

Supplementary Materials

Sea Urchin-Like Si@MnO₂@rGO as Anodes for High-Performance Lithium-Ion Batteries

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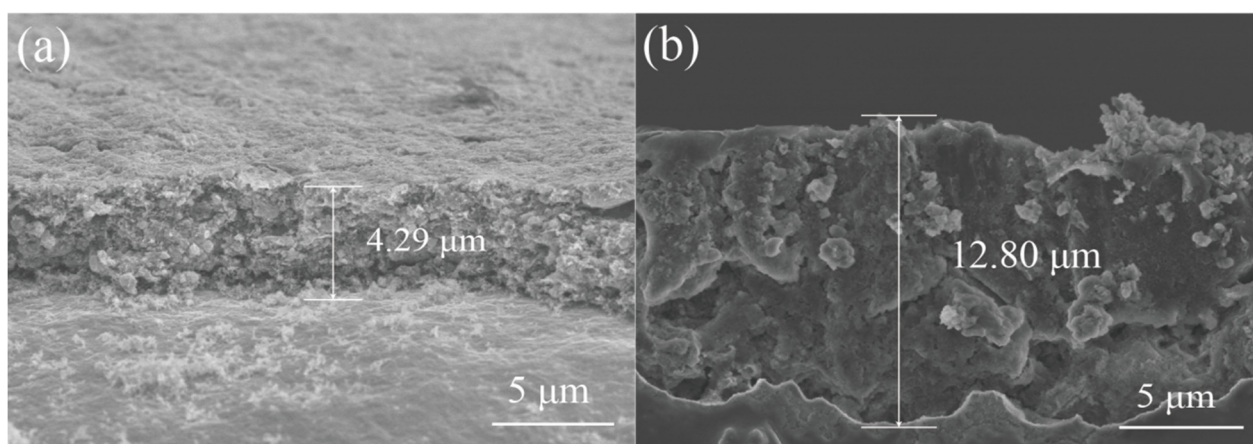


Figure S1. (a,b) Cross-sectional SEM images of Si@MnO₂-50°C before and after 150 cycles.

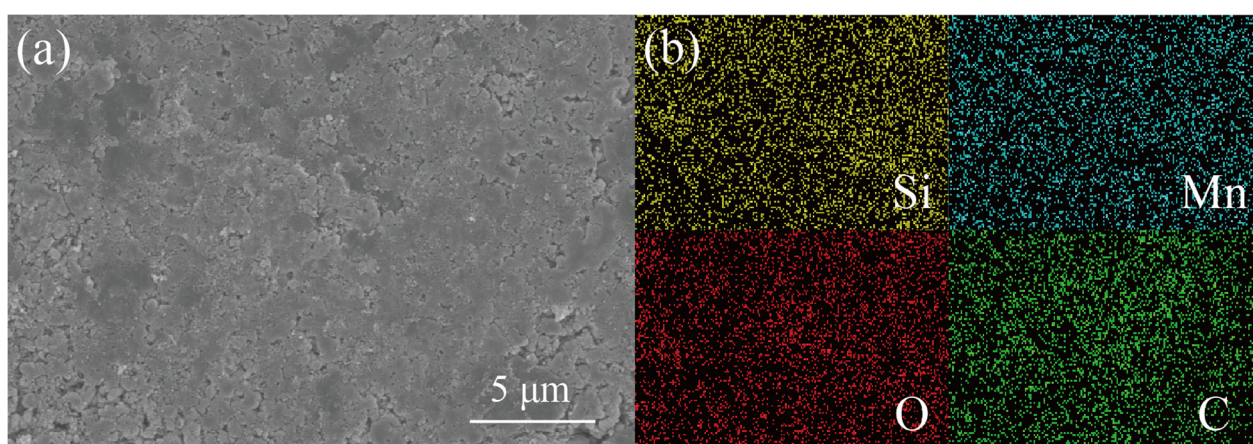


Figure S2. (a) Cross-sectional SEM images of the Si@MnO₂@rGO-50°C electrode sheet after 150 cycles at 0.1 A g⁻¹. (b) Element mapping images of the Si@MnO₂@rGO-50°C electrode sheet after 150 cycles at 0.1 A g⁻¹.

Table S1. Capacity contribution of Si, MnO₂ and rGO.

Sample	Theoretical Capacity	Atom Percentage	Weight Percentage	Capacity Contribution
Si	4200 mAh g ⁻¹	47%	32%	63.3%
MnO ₂	1223 mAh g ⁻¹	31%	62%	35.6%
rGO	372 mAh g ⁻¹	21%	6%	1.1%

Table S2. Synthesis strategies and electrochemical performance comparison Si-based anode materials and MnO₂-based anode materials in lithium-ion batteries.

Sample	Synthesis Method	Cycle Retention	Cycling Stability (mAh/g)	Refs.
Si@MnO ₂ @rGO	Stirring and freeze-dry	88% after 1000 cycles at 1A g ⁻¹	1282 mAh g ⁻¹ after 1000 cycles at 1A g ⁻¹	This work
Porous Si/rGO	Stirring, chemical etching and water bath.	75% after 200 cycles at 1 A g ⁻¹	About 1026mAh g ⁻¹ after 50 cycles at 1 A g ⁻¹	[61]
Si/rGO	Stirring, freeze-dry and thermal treatment	53% after 200 cycles at 1 A g ⁻¹	About 550mAh g ⁻¹ after 200 cycles at 1 A g ⁻¹	[20]
Si/rGO	Stirring, chemical etching, calcine and ball-milling	67% after 300 cycles at 0.5 A g ⁻¹	548 mAh g ⁻¹ after 300 cycles at 0.5 A g ⁻¹	[46]
CL-Si@C/rGO	Calcine and stirring	About 50% after 100 cycles at 1 A g ⁻¹	910 mAh g ⁻¹ after 100 cycles at 1 A g ⁻¹	[62]
α -Fe ₂ O ₃ /MnO ₂	Calcine and stirring	About 62% after 500 cycles at 0.5 A g ⁻¹	494 mAh g ⁻¹ after 500 cycles at 0.5 A g ⁻¹	[63]
MnO ₂ /rGO	Hydrothermal method	About 44% after 500 cycles at 0.5 A g ⁻¹	About 500 mAh g ⁻¹ after 500 cycles at 0.5 A g ⁻¹	[64]

Table S3. The R_s and R_{CT} values fitted from the equivalent circuit model are summarized for comparison.

Electrode	R _s /Ω	R _{CT} /Ω
Si	5.8	272.1
Si@MnO ₂	3.8	233.0
Si@MnO ₂ @rGO	11.3	146.2
Si@MnO ₂ @rGO-150th	13.7	72.7