Supplementary Information

Modified preparation of Si@C@TiO_2 porous microspheres as anodes for high-performance lithium-ion batteries

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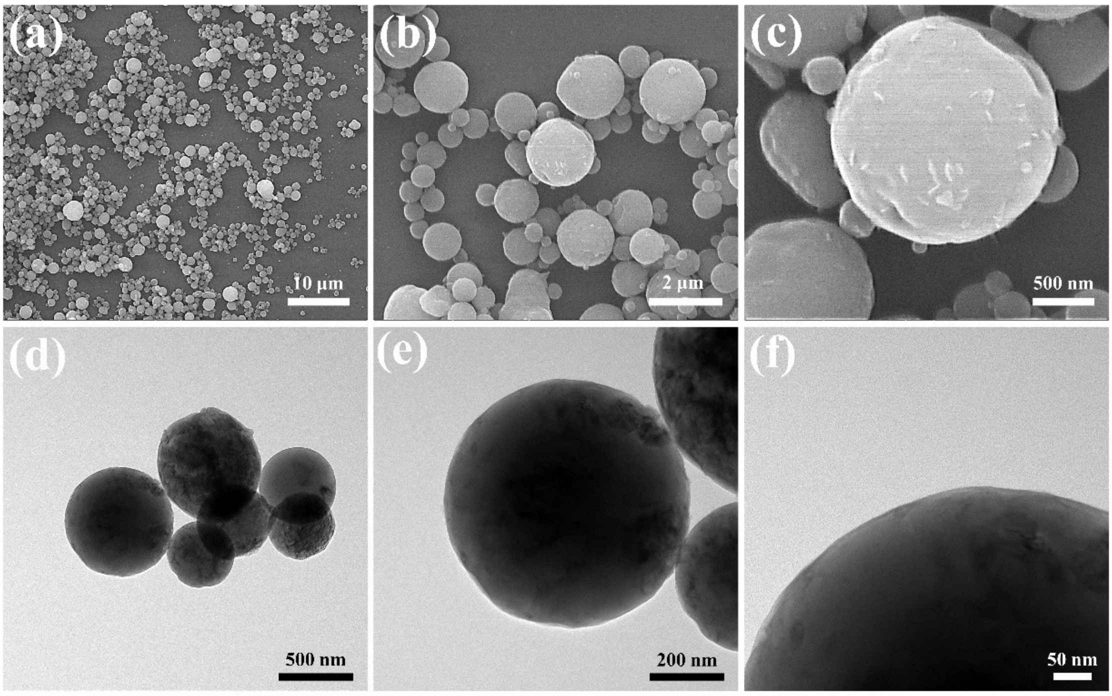

Figure S1. SEM and TEM images of the Al-Si powders.

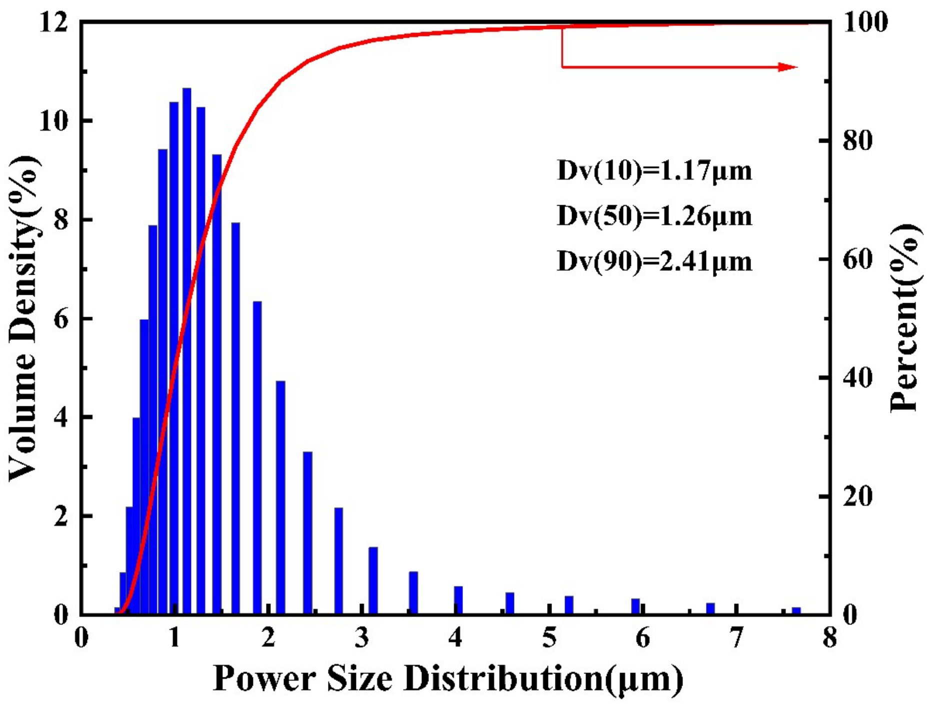

Figure S2. Particle size distribution of the Al-Si powders.

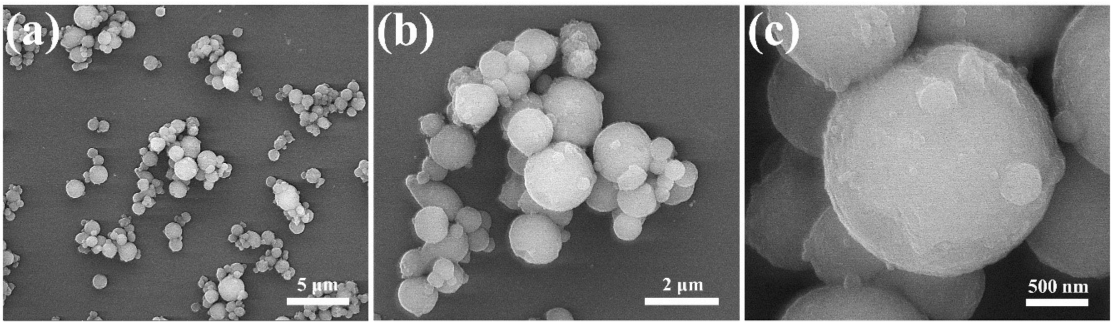

Figure S3. SEM images of the Al-Si@RF microspheres.

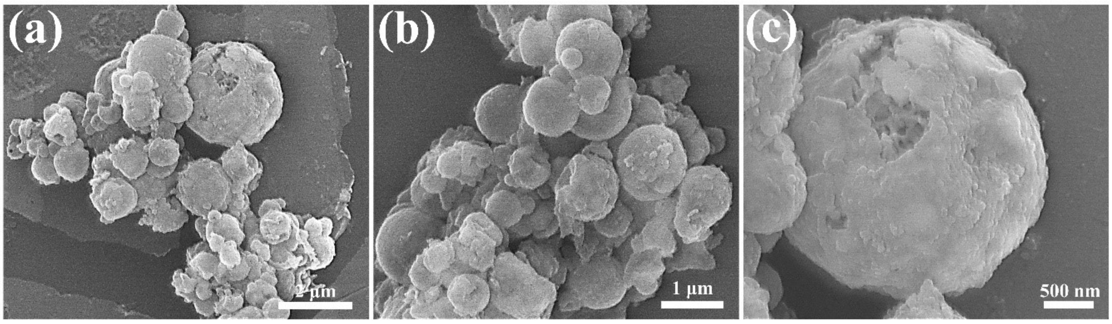

Figure S4. SEM images of the PSi@RF microspheres.

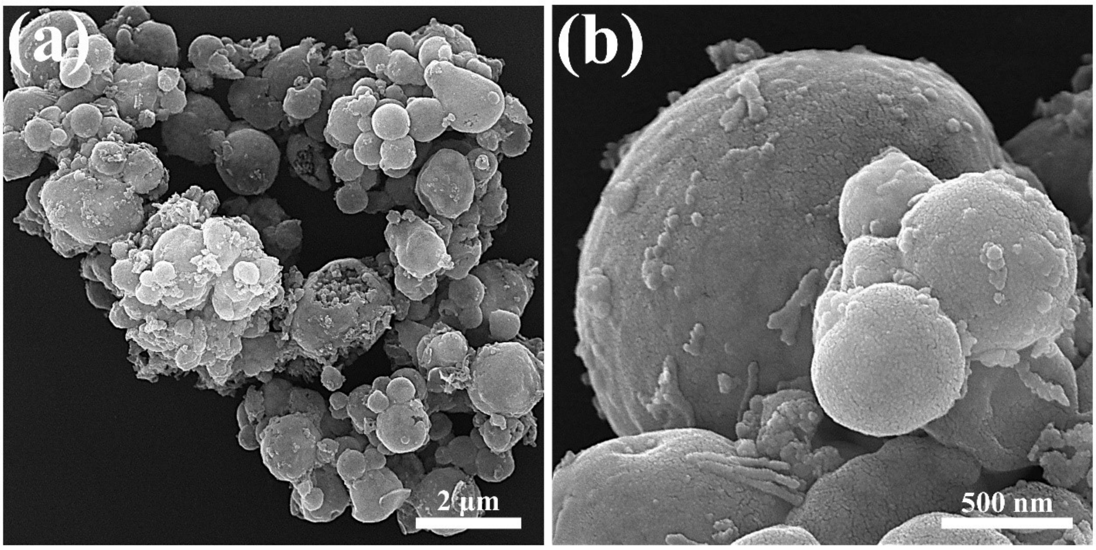

Figure S5. SEM images of the PSi@C microspheres.

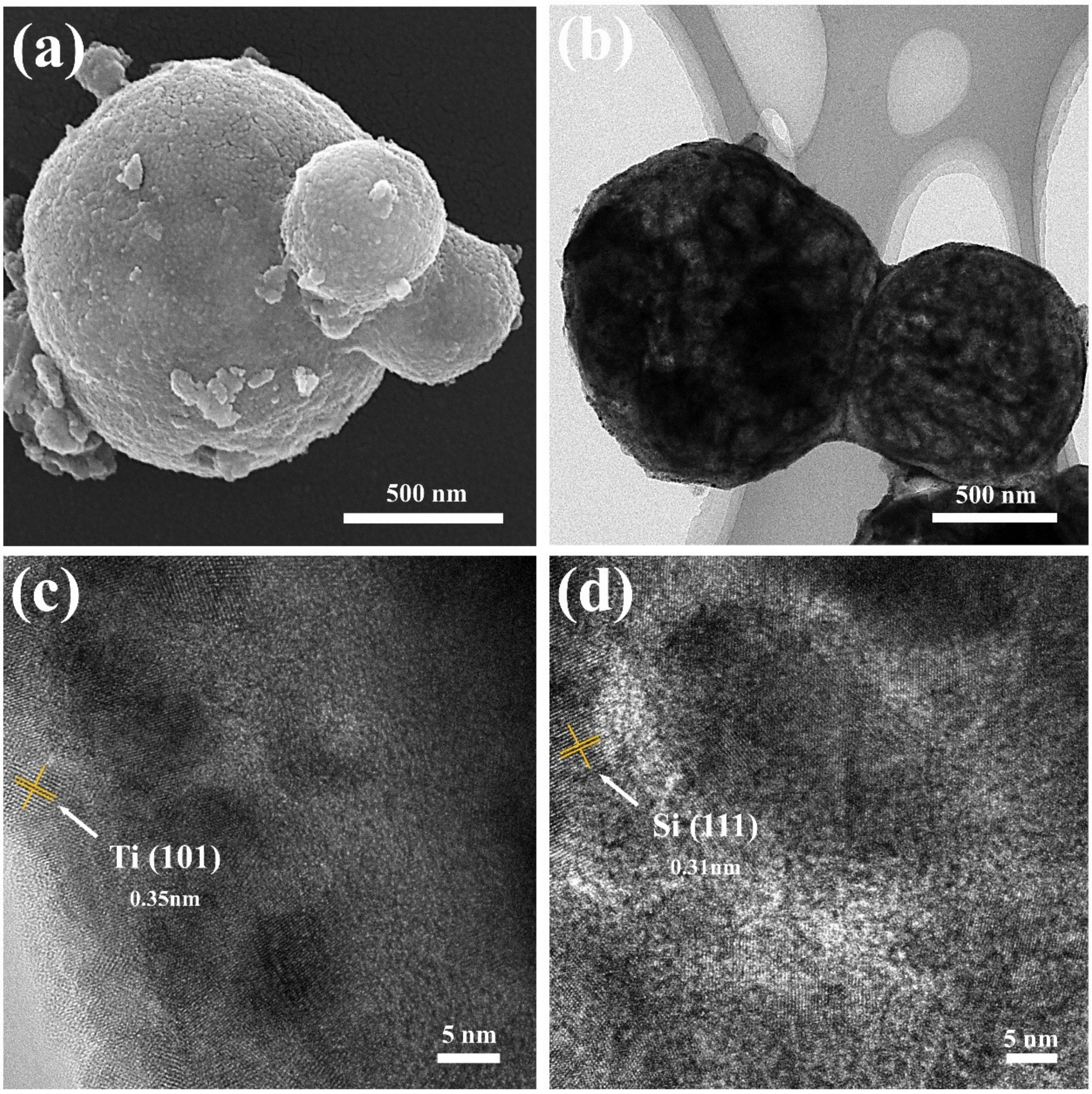

Figure S6. SEM and TEM images of the PSi@C@TiO_2 microspheres.

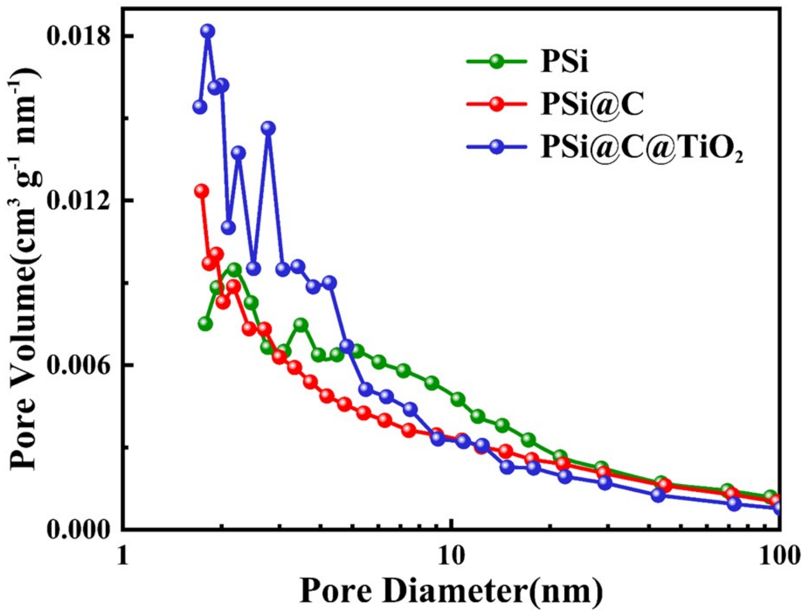

Figure S7. The pore size distribution diagrams of the PSi, PSi@C and PSi@C@TiO_2 microspheres.

Table S1. Geometric parameters of sample. (Total surface: S_{BET}; Volume of pores in the range of 1.7–300 nm in diameter: $V_{\mathrm{1.7\text{-}300\ nm}}$; Average pore size: P_{BJH}).

Samples	S_{BET} (m^2 g^{-1})	$V_{\mathrm{1.7\text{-}300nm}}$ (cm^3 g^{-1})	P_{BJH} (nm)
PSi	68.7	0.293	10.7
PSi@C	143.2	0.268	16.8
PSi@C@TiO_2	125.3	0.255	12.5

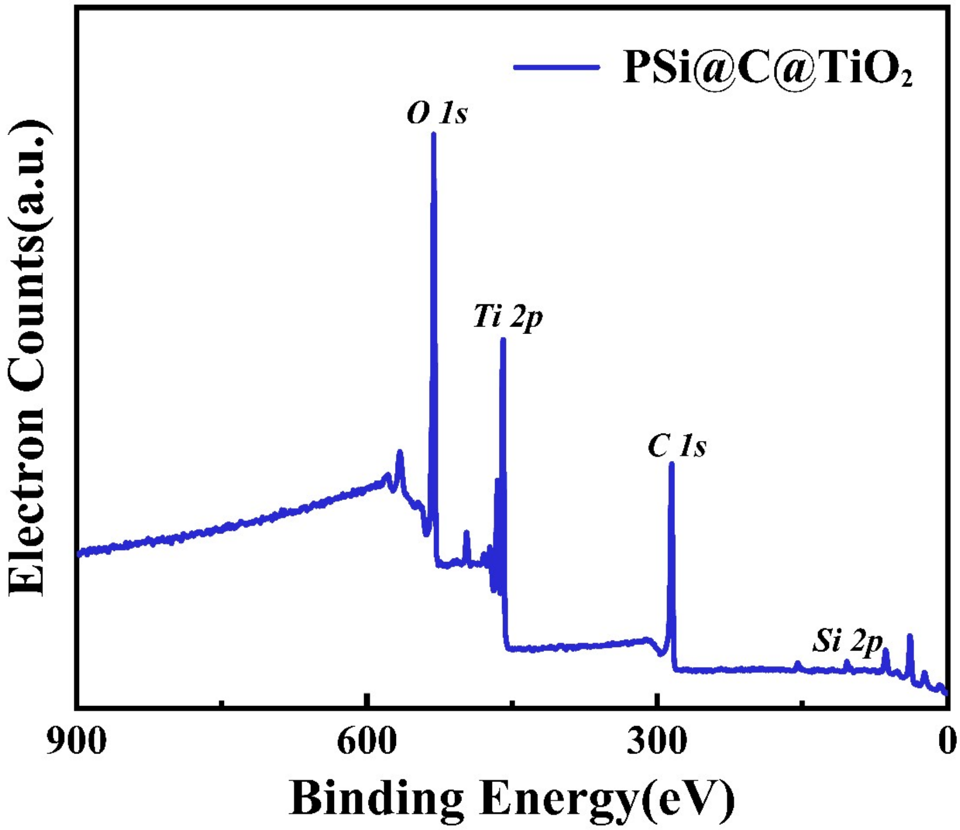

Figure S8. XPS survey of the PSi@C@TiO_2 microspheres.

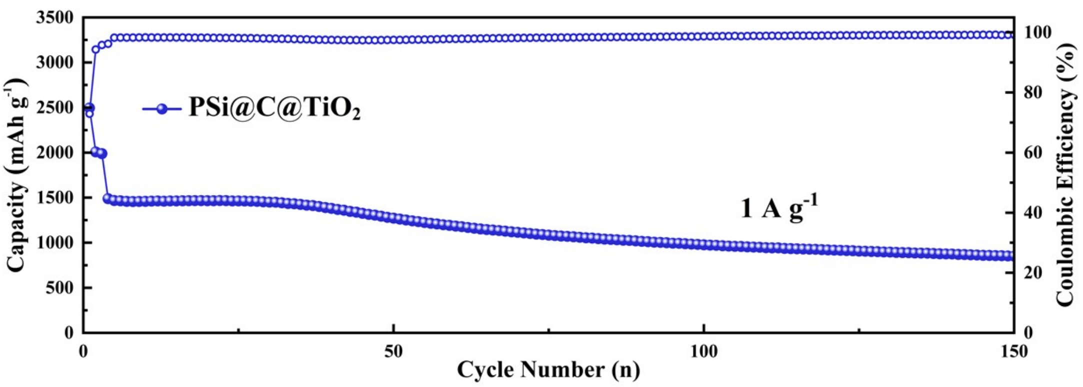

Figure S9. The cycling performance of the PSi@C@TiO_2 electrode at 0.1 A g^{-1} for the first three cycles and 1 A g^{-1} for the subsequent cycles.

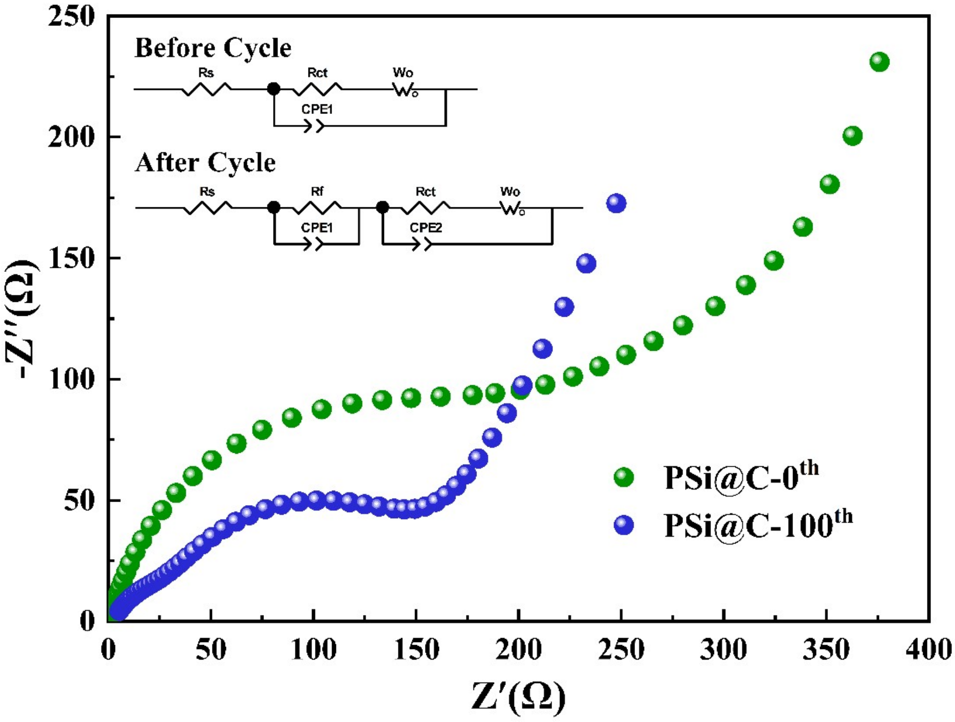

Figure S10. Nyquist plots and equivalent circuits of the PSi@C electrode at different cyclic states.

Table S2. Electrode kinetic parameters calculated by fitting the EIS curves in Fig. 5f and Fig. S10.

Cycle number	Resistance	PSi	PSi@C	PSi@C@TiO_2
Before cycle	$R_s(\Omega)$	1.245	1.328	1.093
	$R_{ct}(\Omega)$	141.5	177	92.08
After 100 cycles	$R_s(\Omega)$	5.284	2.615	2.175
	$R_f(\Omega)$	35.38	26.19	7.909
	$R_{ct}(\Omega)$	159.9	124.4	26.05

Table S3. The electrochemical performance of the PSi@C@TiO2 microspheres and other reported Si-based materials as anodes for LIBs.

Materials	Content of Si (%)	Cycling performance (mAh g^{-1})	Rate capacity (mAh g^{-1})	ICE (%)	Electrode thickness swelling	Refs.
Porous Si sponge	40	570 after 1000 cycles at 1 A g^{-1}	410 at 4.2 A g^{-1}	56	30%	1
TC-SiO	-	674.5 after 100 cycles at 0.14 A g^{-1}	~800 at 1.4 A g^{-1}	71.9	-	2
SiO_X-TiO_2@C	70.6 (SiO_X)	910 after 200 cycles at 0.1 A g^{-1}	542 at 3.2 A g^{-1}	62.5	-	3
Hollow Si@TiO_2@C	67.2	1270 after 250 cycles at 1 A g^{-1}	730 at 8 A g^{-1}	86.06	45.6%	4
Compacted SiOx/G/C granules	31	487 after 500 cycles at 0.3 A g^{-1}	610 at 3 A g^{-1}	84.3	13.7%	5
Si@TiO_2	~95	1580 after 50 cycles at 0. 42A g^{-1}	-	80.8	-	6
Si@TiO_2/NC	-	1070 after 100 cycles at 0.2 A g^{-1}	627 at 3 A g^{-1}	75.9	-	7
p-SiO_x@ TiO_2@C	~44	801 after 100 cycles at 0.28 A g^{-1}	414 at 7 A g^{-1}	67	20%	8
Si/C@TiO_2	53	1077 after 100 cycles at 0.2 A g^{-1}	749.4 at 5 A g^{-1}	75	-	9
PSi@C@ TiO_2	65.2	1041 after 250 cycles at 0.5 A g^{-1}	745 at 5 A g^{-1}	73	35.3%	In this work

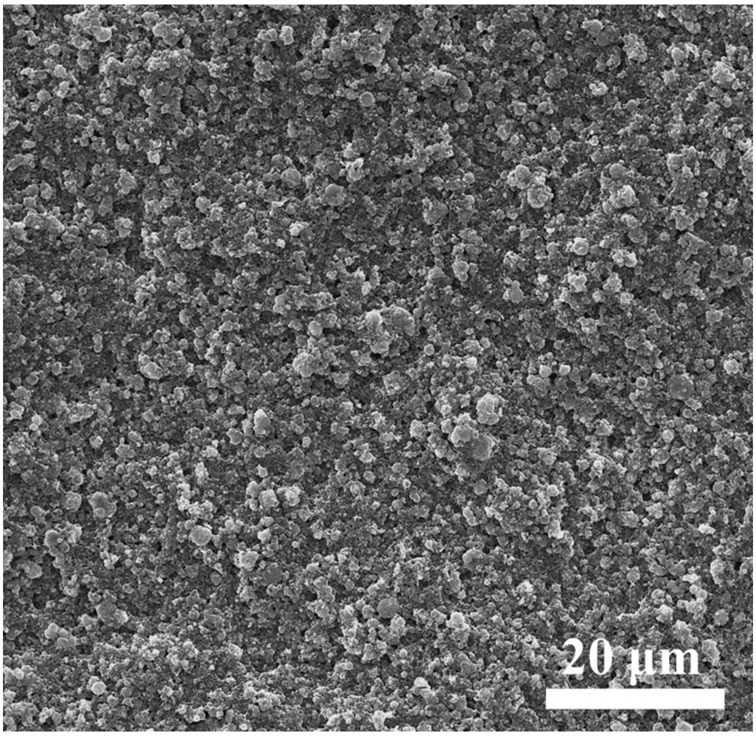

Figure S11. SEM images of the pristine PSi@C@TiO_2 electrode.

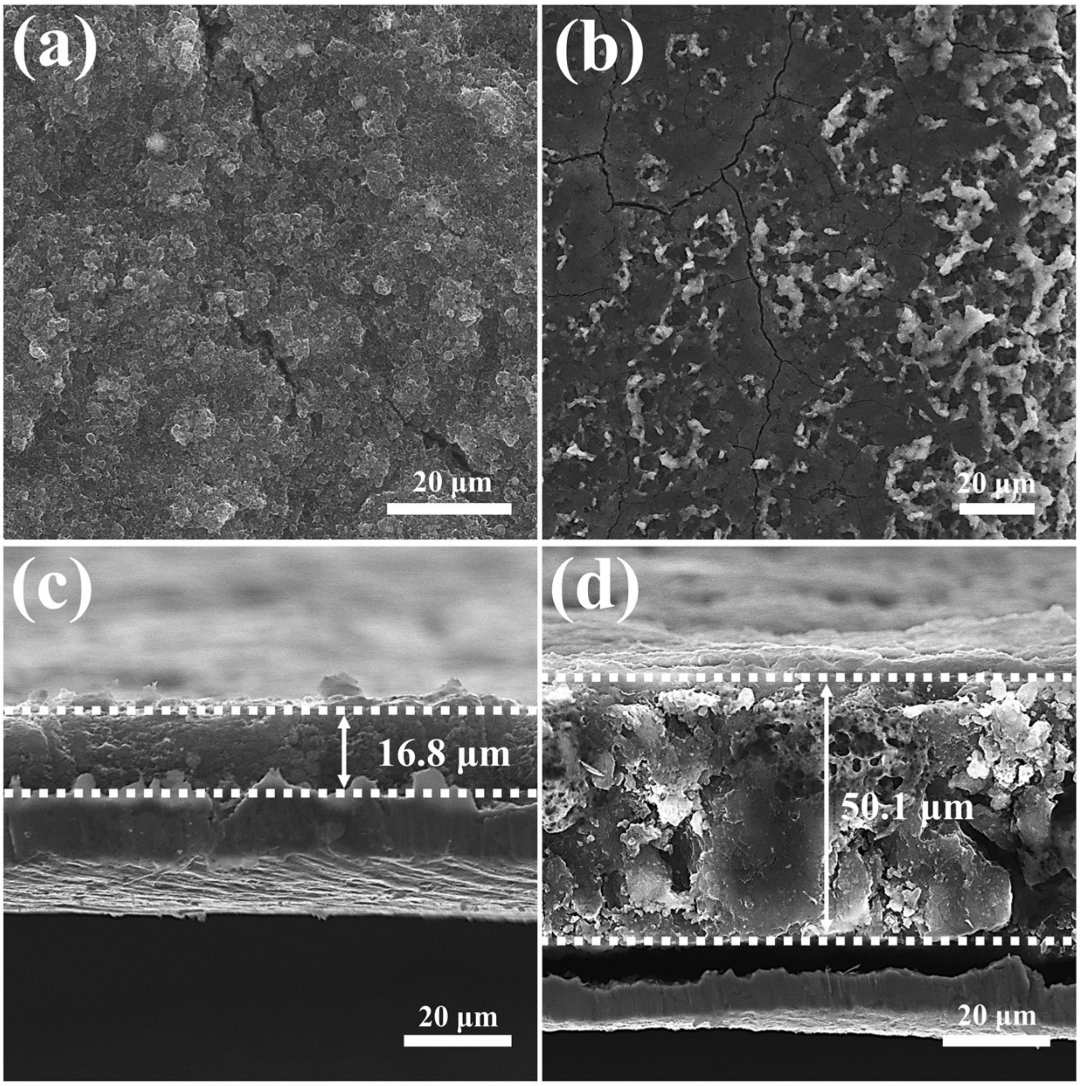

Figure S12. SEM images of the PSi@C electrode after 100 cycles (a-b). Cross-sectional SEM image of the PSi@C electrode: before cycling (c) and after 100 cycles (d) at 0.5 A g^{-1}.

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