

Electronic Supplementary Information for

A novel graphene sheet-wrapped $\text{Co}_2(\text{OH})_3\text{Cl}$ composite as a long-life anode material for lithium ion batteries

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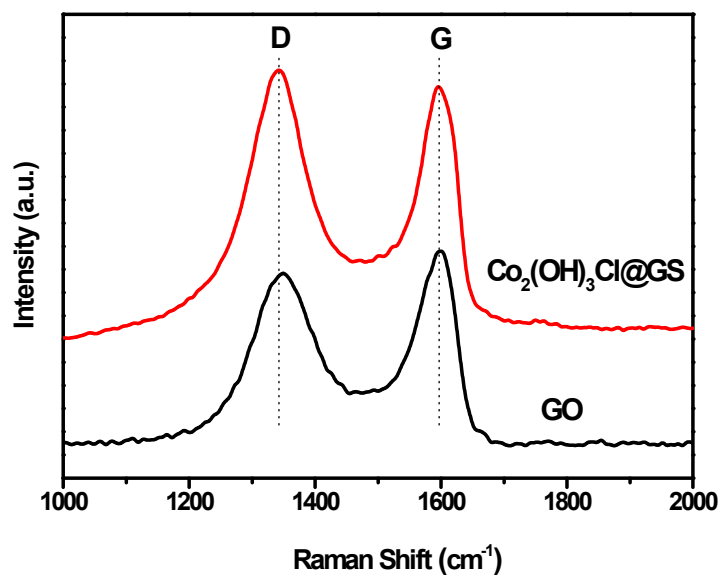


Fig. S1. Raman spectra for the $\text{Co}_2(\text{OH})_3\text{Cl}@GS$ and GO

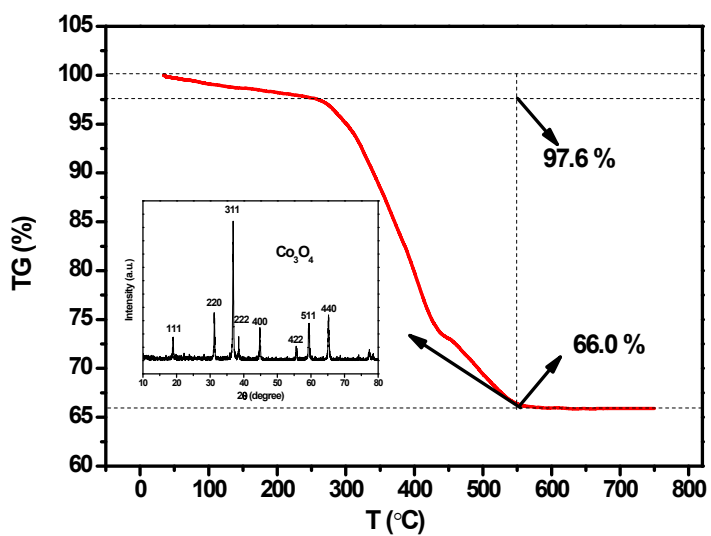


Fig. S2. TGA curve of the $\text{Co}_2(\text{OH})_3\text{Cl}@GS$ composite in air atmosphere. The inset is the XRD pattern of the calcination product of $\text{Co}_2(\text{OH})_3\text{Cl}$ at 550 °C.

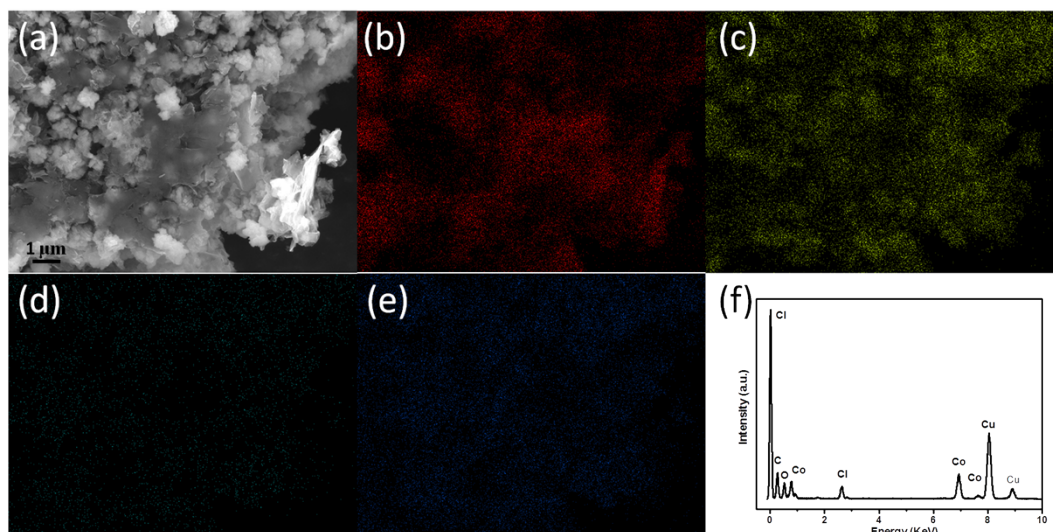


Fig. S3. Elemental mapping images of the $\text{Co}_2(\text{OH})_3\text{Cl}@GS$ composite. (a) Typical SEM image with corresponding EDS mapping images over a relatively large area (about $10 \mu\text{m} \times 14 \mu\text{m}$) for the elements (b) carbon, (c) oxygen, (d) cobalt and (e) chloride, and (f) EDS spectrum.

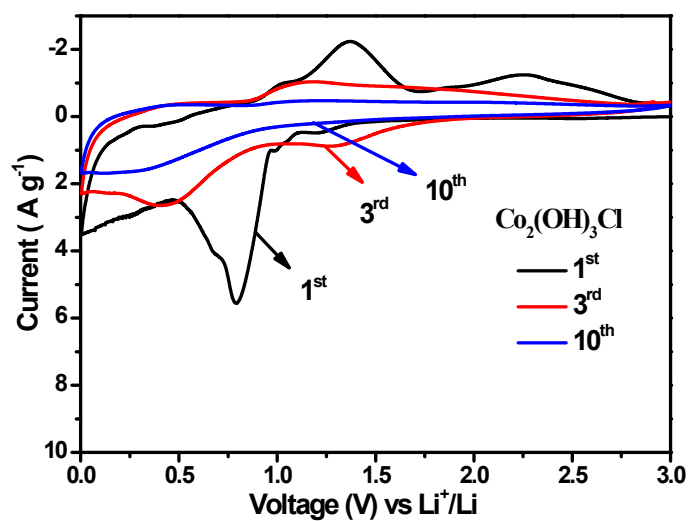


Fig. S4. CV curves of the bare $\text{Co}_2(\text{OH})_3\text{Cl}$ in the potential range of 0.005–3 V at a scan rate of 0.1 mV s^{-1}

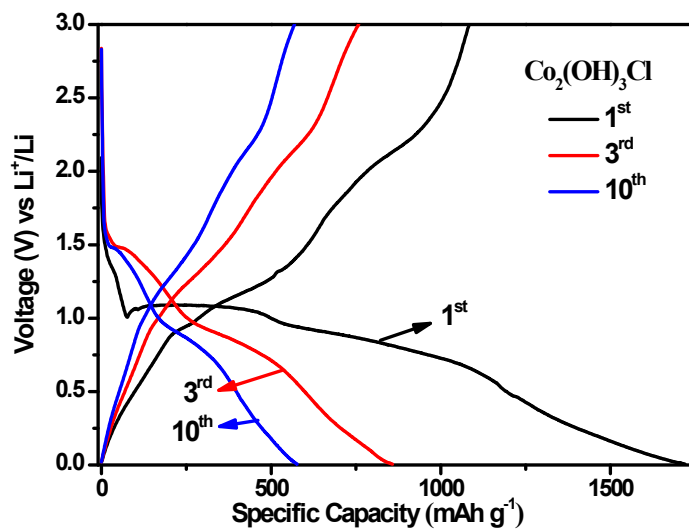


Fig. S5. Charge–discharge curves of the bare $\text{Co}_2(\text{OH})_3\text{Cl}$ composite at a current density of 50 mA g^{-1} .

Table S1 Comparison of the rate and cycling capability of bare $\text{Co}_2(\text{OH})_3\text{Cl}$ and $\text{Co}_2(\text{OH})_3\text{Cl}@GS$ composite synthesized in this work with those of $\text{Co}(\text{OH})_2$ and $\text{Co}(\text{OH})_2$ -based composites reported in the literatures

Samples	Initial reversible capacity (mAh g^{-1})	Initial Coulombic efficiency (%)	Capacity	Current densities (mA g^{-1})	corresponding capacity (mAh g^{-1})	Capacity retention (%)	Ref.
Bare $\text{Co}_2(\text{OH})_3\text{Cl}$	1083	63	Rate	50	570	52.6	This work
				100	473	43.7	
				200	416	38.4	
				400	278	25.7	
				800	192	17.8	
			Cycling	200	407 after 50 cycles	37.6	
Pure $\text{Co}(\text{OH})_2$	670	43	Cycling	200	400 after 30 cycles	58.0	[S1]
$\text{Co}(\text{OH})_2$	700	77	Rate	58	480	68.6	[S2]
				580	90	12.9	
			Cycling	1160	30	4.3	
Bare $\text{Co}(\text{OH})_2$	581	63	Rate	58	500	86	[S3]
				290	100	17.2	
				580	30	5.2	
			Cycling	1160	10	1.7	
$\text{Co}_2(\text{OH})_3\text{Cl}@GS$	1081	66	Rate	58	98 after 40 cycles	16.9	This work
				50	840	77.7	
				100	767	71.0	
				200	685	63.4	
				400	601	55.6	
			Cycling	800	496	45.9	
			1600	397	36.7		
$\text{Co}(\text{OH})_2-GS$	1120	70	Cycling	200	753 after 50 cycles	69.7	[S1]
Graphene coated $\text{Co}(\text{OH})_2$	786	68	Rate	200	414 after 300 cycles	38.3	[S2]
				1600	910 after 30 cycles	82.0	
			Cycling	58	706 after 50 cycles	89.8	
$\text{Co}(\text{OH})_2/\text{Co}_3\text{O}_4$ hybrids	1066	73	Rate	58	1200	112.5	[S3]
				290	800	75.0	
				580	440	41.3	
				1160	200	18.8	
			Cycling	58	1160 after 40 cycles	108.8	

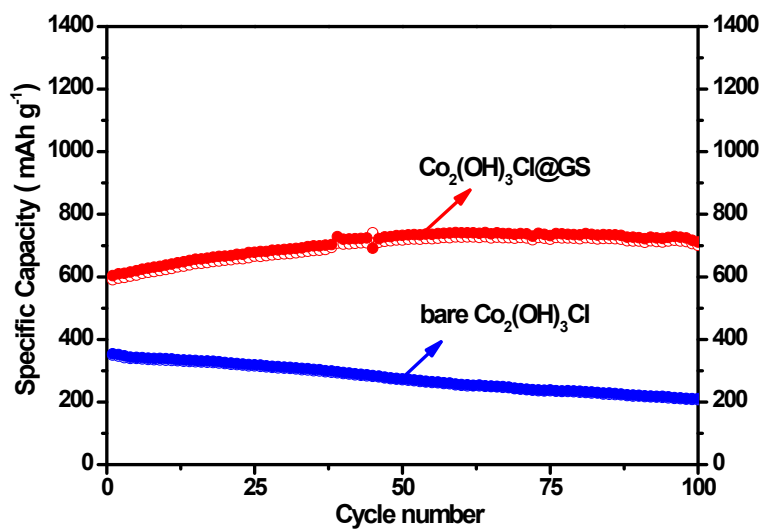


Fig. S6. Reversible Li extraction capacity of the Co₂(OH)₃Cl@GS and bare Co₂(OH)₃Cl at a charge/discharge current density of 1600 mA g⁻¹ at 55 °C. All cells were cycled at a current density of 50 mA g⁻¹ for the initial two cycles before each test. Solid and hollow point symbols represent lithium insertion and extraction, respectively.

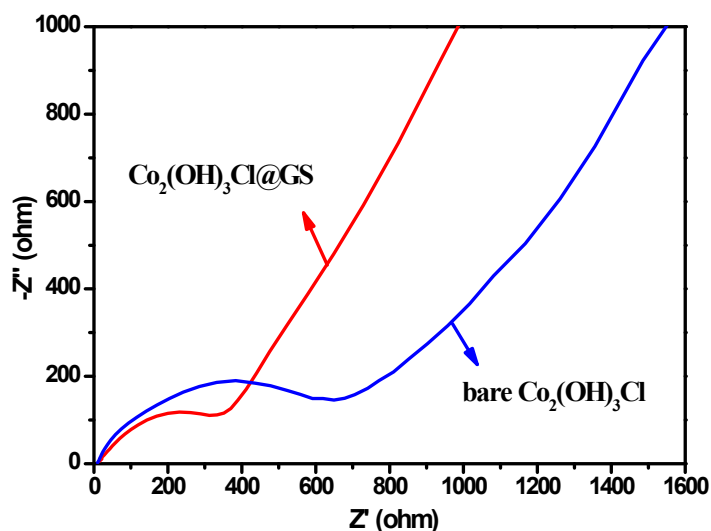


Fig. S7. Nyquist plots of the bare $\text{Co}_2(\text{OH})_3\text{Cl}$ and $\text{Co}_2(\text{OH})_3\text{Cl}@GS$ electrodes after 50 cycles at a current density of 200 mA g^{-1} under a three-electrode system. The electrolyte contained 1 M LiPF_6 in dimethyl carbonate (DMC) and ethylene carbonate (EC) mixed solvent with a v/v ratio of 1:1. The cells were assembled in an argon-filled glove box. Charge–discharge cycles of the three-electrode cells were carried out between 0.005 and 3 V vs. Li/Li^+ at room temperature, using the Autolab PGSTAT302N (Metrohm) model electrochemical workstation under constant current conditions. All measurements were conducted in the delithiated state.

References

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- [S2] X.-l. Huang, J. Chai, T. Jiang, Y.-J. Wei, G. Chen, W.-q. Liu, D. Han, L. Niu, L. Wang and X.-b. Zhang, *J. Mater. Chem.*, 2012, **22**, 3404-3410.
- [S3] X.-l. Huang, X. Zhao, Z.-l. Wang, L.-m. Wang and X.-b. Zhang, *J. Mater. Chem.*, 2012, **22**, 3764-3769.