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Ultra-long life Si@rGO/g-C_3N_4 with Multiple Synergetic Effect as Anode Materials for Lithium-ion Batteries

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The counting process:

As shown in **Table S1,** the weight percentage of C, N in the as-prepared Si@rGO/g-C_3N_4 hybrid is 37.442% and 11.521% respectively. Supposing that total amount of other trace elements (e.g. H, O) contained in synthesized Si@rGO/g-C_3N_4 is less than 1 wt%, the content of Si could be calculated as the following equation:

$$\omega_{Si} = 100\% - \omega_C - \omega_N$$ **(Equation S1)**

Where ω_{Si}, ω_C, ω_N are respectively the mass fraction of silicon, carbon and nitrogen. So the silicon mass fraction is 51.037% in hybrid.

The mass fraction of CN (ω_{CN}) could be calculated by

$$\omega_{CN} = \omega_N + \omega_N \times \frac{3M_C}{4M_N} = 1.643 \times \omega_N$$ **(Equation S2)**

The mass fraction of rGO (ω_{rGO}) could be calculated as follows:

$$\omega_{rGO} = \omega_C - \omega_N \times \frac{3M_C}{4M_N} = \omega_C - 0.643 \times \omega_N$$ **(Equation S3)**

So, the mass fractions of chemical compositions are calculated to be Si 51.037%, rGO 30.036% and CN 18.927% in Si@rGO/g-C_3N_4 hybrid, which are close to our estimated results.

Table S1 The content of element and chemical compositions of the as-prepared samples

	Elemental content(wt%)			Chemical compositions(wt%)		
Si@rGO/g-C_3N_4	C	N	Si	rGO	CN	Si
	37.442	11.521	51.037	30.036	18.927	51.037

Table S2 Results of EIS, σ and D in Si, Si@rGO, Si@rGO/g-C_3N_4

Active Material	R_S[Ω]	R_1[Ω]	W[Ω]	σ[S cm^{-1}]	D[cm^2 S^{-1}]
Si@rGO/g-C_3N_4	1.43	17.12	59.45	2.18×10^{-5}	9.30×10^{-14}
Si@rGO	1.60	42.03	124.30	1.01×10^{-5}	5.12×10^{-14}

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Si	2.20	187	1328.93	1.12 x 10^{-6}

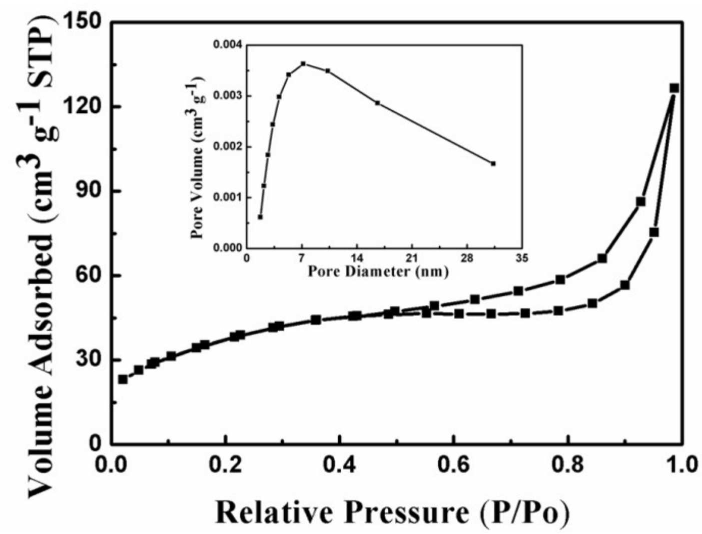

Figure S1 Nitrogen adsorption-desorption isotherm and the inset displaying the corresponding pore-size distribution curve of Si@rGO/g-C_3N_4

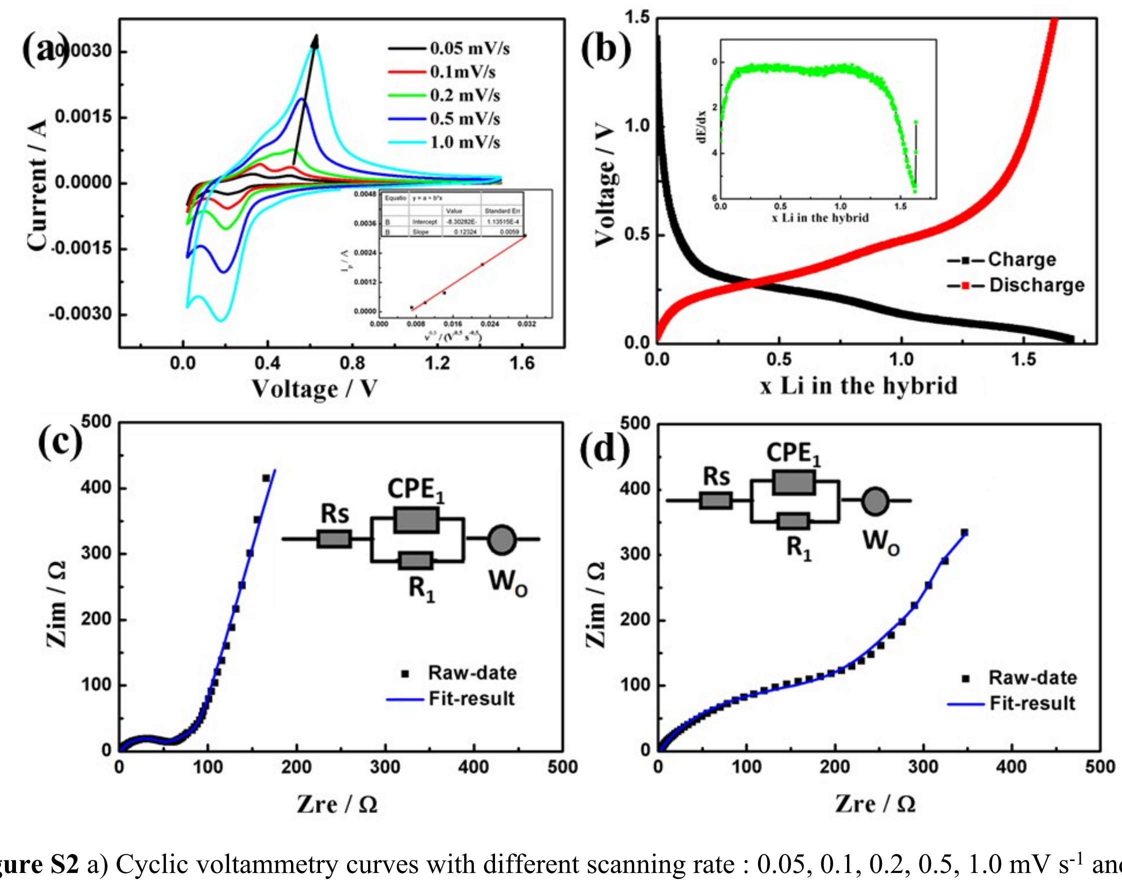

Figure S2 a) Cyclic voltammetry curves with different scanning rate : 0.05, 0.1, 0.2, 0.5, 1.0 mV s^{-1} and the relationship of the peak current (I_p) and the square root of scanning rate ($v^{0.5}$) of Si@rGO hybrid. b) Galvanostatic the charge-discharge curves of Si@rGO hybrid at 0.5 C. c) Nyquist plot of Si@rGO electrode measured before cycling with selected equivalent circuit (inset), and d) Nyquist plot of the Si fresh electrode with selected equivalent circuit (inset).

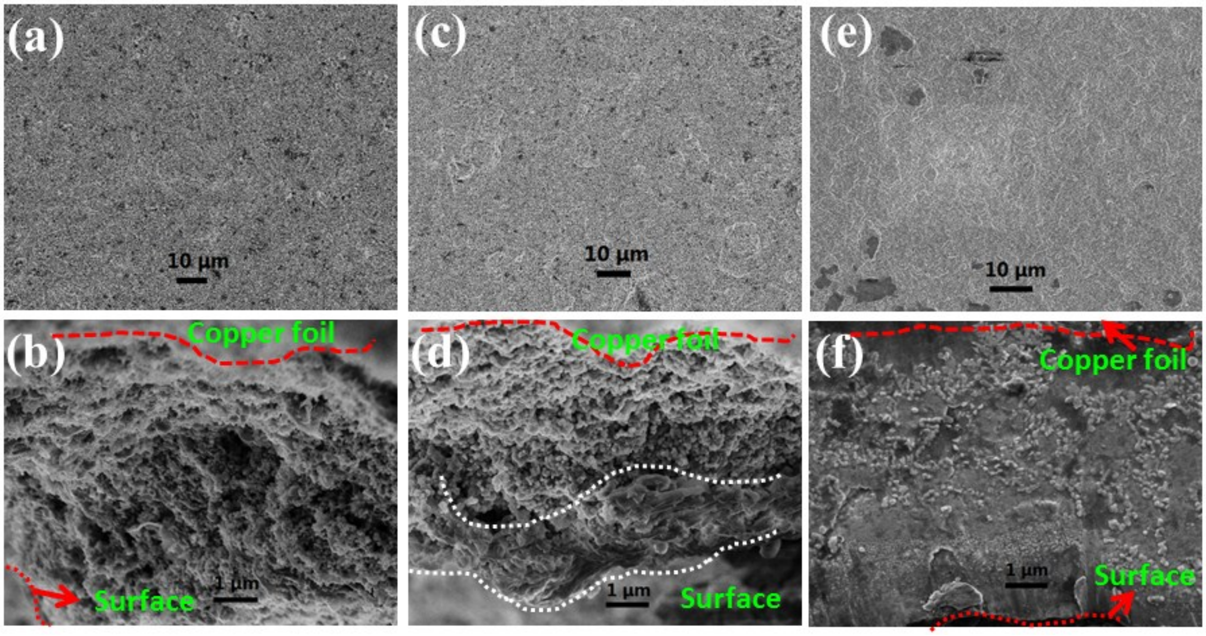

Figure S3 SEM images of Si@rGO/g-C_3N_4 electrode after (a-b) 0 cycles, (c-d) 50 cycles and (e-f) 1000 cycles at 0.5C. b, d and f are SEM images of transverse section of the electrodes.

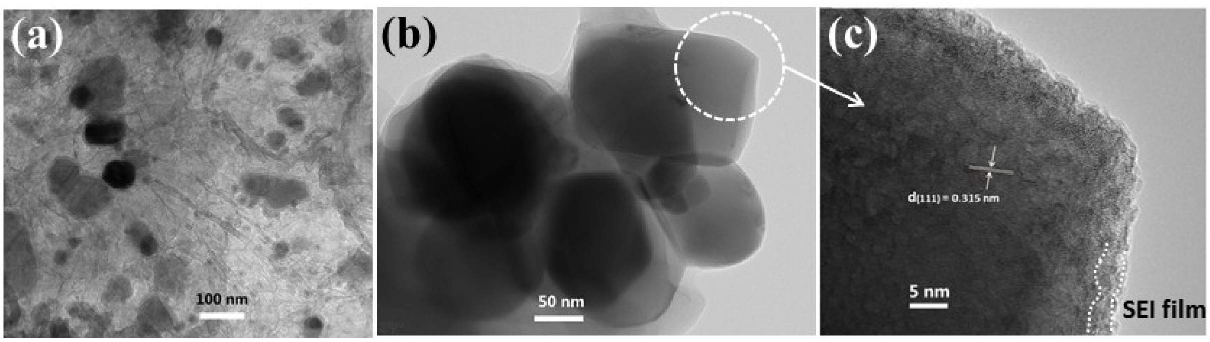

Figure S4 TEM images of Si@rGO/g-C_3N_4 after (a) 50 cycles and (b-c) 1000 cycles.

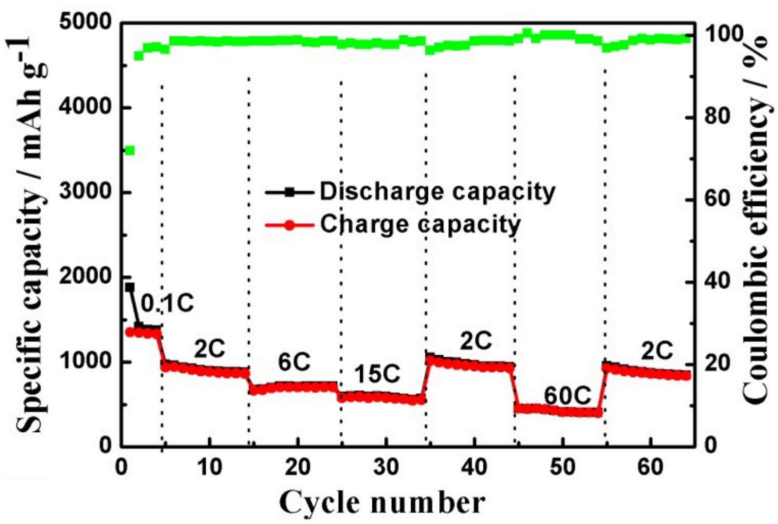

Figure S5 Rate performance of Si@rGO/g-C_3N_4 at various current rates.