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Energy Materials

Supplementary Materials

Modulation of physical and chemical connections between SiO_x and carbon for high-performance lithium-ion batteries

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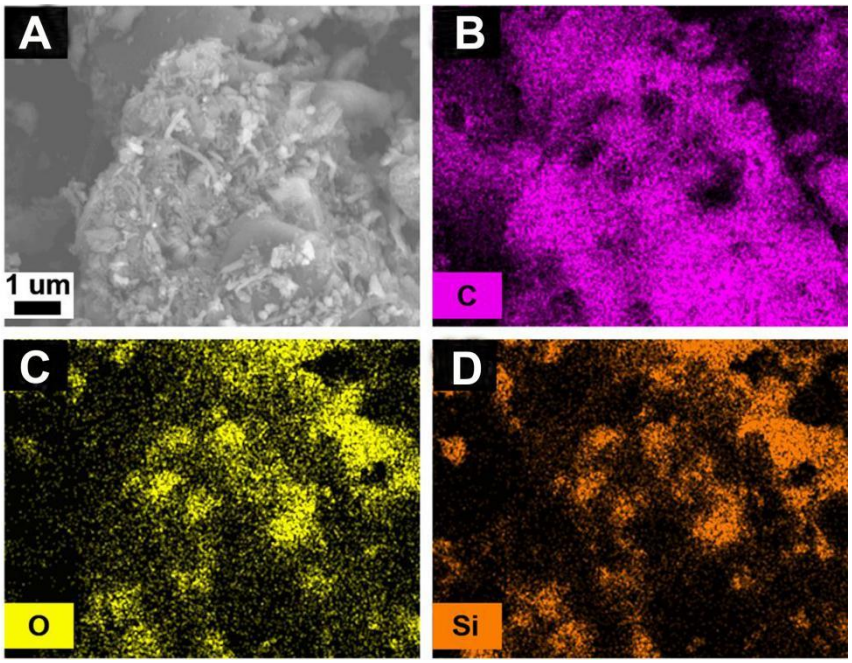
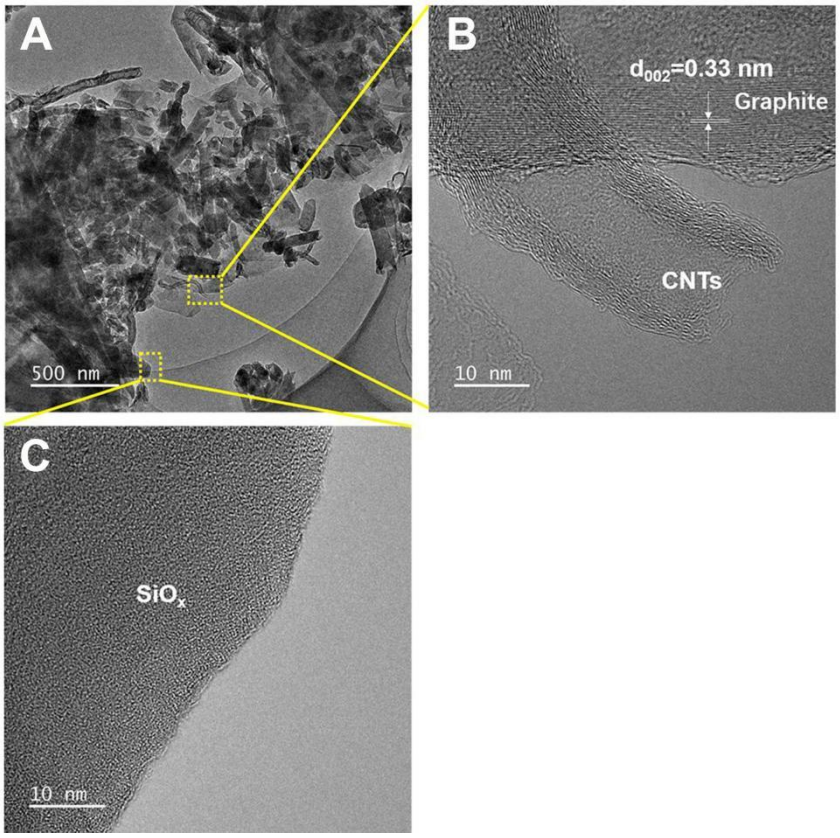
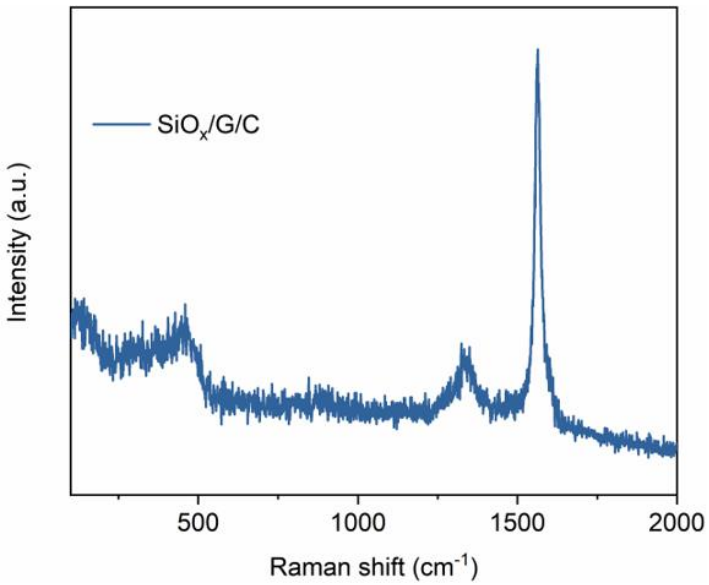
Supplementary Figures



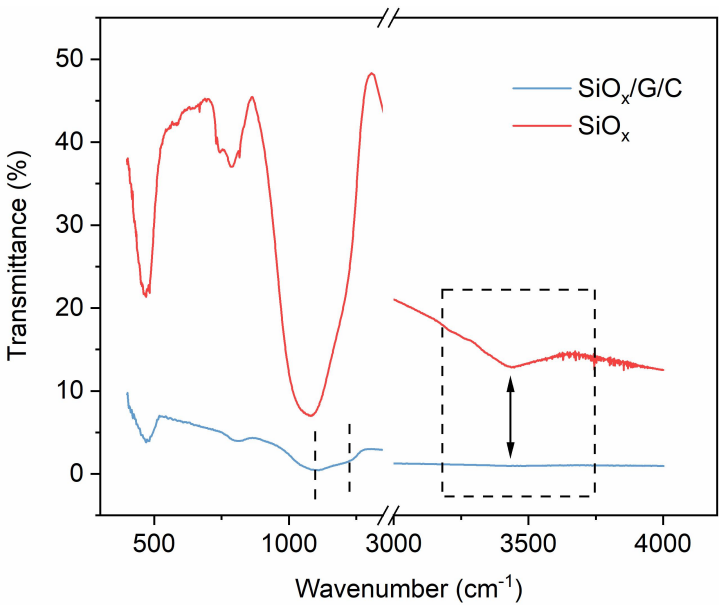
Supplementary Figure 1. SEM image of SiO_x/G/C composite and corresponding element mapping of (B) C, (C) O, and (D) Si.



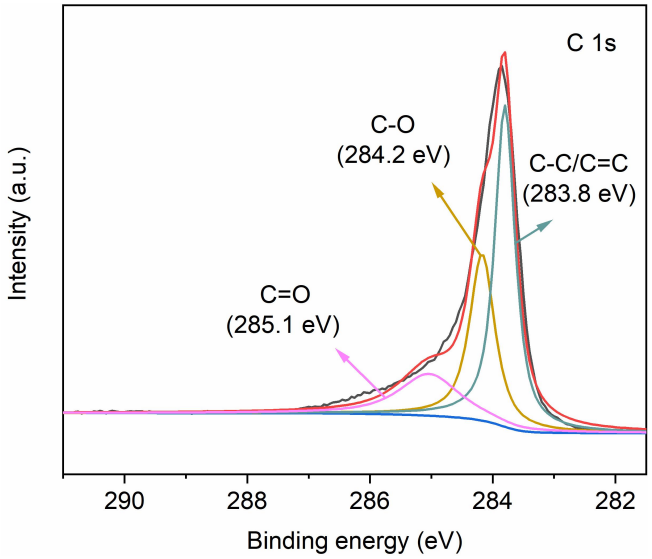
Supplementary Figure 2. HRTEM images of SiO_x/G/C composite.



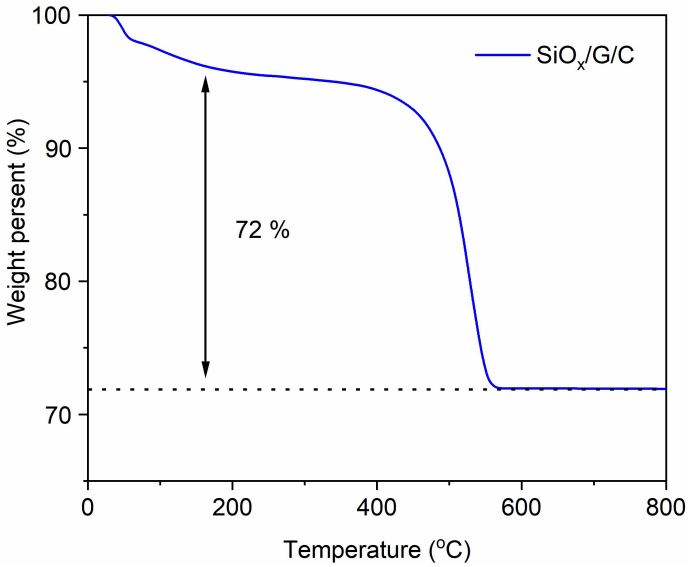
Supplementary Figure 3. Raman spectrum of SiO_x/G/C between 100 cm^{-1} and 2,000 cm^{-1}.



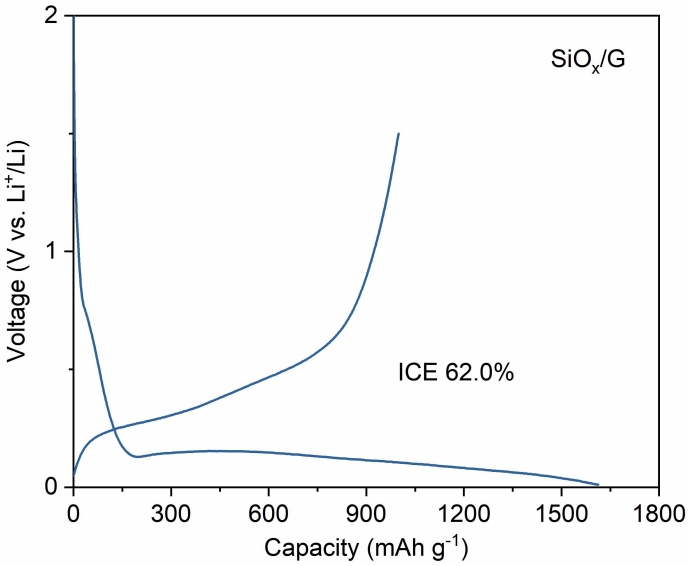
Supplementary Figure 4. FTIR spectra of SiO_x/G/C and SiO_x.



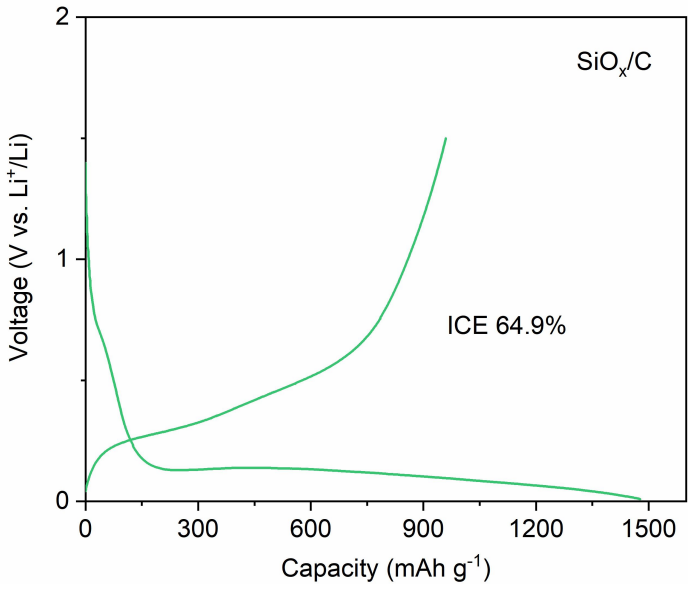
Supplementary Figure 5. C 1s XPS spectrum of SiO_x/G/C.



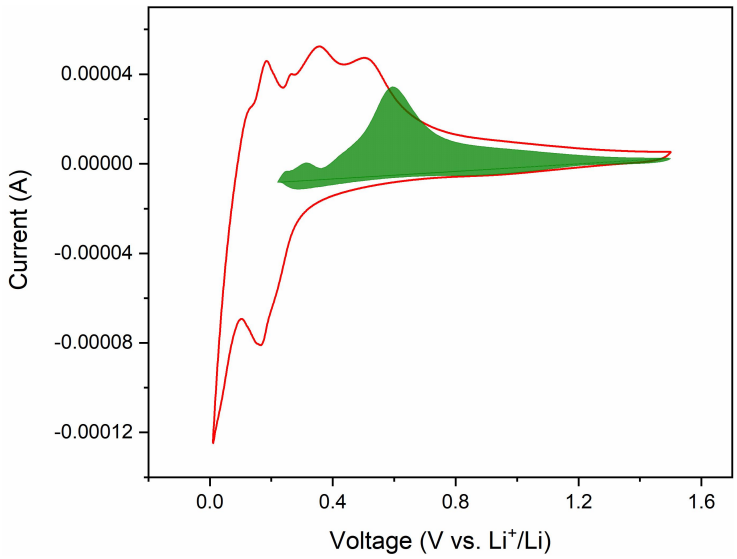
Supplementary Figure 6. TGA curve of the SiO_x/G/C composite in air.



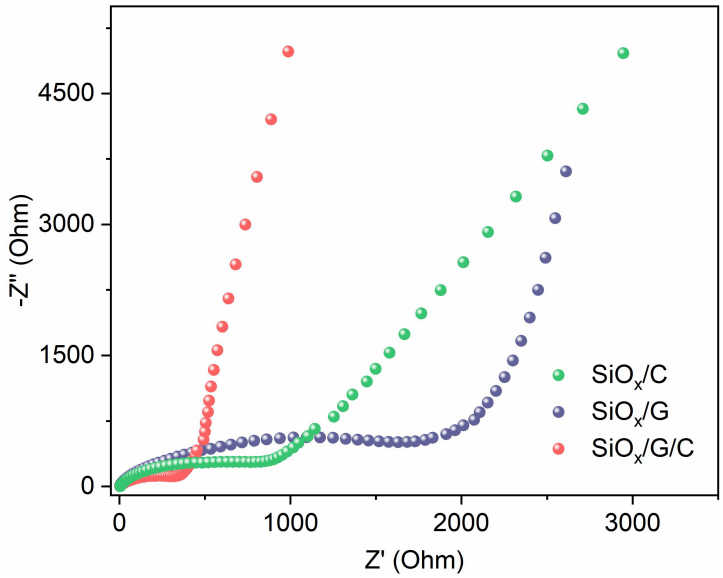
Supplementary Figure 7. Voltage profiles of SiO_x/G.



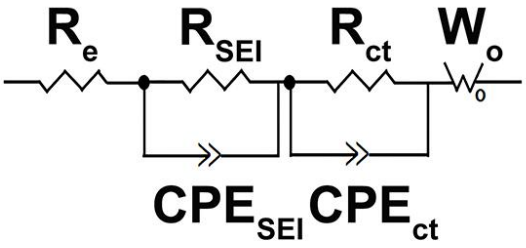
Supplementary Figure 8. Voltage profiles of SiO_x/C.



Supplementary Figure 9. Contribution of capacitive charge storage to the total capacity of SiO_x/G/C electrode at the scan rate of 0.1 $mV \cdot s^{-1}$.



Supplementary Figure 10. EIS spectra of SiO_x/G/C, SiO_x/C, and SiO_x/G electrodes.



Supplementary Figure 11. The equivalent circuit used for modeling the impedance spectra.

Supplementary Tables

Supplementary Table 1. Comparison of electrochemical performance with reported SiO_x-based anodes for LIBs

Electrode	Initial coulombic efficiency (%)	Reversible capacity ($mAh \cdot g^{-1}$)	Current density ($A \cdot g^{-1}$)	Cycle number	Ref.
SiO_x/G/C	64	700	1.0	500	This
SGA-1	51.7	937.1	1.0	400	work
NSR-2	74.85	595.8	1.0	200	[18]
SNG/H-SiO_x@C	72	448	0.5 C	500	[21]
SiO_x/Fe-N-C	61.8	173.7	5.0	5,000	[25]
					[38]
SiMoO-1000	47	510	0.5	500	[39]
SiO-S-CNFs	-	367	1.0	500	[40]
N-SiO_x/C@C	73	600.3	0.5	500	[41]
PSiO-TiO_{2-x}	65	501.2	1.0	300	[42]
SiO_x@G-Ni	63	~470	1.6	500	[43]

Supplementary Table 2. Details about the results of electrical resistivities for SiO_x/G/C composite

Number	Height (mm)	Pressure (Mpa)	Temperature (^oC)	Relative humidity (%RH)	Forward value (Ω·cm)	Backward value (Ω·cm)	Average value (Ω·cm)
1	1.43	1.1	25	50	0.359	0.359	0.359
2	1.31	2.04	25	50	0.211	0.211	0.211
3	1.21	3.07	25	50	0.1445	0.1445	0.1445
4	1.15	4.03	25	50	0.1118	0.1118	0.1118
5	1.09	4.98	25	50	0.0926	0.0926	0.0926
6	1.05	6.05	25	50	0.0803	0.0803	0.0803
7	1	6.99	25	50	0.0668	0.0668	0.0668
8	0.97	8.06	25	50	0.0581	0.058	0.05805
9	0.94	9.04	25	50	0.0523	0.0522	0.05225
10	0.89	9.99	25	50	0.046	0.0459	0.04595
11	0.84	11	25	50	0.0415	0.0415	0.0415
12	0.8	12	25	50	0.0366	0.0366	0.0366
13	0.76	13.02	25	50	0.033	0.0331	0.03305
14	0.74	13.98	25	50	0.0309	0.0309	0.0309
15	0.7	15.07	25	50	0.0284	0.0284	0.0284
16	0.67	16.01	25	50	0.0264	0.0261	0.02625
17	0.63	16.96	25	50	0.0237	0.0238	0.02375
18	0.57	18.04	25	50	0.02059	0.02059	0.02059
19	0.54	18.94	25	50	0.01885	0.01885	0.01885
20	0.5	20.13	25	50	0.01673	0.01672	0.016725

Supplementary Table 3. Simulated kinetic parameters obtained from the SiO_x/G/C, SiO_x/C and SiO_x/G electrodes

Electrode	R_e/Ω	R_{SEI}/Ω	R_{ct}/Ω
SiO_x/G/C	3.47	305.9	53.95
SiO_x/C	3.38	558.7	250.7
SiO_x/G	2.45	1467	299.5