Supplementary Information

Urchin-like hierarchical spheres of $FeSe_2$ embedded in TiN/C composite covered by CNTs as anodes for sodium-ion storage

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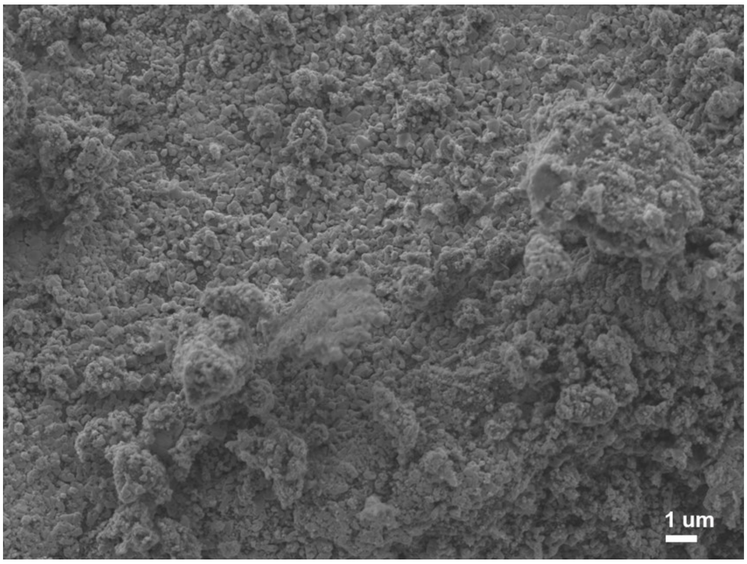

Fig.S1 SEM image of $FeSe_2$@Ti/C

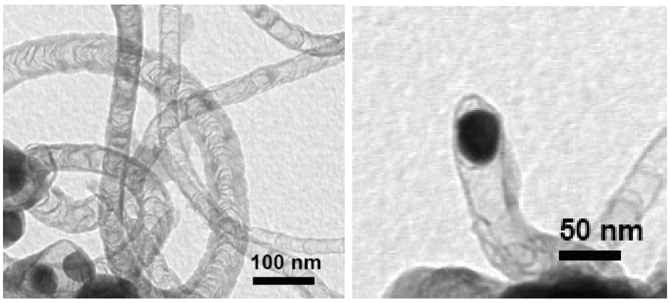

Fig.S2 TEM image of CNTs on the surface of $FeSe_2$@TiN/C@CNTs

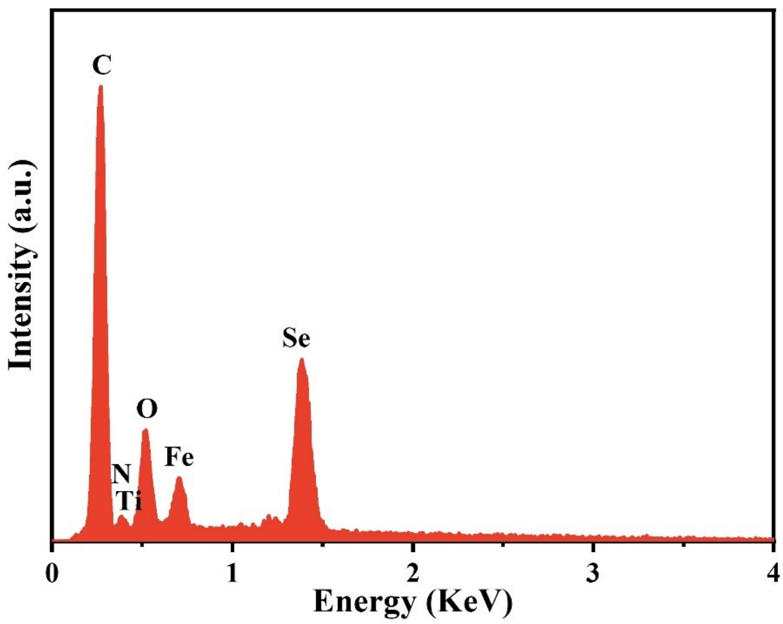

Fig.S3 Energy dispersive spectrometer result of $FeSe_2$@TiN/C@CNTs

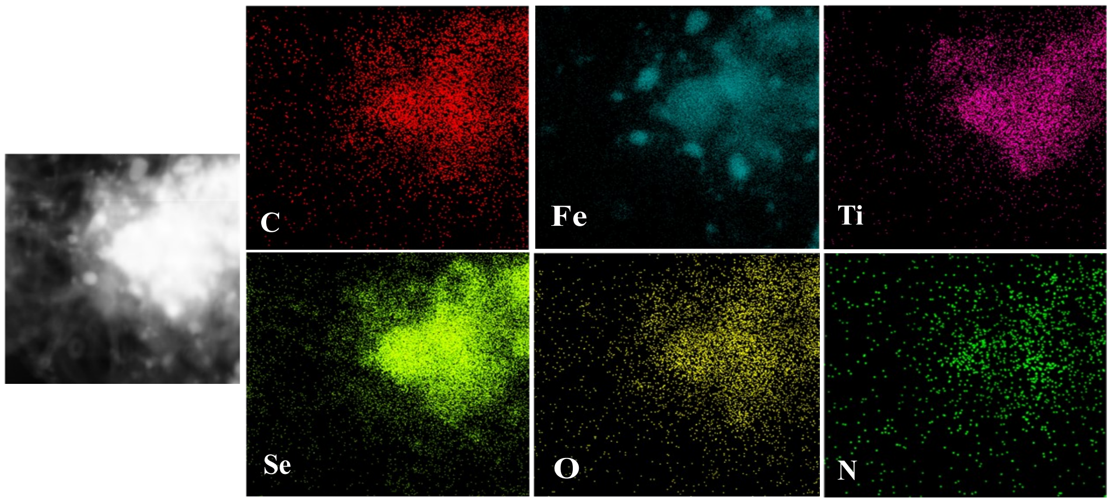

Fig.S4 Elemental mapping images of $FeSe_2$@TiN/C@CNTs

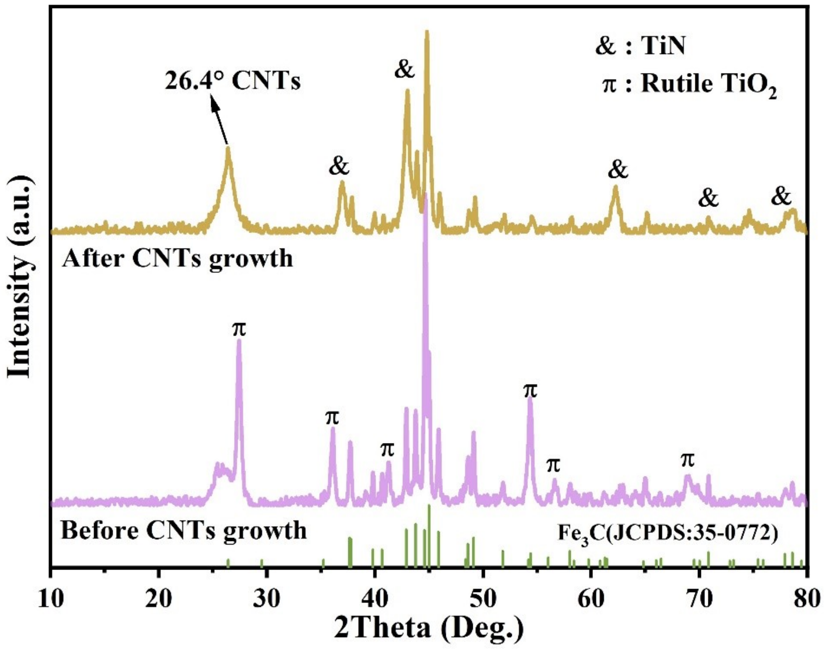

Fig.S5 XRD patterns of samples before and after CNTs growth

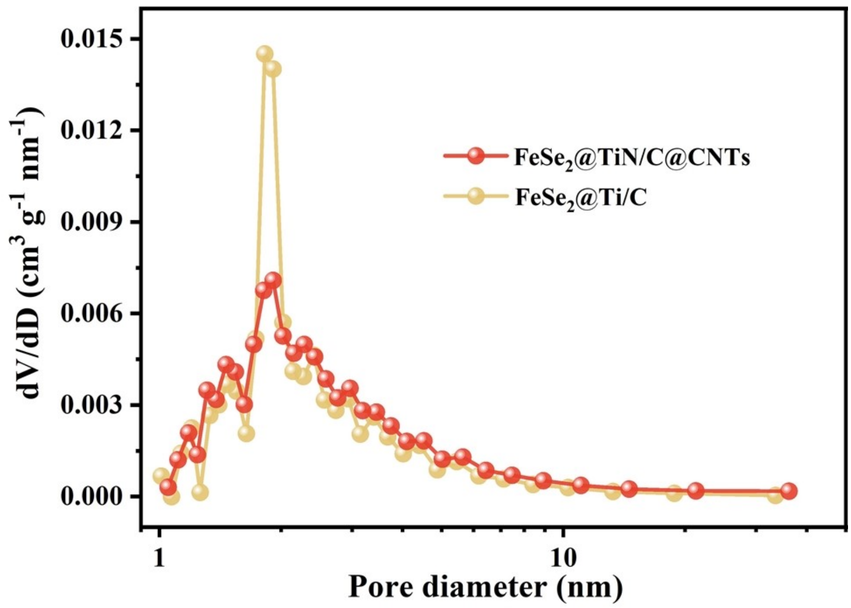

Fig.S6 Pore size distributions of $FeSe_2$@TiN/C@CNTs and $FeSe_2$@Ti/C samples

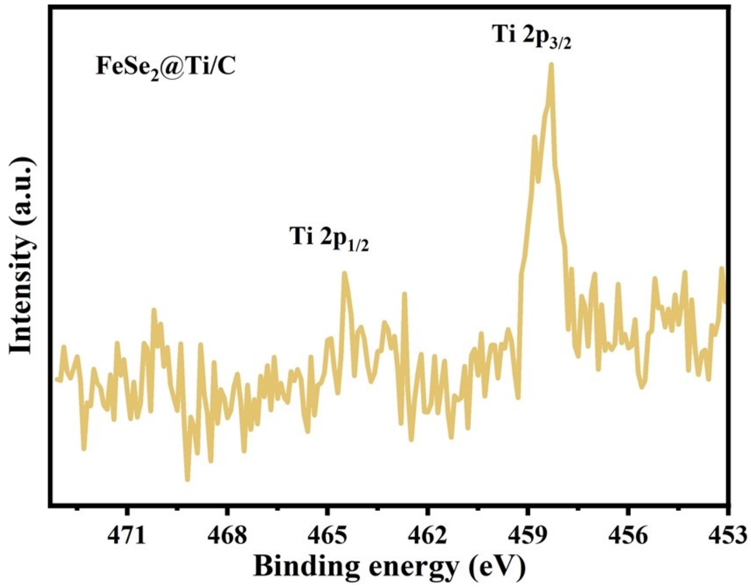

Fig.S7 Ti 2p high-resolution XPS spectrum of $FeSe_2$@Ti/C

Table S1 Electrochemical properties of various $FeSe_2$-based SIBs anodes reported before.

Materials	**Current rate ($A\ g^{-1}$)**	**Capacity ($mAh\ g^{-1}$)**	**Cycle number**	**Ref.**
$FeSe_2$@TiN/C@CNTs	0.2	343.5	1000	This work
$FeSe_2$-10	1	325	100	S1
FeS_2@$FeSe_2$	1	350	2700	S2
$FeSe_2$/NC@G	2	323	1000	S3
$FeSe_2$@C	1	359	200	S4
CNT/$FeSe_2$/C	0.1	546	100	S5
$FeSe_2$@C MFs	0.05	461	100	S6
$FeSe_2$@TNCF/CNTs	0.2	388.5	1000	S7
$FeSe_2$@NC	1	327.6	600	S8
$FeSe_2$/C	10	412	1000	S9
$FeSe_2$@rGO	5	350	600	S10
$FeSe_2$@NC	1	269.8	500	S11
$FeSe_2$-AC-30	0.5	375	150	S12
$FeSe_2$@C/NG	0.5	411	100	S13
O-$FeSe_2$ NSs	0.1	331	100	S14

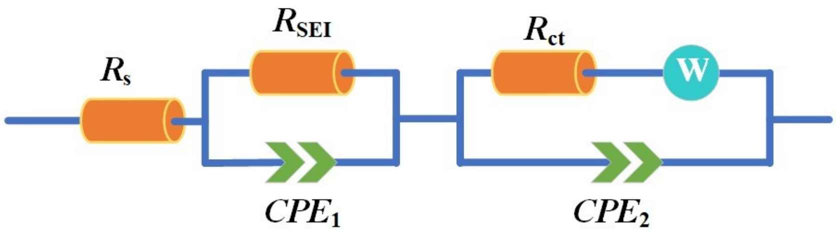

Fig.S8 The equivalent circuit model

Table S2 EIS fitting results

Sample	R_s/Ω	R_{SEI}/Ω	R_{ct}/Ω	$CPE_1/\Omega^{-1}\ s^n$	$CPE_2/\Omega^{-1}\ s^n$
$FeSe_2$@TiN/C@CNTs	0.93	4.3×10^6	133.0	0.0015	1.9×10^{-4}
$FeSe_2$@Ti/C	3.39	4.0×10^9	204.3	0.0012	4.2×10^{-5}

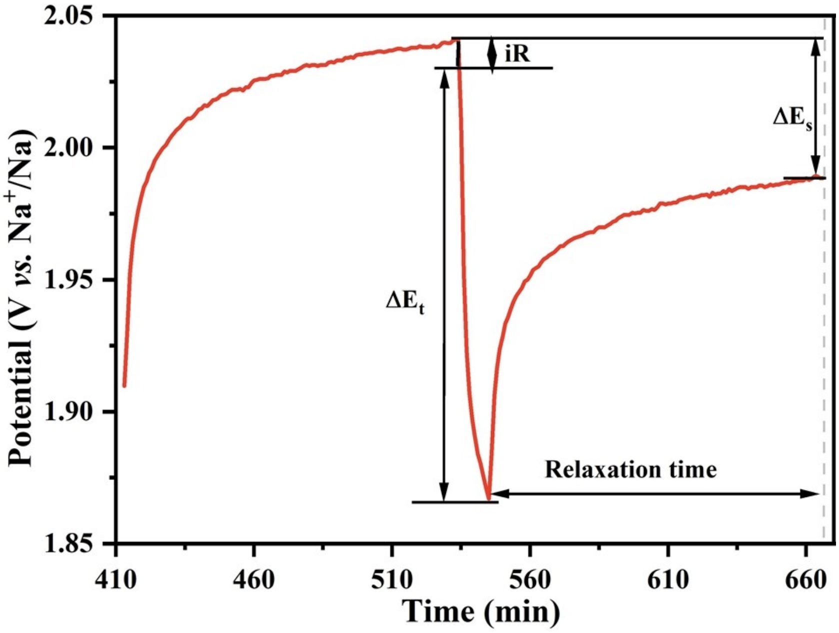

Fig.S9 Detailed potential response during a single current pulse with time of $FeSe_2$@TiN/C@CNTs electrode

On GITT test, the D_{Na^+} values could be calculated by the following equation[S8, S15]:

$$D_{\mathrm{Na}^+} = \frac{4}{\pi\tau}\left(\frac{mV_m}{MA}\right)^2\left(\frac{\Delta E_s}{\Delta E_\tau}\right)^2 \left(\tau = \frac{L^2}{D_{\mathrm{Na}^+}}\right) \quad \text{(S1)}$$

Where τ is the relaxation time, m, M and V_m are the mass of the sample, the molar mass of the sample, the molar volume of the sample, A is the total area of the electrode, ΔE_s is the voltage change caused by a pulse, and ΔE_τ are the total change of the cell voltage during a constant pulse time, respectively. L is the thickness of the electrode.

Reference

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