear Magnetic Resonance spin echo spectrum ^{31}P in $Na_{3.2}Ni_{0.2}V_{1.8}(PO_4)_2F_2O$ near 0 ppm. Peaks with an asterisk denote spinning sidebands.

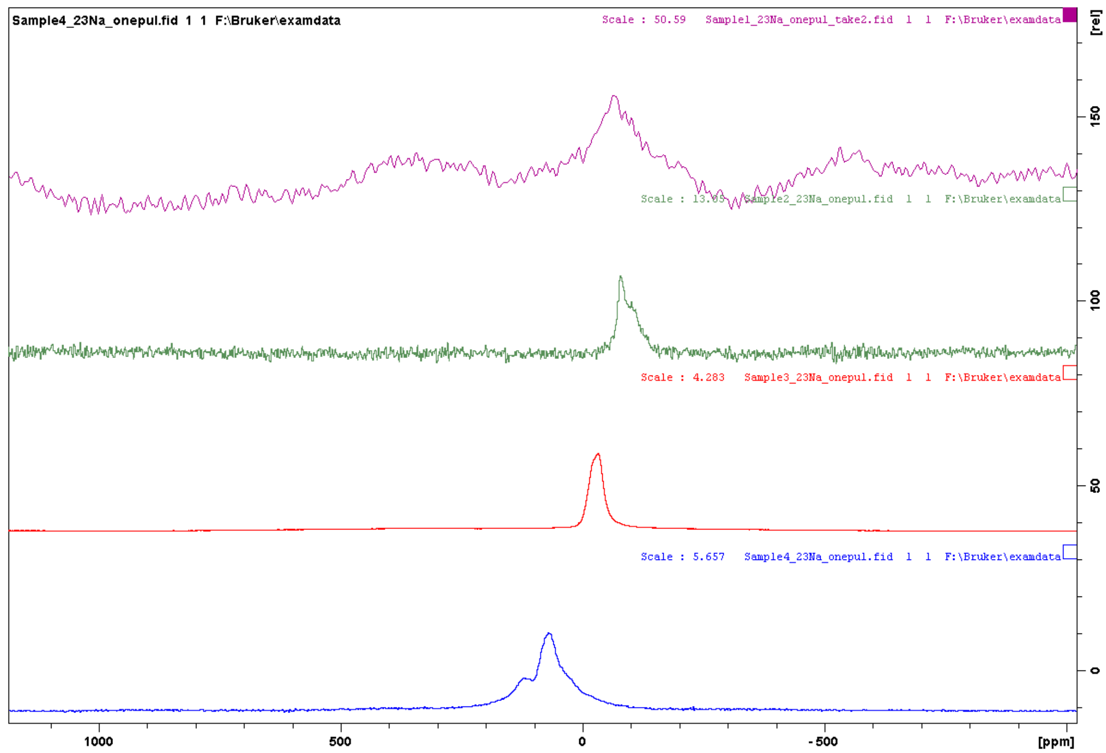

Figure S4. [23]Na Nuclear Magnetic Resonance spin echo spectra $Na_{3.2}Ni_{0.2}V_{1.8}(PO_4)_2F_2O$ (red).

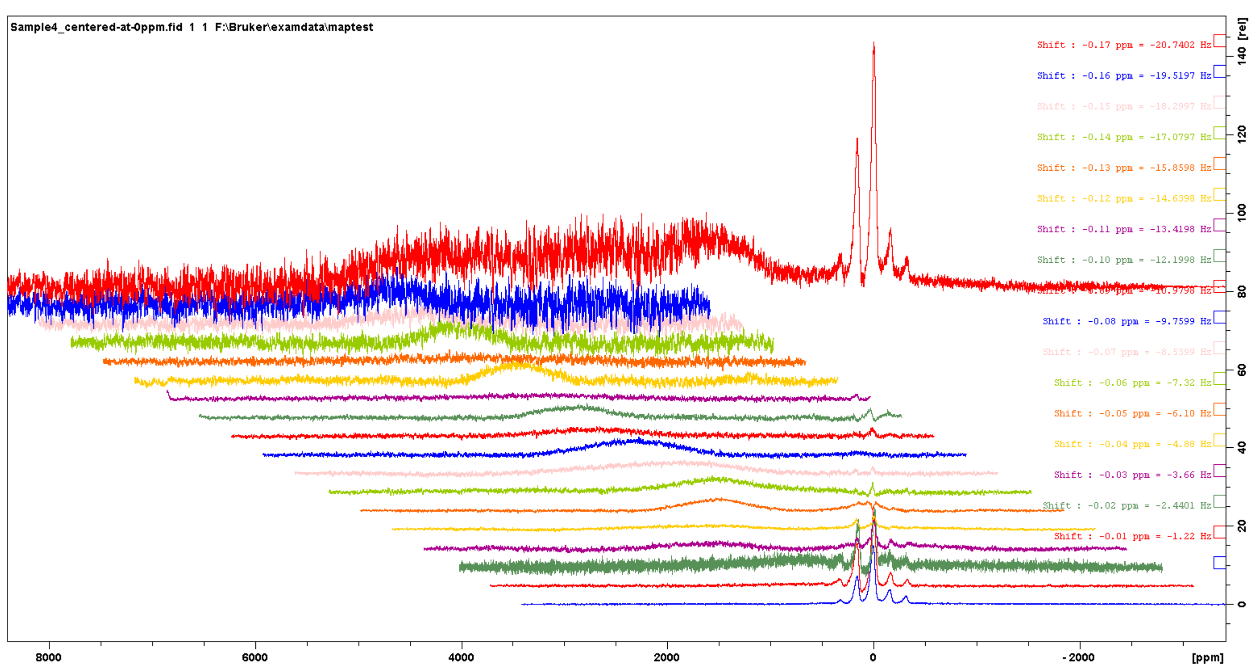

Figure S5. The Nuclear Magnetic Resonance spectra for sodium in $Na_{3.2}Ni_{0.2}V_{1.8}(PO_4)_2F_2O$(red). The carrier frequency was shifted in intervals of 37.8 kHz to resolve the broad components from 1,000 to 4,000 ppm.

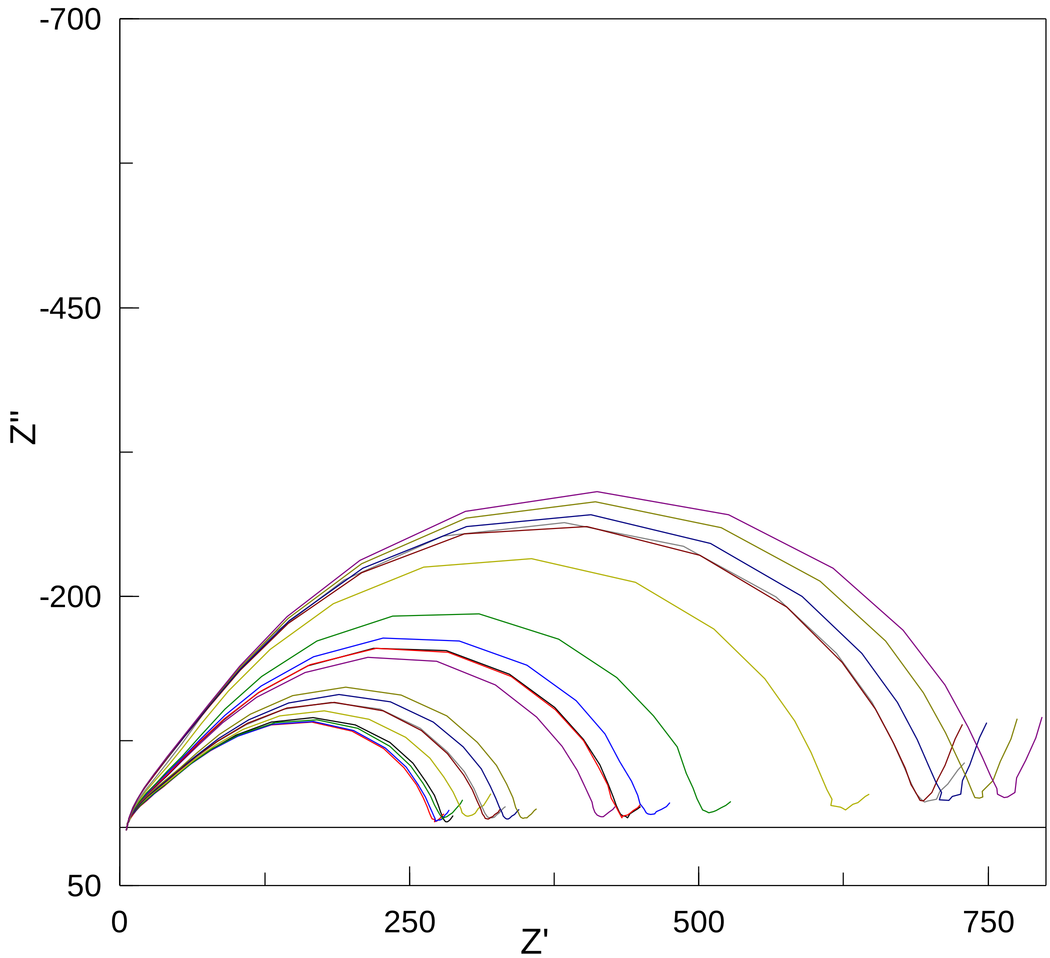

Figure S6. Impedance spectra as a function of state of charge at ambient conditions, consisting of high-frequency intercept, with two semicircles in the medium frequency regime followed by Warburg diffusion spike.

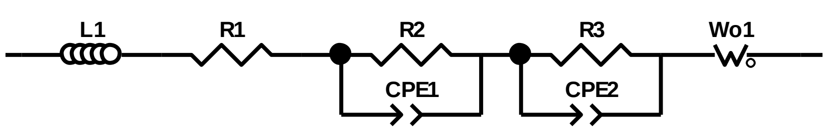

Figure S7. Equivalent circuit model is used to fit the impedance spectra. L1 is the inductance due to wire and other parts of the cell. R1 is the series resistance due to the electrolyte. R2 is the charge transfer interfacial resistance due to the anode/electrolyte interface. R3 is the charge transfer interfacial resistance due to the cathode/electrolyte interface. Wo1 is the Warburg part due to the diffusion. CPE is the constant phase element.

Table S1. Structural Parameters Obtained from Rietveld Refinement of Synchrotron Radiation Diffraction Data of Na3V2(PO4)2F3 at T = 400 K from Chem. Mater. (2014) 26, 4238-4247.

Atom	Wyck.	occupancy	x/a	y/b	z/c	Biso
Na(1)	8h	0.45(3)	0.277(1)	0.277(1)	0	2.3(5)
Na(2)	16l	0.15(2)	0.409(5)	0.225(4)	0	2.6(9
V	4e	1	0	0	0.1841(2)	0.67(6)
P	4d	1	1/2	0	1/4	0.75(8)
O	16n	1	0.3087(6)	0	0.1646(5)	1.1(1)
F(1)	2a	1	0	0	0	1.3(2)
F(2)	4e	1	0	0	0.3672(8)	1.7(2)

Table S2. EDS Elemental Quantification

Element	[wt.%]	[norm. wt.%]	[norm. at.%]
Phosphourous	11.4	15.71	11.18
Sodium	11.74	16.18	15.51
Vanadium	15.24	21.01	9.09
Oxygen	19.31	26.62	36.66
Flourine	6.72	9.27	10.75
Nickel	1.86	2.56	0.96
Carbon	6.27	8.65	15.86
Sum	72.55	100	100.0