Supporting Information

Phase-junction Engineering Boosts the CoSe₂ for Efficient Sodium/Potassium Storage

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Fig. S1 SEM images of a~b) ZIF-67, c~d) ZIF-67@SiC, and e) c/o-CoSe₂@SiC.

SEM images (Fig. S1a, b) showed the ZIF-67 at different magnification, indicating the ZIF-67 was a polyhedron with uniform size of about 300 nm. Fig. S1c and S1d displayed that the ZIF-67 was successfully anchored on SiC NWs to form precursors of ZIF-67@SiC. As shown in Fig. S1e, c/o-CoSe₂@SiC maintained the similar morphology and size of ZIF-67@SiC precursor, except that the surface became rougher.



Fig. S2 a) TEM image of *c/o*-CoSe₂ and b) magnified TEM image of *c/o*-CoSe₂.



Fig. S3. a) PXRD pattern, b) SEM image, c) TEM image of SiC NWs.

The PXRD, SEM and TEM of SiC NWs indicated that SiC nanowires with smooth surface and a diameter of about 30 nm were successfully prepared.



Fig. S4 TEM images of a) *o*-CoSe₂ and b) *c*-CoSe₂.



Fig. S5 HRTEM images (insets: the corresponding SAED) of a) *c*-CoSe₂ and b) *o*-CoSe₂.

As shown in HRTEM image (Fig. S5a), an interplanar spacing of 0.293 nm corresponding to the (200) plane of c-CoSe₂, and the SAED analysis also verified the identification of c-CoSe₂ (inset in Fig. S5a). As shown in Fig. S5b, the spacing of 0.261 nm correlating to the (111) plane of o-CoSe₂ was further discerned by SAED (inset in Fig. S5b).



Fig. S6 PXRD patterns of c/o-CoSe₂@SiC and CoSe₂ synthesized with various weight ratios of Se powder to ZIF-67. The ratios of Se to ZIF-67 are *x*: 1 with x = 2, 5, 10, 15, 20.

PXRD patterns (Fig. S6) showed that $CoSe_2$ with the different *c*-CoSe₂/*o*-CoSe₂ ratio was gained by adjusting the feeding ratio of Se powder to precursors of ZIF-67 (Se: ZIF-67 = *x*: 1, CoSe₂ designated as CoSe₂-*x*: 1). The diffraction peaks testified that *o*-CoSe₂ (space group Pnnm (58), PDF-2 No. 00-053-0449) was obtained at the *x* = 2. When *x* = 5, the diffraction peaks of *c*-CoSe₂ (space group Pa-3 (205), PDF-2 No. 01-071-4945) appeared. The intensity of diffraction peaks for *c*-CoSe₂ enhanced with increase of Se powder ratio, and the diffraction peaks only belong to *c*-CoSe₂ were obtain at *x* = 20. The optimal *c*/*o*-CoSe₂ was obtained at *x* = 10. And the additional diffraction peaks at 35.6 °, 60.0 ° and 71.8 ° convincingly proved that *c*/*o*-CoSe₂ was successfully anchored on SiC NWs (PDF-2 No. 29-1129).



Fig. S7 PXRD profiles for the Rietveld refinement: a) $CoSe_2$ -2: 1(*o*), b) $CoSe_2$ -5: 1(*c*/*o*), c) $CoSe_2$ -15: 1(*c*/*o*) and d) $CoSe_2$ -20: 1(*c*). Red open circles correspond to experimental values, and the continuous black lines correspond to the calculated pattern; green and yellow vertical bars (|) indicate the positions of Bragg peaks. The bottom blue trace depicts the difference between the experimental and the calculated intensity values.



Fig. S8 Raman spectra of $CoSe_2$ with various ratios of Se powder to ZIF-67. The ratios of Se to ZIF-67 are *x*: 1 with x = 2, 5, 10, 15, 20.

Raman spectra further proved the evolution of crystal structure for $CoSe_2$ as a function of x: 1. The stretched mode of Se-Se bands at 172 cm⁻¹ indicated that the o-CoSe₂ was obtained when x = 2. Increasing x, the characteristic peak of o-CoSe₂ was red-shifted, while the characteristic peak of c-CoSe₂ began to appear and enhance. When x = 20, only the characteristic peak of c-CoSe₂ was observed.



Fig. S9 a) PXRD pattern of *m*-CoSe₂. b) Raman spectra of *m*-CoSe₂ and c/o-CoSe₂. c) SEM image of *m*-CoSe₂. d) HRTEM image of *o*-CoSe₂ in *m*-CoSe₂. e) HRTEM image of *c*-CoSe₂ in *m*-CoSe₂.

The crystal structure /phase, morphology and size of as-prepared mixed $CoSe_2$ (*m*- $CoSe_2$) by mechanical mixing of *c*- $CoSe_2$ and *o*- $CoSe_2$ was characterized and analyzed. As shown in Fig. S9a, the PXRD pattern of *m*- $CoSe_2$ exhibited the diffraction peaks of both *o*- $CoSe_2$ (space group Pnnm, PDF-2 No. 00-053-0449) and *c*- $CoSe_2$ (space group Pa-3, PDF-2 No. 01-071-4945), indicating the *m*- $CoSe_2$ is composed of *o*- $CoSe_2$ and *c*- $CoSe_2$. Further, Raman characterizations (Fig. S9b) showed that the stretched mode of Se-Se modes at 172 cm⁻¹ and 184 cm⁻¹ of *m*- $CoSe_2$ were attributed to *o*- $CoSe_2$ and *c*- $CoSe_2$, respectively. It is worth noting that no Raman shift in *m*- $CoSe_2$ was observed, indicating that there is no electron interaction in *m*- $CoSe_2$. As shown in Fig. S9c, the mixed $CoSe_2$ showed a

dodecahedron size of about 300 nm similar to that of c-CoSe₂, o-CoSe₂ and c/o-CoSe₂. HRTEM was used to further differentiate the crystalline properties of m-CoSe₂. Distinctly, the interplanar distances are ~ 0.369 nm (Fig. S9d) and ~ 0.292 nm (Fig. S9e), matching well with $d_{(110)}$ (o-CoSe₂) and $d_{(200)}$ (c-CoSe₂), respectively.



Fig. S10 XPS spectra of *c/o*-CoSe₂ and *c/o*-CoSe₂@SiC.

The results revealed that both c/o-CoSe₂ and c/o-CoSe₂@SiC were mainly composed of Co, Se, C, N and O elements, while the extra Si element was detected in c/o-CoSe₂@SiC due to the introduction of SiC NWs.^{1, 2}



Fig. S11 Co 2p XPS spectra of CoSe₂-*x*: 1 (Se: ZIF-67 = *x*: 1) with x = 2, 5, 10, 15, and 20.



Fig. S12 Se 3*d* XPS spectra of CoSe₂-*x*: 1 (Se: ZIF-67 = *x*: 1) with *x* = 2, 5, 10, 15, and 20.



Fig. S13 XPS spectra of *c/o*-CoSe₂@SiC a) Co 2*p* and b) Se 3*d*.



Fig.S14 TGA curves of c/o-CoSe₂@SiC

The TGA curves in Fig. S14 suggests multiple steps for the weight loss. The small mass below 200 °C was attributed to the evaporation of adsorbed water.^{3, 4} The major loss between 200 and 800 °C was ascribed to the oxidation of $CoSe_2$ to Co_3O_4 , the combustion of carbon, and transformation of $CoSe_2O_5$ to Co_3O_4 . The carbon weight loss percentage of in c/o- $CoSe_2@SiC$ were calculated to be 8.8 %, because of the high thermal stability of SiC NWs.^{5, 6}. The calculation process is as follows:

The weight loss percentage between 200 and 800 $^{\circ}$ C in (c/o-CoSe₂@SiC) without adsorbed water:

$$67.2\% / [100\% - (73.6\% - 76.2\%)] = 71.8\% \tag{1}$$

The weight loss percentage of CoSe₂ transition to Co₃O₄ in c/o-CoSe₂@SiC:

$$[M(CoSe_2)-1/3 M(Co_3O_4)]/M(CoSe_2)=63\%$$
(2)

The carbon weight loss percentage in (c/o-CoSe₂@SiC) without adsorbed water:



Fig. S15 I-V curves of SiC NWs and Super P.

To gain the electrical conductivity of SiC NWs, the voltammetry was applied. The SiC NWs and Super P was pressed into cylinders with diameter of 1.2 cm and their lengths are both 0.2 cm. The I-V curve showed that SiC NWs had an electrical conductivity of 3.121 S/m, which was almost an order of magnitude higher than the conductive additive super P used in this work with 0.3571 S/m. The results indicated that SiC NWs could be used as a conductive material.



Fig. S16 a) CV curves at a scan rate of 0.2 mV s⁻¹ of c/o-CoSe₂@SiC and c/o-CoSe₂. b) The capacity-voltage charge-discharge curve of c/o-CoSe₂@SiC.

Fig. S16a is for a clearer comparison of the CVs changes of c/o-CoSe₂@SiC and c/o-CoSe₂. The working voltage of c/o-CoSe₂@SiC as anode material should be about 1.73 V (Fig. S16b).



Fig. S17 Cycling performance of SiC at 0.2 A g⁻¹.

Fig. S17 showed that SiC barely provides capacity with a poor electrochemical activity. Herein, SiC NWs are used as the conductive skeleton.



Fig. S18 The capacity retention ratio of c-CoSe₂, c/o-CoSe₂, o-CoSe₂ and c/o-CoSe₂@SiC at current density of 0.2 A g⁻¹ after 300 cycles.



Fig. S19 Cycling performance of m-CoSe₂ at 0.2 A g⁻¹.



Fig. S20 PXRD patterns of a) c-CoSe₂@SiC and b) o-CoSe₂@SiC. c) Cycling performances of c-CoSe₂@SiC, o-CoSe₂@SiC and c/o-CoSe₂@SiC at current density of 0.2 A g⁻¹.

The control samples of c-CoSe₂@SiC and o-CoSe₂@SiC were prepared, and their PXRD patterns are presented in Fig. S20a and b. Obviously, the PXRD patterns showed that c-CoSe₂@SiC is composed of both c-CoSe₂ (space group Pa-3, PDF-2 No. 01-071-4945) and SiC (PDF-2 No. 29-1129), while the o-CoSe₂@SiC is composed of both o-CoSe₂ (space group Pnnm, PDF-2 No. 00-053-0449) and SiC (PDF-2 No. 29-1129), confirming the c-CoSe₂@SiC and o-CoSe₂@SiC were prepared successfully. Further, the cycling performance of c-CoSe₂@SiC and o-CoSe₂@SiC were tested and compared with that of c/o-CoSe₂@SiC (Fig. S20c). It was found that c/o-CoSe₂@SiC exhibited superior cycling performance compared to both o-CoSe₂@SiC and c-CoSe₂@SiC.



Fig. S21 *Ex situ* TEM images after 300 cycles at current density of 0.2 A g^{-1} for a) *c/o*-CoSe₂ and b) *c/o*-CoSe₂@SiC

Ex situ TEM image (Fig. S21a) showed that *c/o*-CoSe₂ was agglomerated severely, while the SiC NWs could obviously avoid the agglomeration in *c/o*-CoSe₂@SiC (Fig. S21b).



Fig. S22 a) Cycling performances at 0.2 A g⁻¹ of CoSe₂-*x*: 1 (Se: ZIF-67 = *x*: 1) with x = 2, 5, 10, 15, and 20. HRTEM image of b) CoSe₂-5: 1. c) CoSe₂-10: 1. Red and green correspond to *o*-CoSe₂ and *c*-CoSe₂, respectively. d). I-V curves of *c*-CoSe₂ and *o*-CoSe₂.

The *c*-CoSe₂ and *o*-CoSe₂ was pressed into cylinders with diameter of 0.5 cm and their lengths are both 0.17 cm and 0.18 cm, respectively, and their electrical conductivity was measured by voltammetry. I-V curves showed that *c*-CoSe₂ has a better electrical conductivity (2.08 S/m) than *o*-CoSe₂ (1.59 S/m). As shown in Fig. S22a, the *c*/*o*-CoSe₂ (x = 10, *c*-CoSe₂: *o*-CoSe₂=7: 3) displayed the best performance among various CoSe₂ samples, which might be due to that the phase-junction plays an important role since it will introduce electron interaction and thus, improve the performance. Therefore, it seems that the best performance should be obtained when the area of the junction is maximized. Therefore, the reason for why

the optimal performance is not achieved at c-CoSe₂ : o-CoSe₂ = 1:1, might be complicated. When the ratio of c-CoSe₂: o-CoSe₂ is 1: 1(x=5), the area of the junction might be limited due to the larger grain size of c-CoSe₂ and o-CoSe₂ (see Fig. S22b). Further, when the ratio of c-CoSe₂: o-CoSe₂ is 7: 3 (x=10), it may have larger contacting area (phase-junction amount) since o-CoSe₂ with smaller size is well dispersed with c-CoSe₂ (Fig. S22c). In addition, it is necessary to note that c-CoSe₂ has a better conductivity (Fig. S22d), stability and overall performance compared to o-CoSe₂ (Fig. 3a). Thus, the best performance was observed in other ratio of c-CoSe₂: o-CoSe₂ than 1:1.



Fig. S23 Comparisons of the rate performance between *c/o*-CoSe₂@SiC (this work) and other reported CoSe₂-based anodes.^{4, 7-12}



Fig. S24. a) CV curves of c/o-CoSe₂@SiC at different scan rates. b) Calculated b value for the cathodic scan and anodic scan. c) The percentage of capacitance contribution at different rates. e) The capacitive contribution to charge storage of c/o-CoSe₂@SiC at scan rates of 1.0 mV s⁻¹.

To further evaluate the pseudocapacitive contribution of the sodium storage, the CV curves of c/o-CoSe₂@SiC electrode were obtained at different scan rates from 0.2 to 1 mV s⁻¹, as shown in Fig. S 25a. In this case, the current response at a particular voltage could be separated into capacitive effects (k_1v) and diffusion-controlled reactions ($k_2v^{1/2}$). The relationship between these two different processes at a fixed potential could be derived from the following equation.

$$i = k_1 v + k_2 v^{1/2} = a v^b \tag{4}$$

where *i* is the current response at a particular voltage; k_1 , k_2 , and *a* are constants; *v* is the scan rate; *b* is a value ranging from 0.5 (diffusioncontrolled contribution) to 1 (capacitive

contribution). Fig. S25b shows the *b* values of c/o-CoSe₂@SiC as a function of potentials for cathodic scans, which was derived from the log(v)-log(*i*) linear relationship, according to Eq. (4). Clearly, the *b* values of cathodic and anodic peaks are 0.65 and 0.54, respectively, suggesting c/o-CoSe₂@SiC also stores Na⁺ with a coupled diffusion- and capacitive-controlled process. The calculated capacitive contributions are ~ 55%, 66%, 71%, 76% and 79% at scan rates of 0.2, 0.4, 0.6, 0.8 and 1.0 mV s⁻¹, respectively, implying excellent pseudocapacitive behaviours and more interfacial Na⁺ storage, induced by phase-juncition interface. (Fig. S25c and 25d)¹³.



Fig. S25. Plots of $\omega^{1/2}$ versus Z' in the low-frequency region of *o*-CoSe₂, *c*-CoSe₂, *c*/*o*-CoSe₂ and *c*/*o*-CoSe₂@SiC.

From low-frequency part with linear feature (ionic diffusion with Warburg behavior), the ionic diffusion coefficient (D) could be obtained.¹⁴

According to this formula,

$$D = \frac{1}{2} \left(\frac{RT}{An^2 F^2 C \sigma} \right)^2 \tag{5}$$

R represents the gas constant, *T* represents the experiment temperature, *F* represents the Faraday constant. *A* represents the electrode surface area, *n* means the electrons per molecule involving in the reaction, and *C* represents the sodium ions concentration in the electrode. The σ is the Warburg coefficient which could be calculated by the gradient of the oblique line $Z' \sim \omega^{-1/2}$ ($\omega = 2\pi f$) in the low-frequency area (Fig. S25). Herein, the D values of *o*-CoSe₂, *c*-CoSe₂, *c*/o-CoSe₂ and *c*/o-CoSe₂@SiC are 7.29×10⁻¹⁴ cm² s⁻¹, 1.87×10⁻¹³ cm² s⁻¹, 2.57×10⁻¹³ cm² s⁻¹ and 6.61×10⁻¹³cm² s⁻¹, respectively. The *c*/o-CoSe₂@SiC exhibits higher Na⁺ diffusion coefficient than *c*-CoSe₂, *c*/o-CoSe₂, *o*-CoSe₂, strongly suggesting that the interior self-built-in electric-field induced by phase-junction and conductive SiC NWs can significantly boost the ions diffusion, thus enhancing the electrochemical properties with high rate capability.



Fig. S26 a) PXRD pattern of NVP/C. b) PXRD profiles for the Rietveld refinement of NVP/C. Red open circles correspond to experimental values, and the continuous black lines correspond to the calculated pattern; green vertical bars (|) indicate the positions of Bragg peaks. The bottom blue trace depicts the difference between the experimental and the calculated intensity values.

Fig. S26a displays the PXRD pattern of NVP/C sample. Obviously, all the peaks from the sample were indexed well on the PDF-2 No 01-078-7289, indicating that NVP/C was synthesized. Further PXRD pattern of the NVP/C was refined (Fig. S26b), indicating the obtained refinement result shows experiment well agree with the calculated files with Rp (\sim 5.8%) and Rwp (4.7%), which matches well with previous reports.^{15, 16}



Fig. S27 a) The initial three GCD curves and b) cycling performance at 1 A g^{-1} of NVP/C.

The performance of as-prepared NVP/C $\,$ is as good as those reported ones.¹⁷



Fig. S28 Capacity-voltage charge-discharge curve of $Na_3V_2(PO_4)_3 || c/o-CoSe_2@SiC$ full cell showed that the working voltage is about 1.8 V.



Fig. S29 Comparisons of the energy density among $Na_3V_2(PO_4)_3 \parallel c/o$ -CoSe₂@SiC full cell (this work) and other full cells at 1700 W kg⁻¹₁₈₋₂₂.



Fig. S30 *Operando* Raman spectra of c/o-CoSe₂@SiC electrode during process of discharge and charge for SIB, a) in the range of 142-219 cm⁻¹ for c/o-CoSe₂, as well as b) in the range of 730-850 cm⁻¹ for SiC.



Fig. S31 a) *Operando* PXRD patterns of c/o-CoSe₂@SiC electrode during the process of discharge and charge for SIBs, b) the enlarged contour plot of *operando* PXRD patterns, black circles, red circles and white circle correspond to Na_xCoSe₂, Na₂Se and Co, respectively.



Fig. S32 *Ex*-situ PXRD patterns of *c/o*-CoSe₂@SiC at discharge to 0.1 V and charge to 2.2 V In order to excluded the influence of noise pollution in *operando* PXRD, the *ex*-situ
PXRD patterns of *c/o*-CoSe₂@SiC electrode at discharge to 0.1 V and charge to 2.2 V were collected at current density of 0.2 A g⁻¹. Fig. S32 showed that the diffraction peaks of Na₂Se (40.83°, 43.96°, 47.83° and 60.72°) and Co (41.68°) were clearly observed when discharged to 0.1 V, while the Na_xCoSe₂ (25.53°, 47.42° and 59.83°) appeared when charged to 2.2 V.



Fig.S33 FFT images of a) Co, b) Na₂Se correspond to the HRTEM image of stage IV in Fig. 4c



Fig. S34 Ex situ HRTEM image of c/o-CoSe₂@SiC electrode after 100 cycles.



Fig. S35 a) *c/o*-CoSe₂ crystal structure diagram for calculating the energy, b) the energy of *c*-CoSe₂, *o*-CoSe₂ and *c/o*-CoSe₂.

The crystal structure for calculating the energy of c/o-CoSe₂ was established by taking c/o-CoSe₂ as the new phase, as shown in Fig. S35a. The Fig. S35b shows the energy of c-CoSe₂, o-CoSe₂ and c/o-CoSe₂.



Fig. S36 Bader charge for the phase-junction of c/o-CoSe₂. The green rectangle and red rectangle corresponds to c-CoSe₂ and o-CoSe₂, respectively.

The red indicated positive charge, blue indicated negative charge. This result showed the 0.0075 electrons from *o*-CoSe₂ transfers to *c*-CoSe₂.



Fig. S37 Na⁺ adsorption site in the phase-junction interface of *c/o*-CoSe₂



Fig. S38 K⁺ storage performances of c/o-CoSe₂@SiC. a) CV curves at a scan rate of 0.1 mV s⁻¹ in the first three cycles, b) GCD curves at current density of 0.1 A g⁻¹ in the first three cycles, c) cycling performances at current density of 0.1 A g⁻¹, d) rate capability from 0.1 to 5 A g⁻¹, e) long cycling performance at 1 A g⁻¹.

The initial three CV curves of c/o-CoSe₂@SiC in the voltage window of 0-3 V versus K⁺/K at a sweep rate of 0.1 mV s⁻¹ were illustrated in Fig. S38a. Obviously, the first CV curve was different from subsequent cycles, which may be related to the decomposition of electrolyte and the formation of SEI film.²³ The overlapped CV curves of the second and third cycles suggests excellent reversibility. According to the first three galvanostatic charge/discharge profiles, the plateaus were well matched with the CV results (Fig. S38b). The c/o-CoSe₂@SiC electrode showed the best performance among all the CoSe₂ samples

with the charge capacity of 285 mA h g⁻¹ after the 100 cycles at 0.2 A g⁻¹ (Fig. S38c). The outstanding rate performance was illustrated in Fig. S38d, the c/o-CoSe₂@SiC electrode exhibits initial charge capacities of 382, 324, 299, 278, 229 and 161 mA h g⁻¹ at 0.1, 0.2, 0.5, 1.0, 2.0 and 5.0 A g⁻¹, respectively. When the current density returns back to 0.1 A g⁻¹, the c/o-CoSe₂@SiC electrode still show the capacity of 355 mA h g⁻¹. Moreover, the long-term cycling performance at 1.0 A g⁻¹ displays that c/o-CoSe₂@SiC electrode could still hold the reversible capacity of 190 mA h g⁻¹ after 500 cycles (Fig. S38e). These results indicate that the phase-junction also boosts the performance for PIBs.



Fig. S39 CV curves of c/o-CoSe2@SiC at different scan rates for PIBs

Similarly, to obtain the capacitance contribution of the potassium storage reactions at different scanning rates, the CV curves of c/o-CoSe₂@SiC electrode in potassium storage at different scan rates from 0.2 to 1 mV s⁻¹ were carried out. Fig. S39 shows that the area of CV curves decreases with the increase of scanning rates, indicating there is no capacitive-controlled process in potassium storage reaction.



Fig. S40 Comparisons of rate performance between c/o-CoSe₂@SiC (this work) and reported series cobalt selenide samples.²⁴⁻²⁷

CoSe ₂ samples synthesized with various amount of Se	Refinement Parameters				Content of Phase	Content of different Phase(%) ^[a]		
powder	R _p	\mathbf{R}_{wp}	Rexp	χ^2	o-CoSe ₂	<i>c</i> -CoSe ₂		
$CoSe_2-2:1$ (<i>o</i> -CoSe ₂)	2.17	2.71	2.59	1.09	100	0		
$CoSe_2-5 : 1 (c/o-CoSe_2)$	3.31	4.11	3.92	1.07	45.27	54.73		
$CoSe_2-10 : 1 (c/o-CoSe_2)$	3.39	4.25	4.19	1.03	67.23	32.77		
$CoSe_2-15$: 1 (c/o -CoSe ₂)	3.95	4.99	4.64	1.16	78.96	21.04		
$CoSe_2-20 : 1 (c-CoSe_2)$	3.86	4.87	4.39	1.23	0	100		

 Table S1 The refinement parameters and content of different phases.

[a] The contents of different phase are gained from the Rietveld refinement results.

Samples	Voltag e range (V)	Binding material	Electrolyte	Current density A/g	Cycle number (high/low current density)	Specific capacity (high/low Current density) mAh/g	Ref.
c/o- CoSe2@Si C	0-3 V	СМС	1 M NaCF3SO3 +DEGDME	1/ 0.2	1000 300	464/ 509	This work
CoSe ₂ /N- CNF	0.5-3 V	СМС	1 M NaCF3SO3 +DEGDME	2/ 0.2	1000/ 500	250/ 323.3	4
CoSe ₂ @VG /CC	0.5-3 V	\	1 M NaCF3SO3 +DEGDME	1/ \	400/ \	200/	7
CoZn-Se	0.01-3 V	СМС	1M NaClO4 +EC:PC(1:1 wt%)+5% FEC	10/ 0.1	240/ 100	240/ 416	8
CNT/ CoSe ₂ @NC	0.001-3 V	СМС	1MNaClO ₄ +EC:PC (1:1 wt%)+5% FEC	\ 0.2	\ 120	\ 505	9
CoSe/CNFs	0.001-3 V	١	1M NaClO ₄ +EC:PC (1:1 V%)+5% FEC	2/ 0.2	1000 400	295 430	10
N- CNF/rGO/ CoSe ₂	0.3-2.9 V	CMC	1 M NaCF3SO3 +DEGDME	10/ 1	1000/ 300	300/ 390	11
CNT/CoSe ₂ /C	0.01-3 V	\	1M NaClO ₄ +5% EC	0.5/ 0.1	300 100	450 535	12

Table S2 Comparisons of the cycling stability of $CoSe_2$ coupled with conductive materials or formed the heterojunctions for SIBs.

Samples	Voltage range (V)	Binding material	Electrolyte	Current density A/g	Cycle number (high/low current density)	Specific capacity (high/low Current density) mAh/g	Ref.
c/o-CoSe2@ SiC	0-3 V	СМС	1 M NaCF3SO3	1/ 0.1	500/ 100	305.6/ 416.7	This work
NCNF@ CoSe ₂	0.01-2.5 V	١	0.8 M KPF ₆ +EC:D EC(1:1 V%)	2/ 0.2	600/ 100	173/ 296.6	24
Co _{0.85} Se/C	0.01-2.5 V	PVDF	1M KFSI+DME	1/ 0.05	500/ 100	280/ 401	25
CoSe ₂ @NC	0.01-2.5 V	PVDF	1M KFSI+DME	0.5/ 0.05	1000/ 1000	184.5/ 431.7	26
rGO@MoSe ₂ / CoSe ₂	0.01-2.5 V	СМС	3M KFSI+DME	0.5/ 0.1	1000/ 1000	470/ 431.7	27

Table S3 Comparisons of the cycling stability for PIBs between c/o-CoSe₂@SiC (this work) and other reported cobalt selenide samples.

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