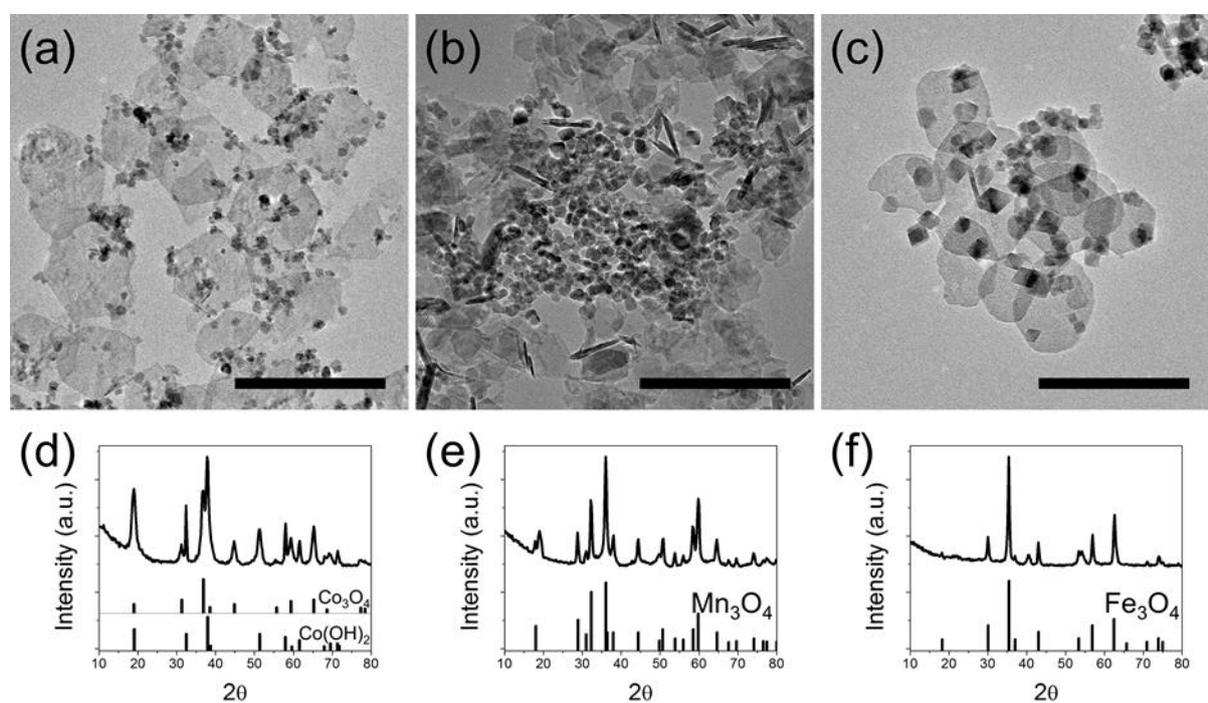


## Electronic Supplementary Information

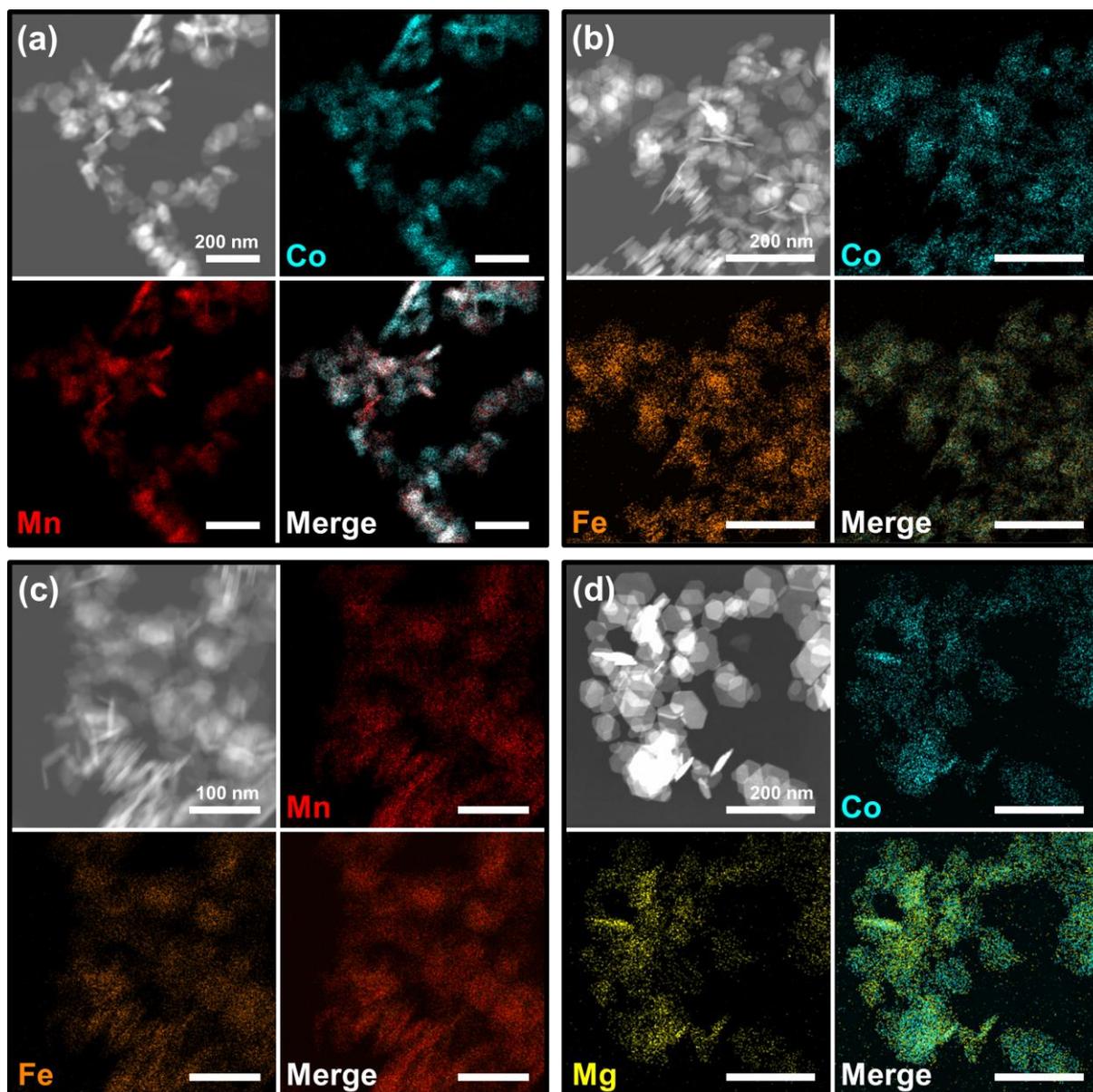
### Facile synthesis of metal hydroxide nanoplates and their applications to lithium ion battery anodes

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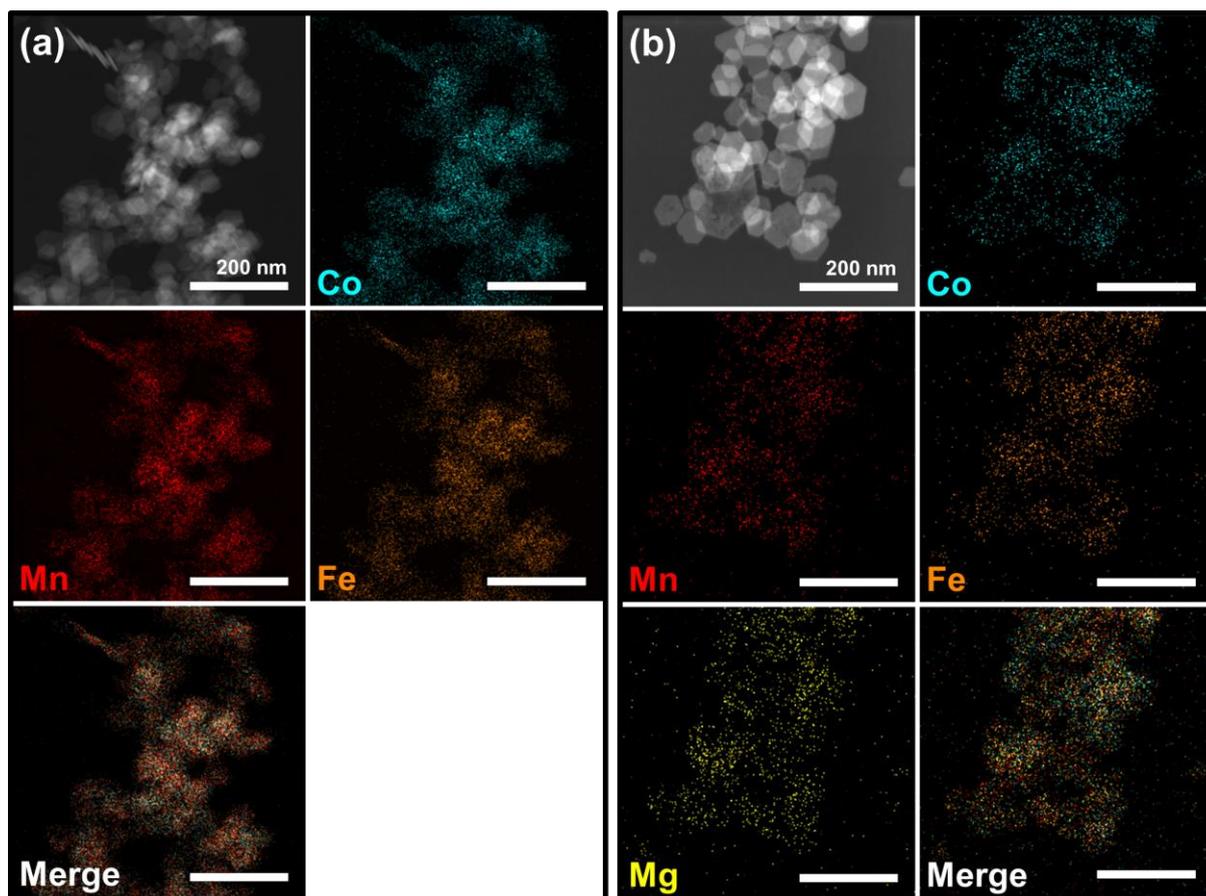
<sup>1</sup>These authors contributed equally to this work.



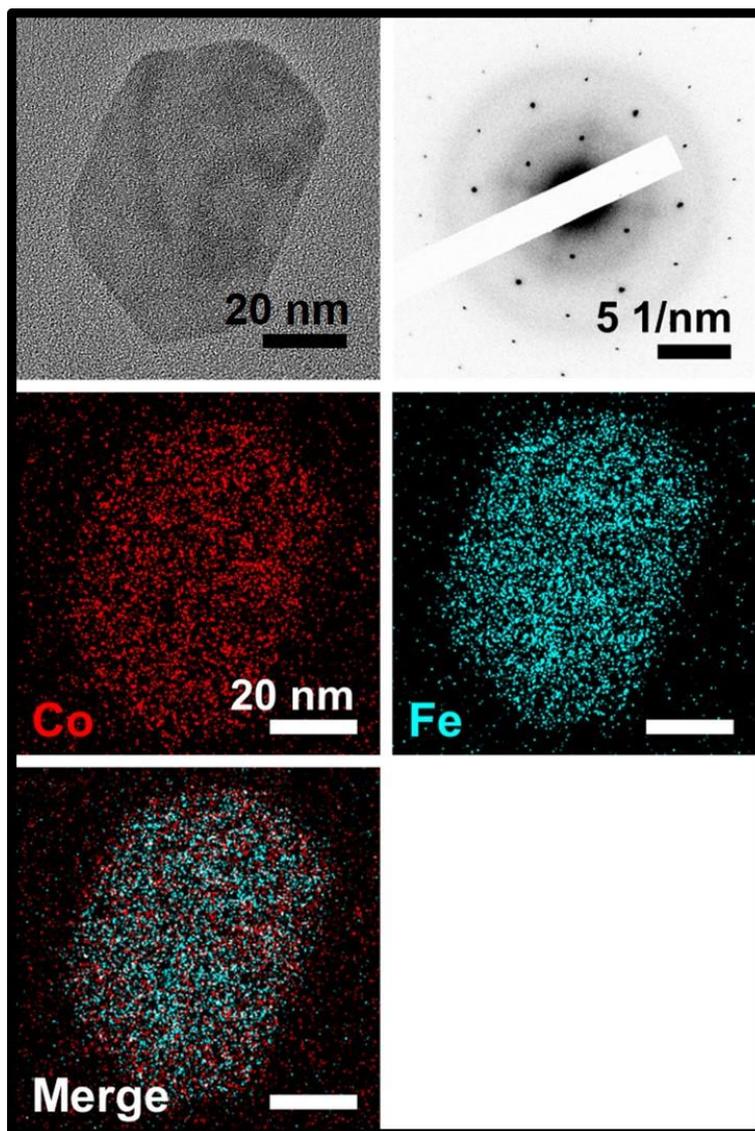
**Fig. S1** (a-c) TEM image and (d-f) XRD data of nanoparticles obtained under an air atmosphere. (a,d) Cobalt, (b,e) manganese, and (c,f) iron. All scale bars are 200 nm.



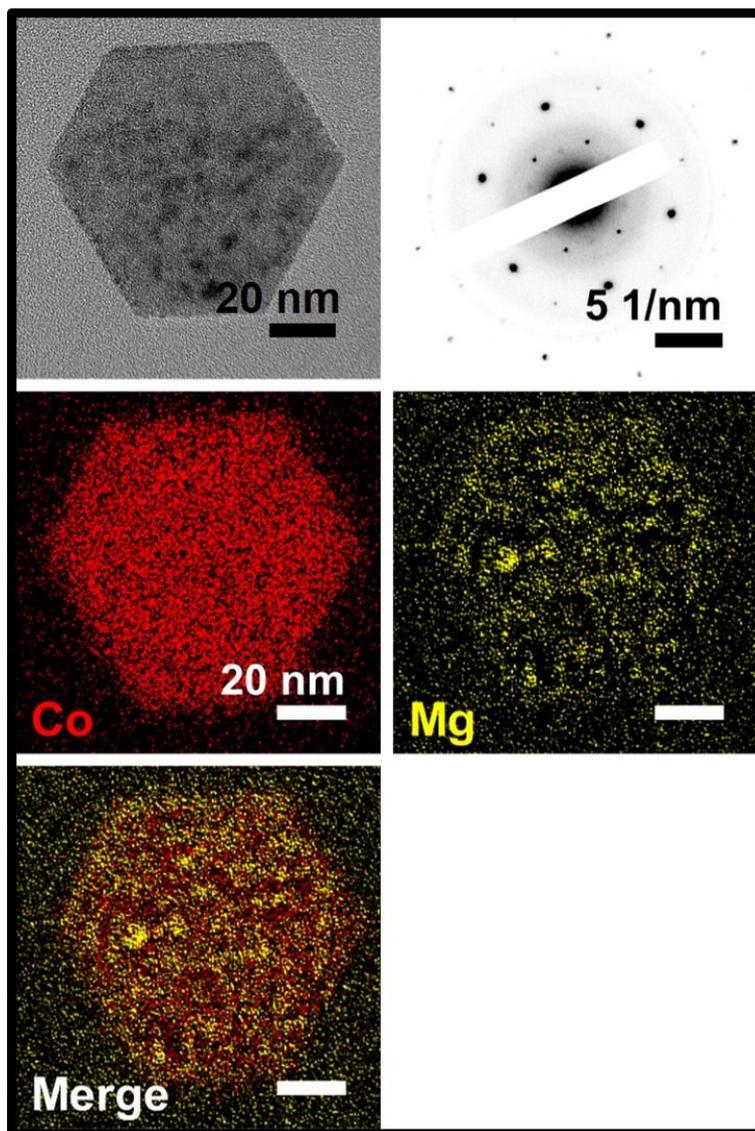
**Fig. S2** Dark-field STEM image and corresponding EDX elemental mapping images of various mixed-metal (oxy)hydroxide nanoplates. (a) Co-Mn, (b) Co-Fe, (c) Mn-Fe, and (d) Co-Mg.



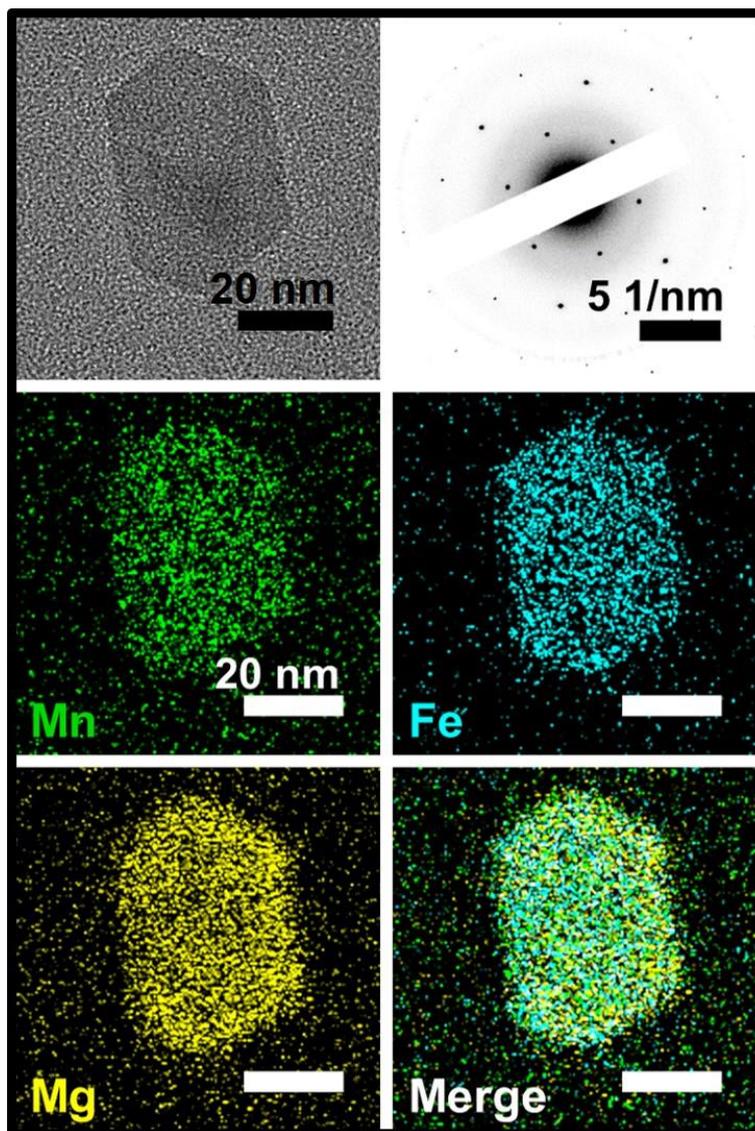
**Fig. S3** Dark-field STEM image and corresponding EDX elemental mapping images of various mixed-metal (oxy)hydroxide nanoplates. (a) Co-Mn-Fe and (b) Co-Mn-Fe-Mg.



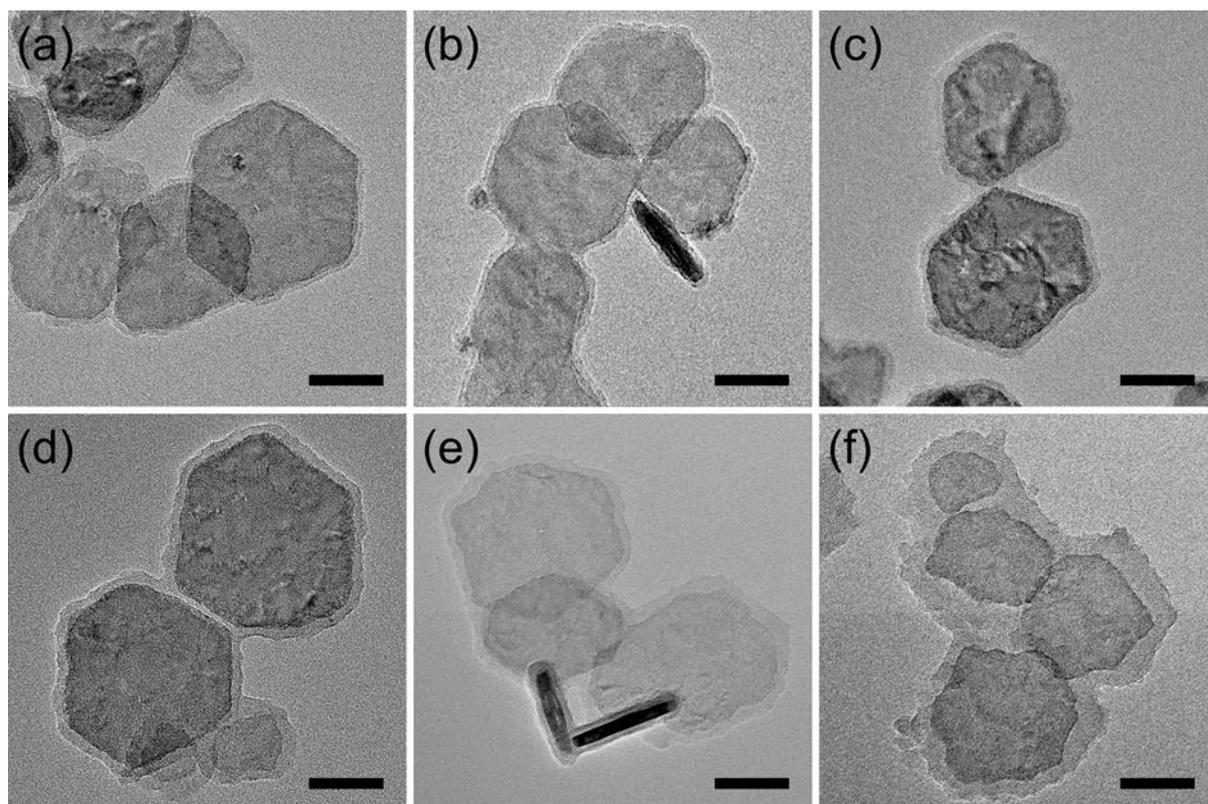
**Fig. S4** TEM image, SAED pattern, and corresponding EFTEM images of Co-Fe (oxy)hydroxide nanoplate.



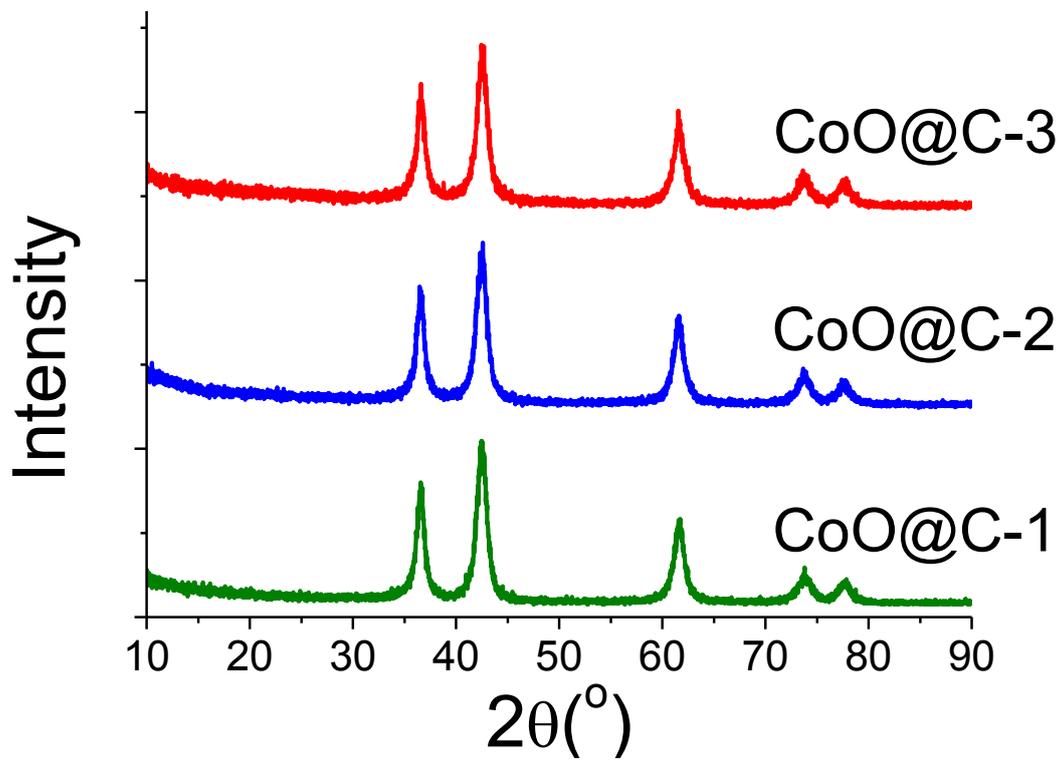
**Fig. S5** TEM image, SAED pattern, and corresponding EFTEM images of Co-Mg (oxy)hydroxide nanoplates



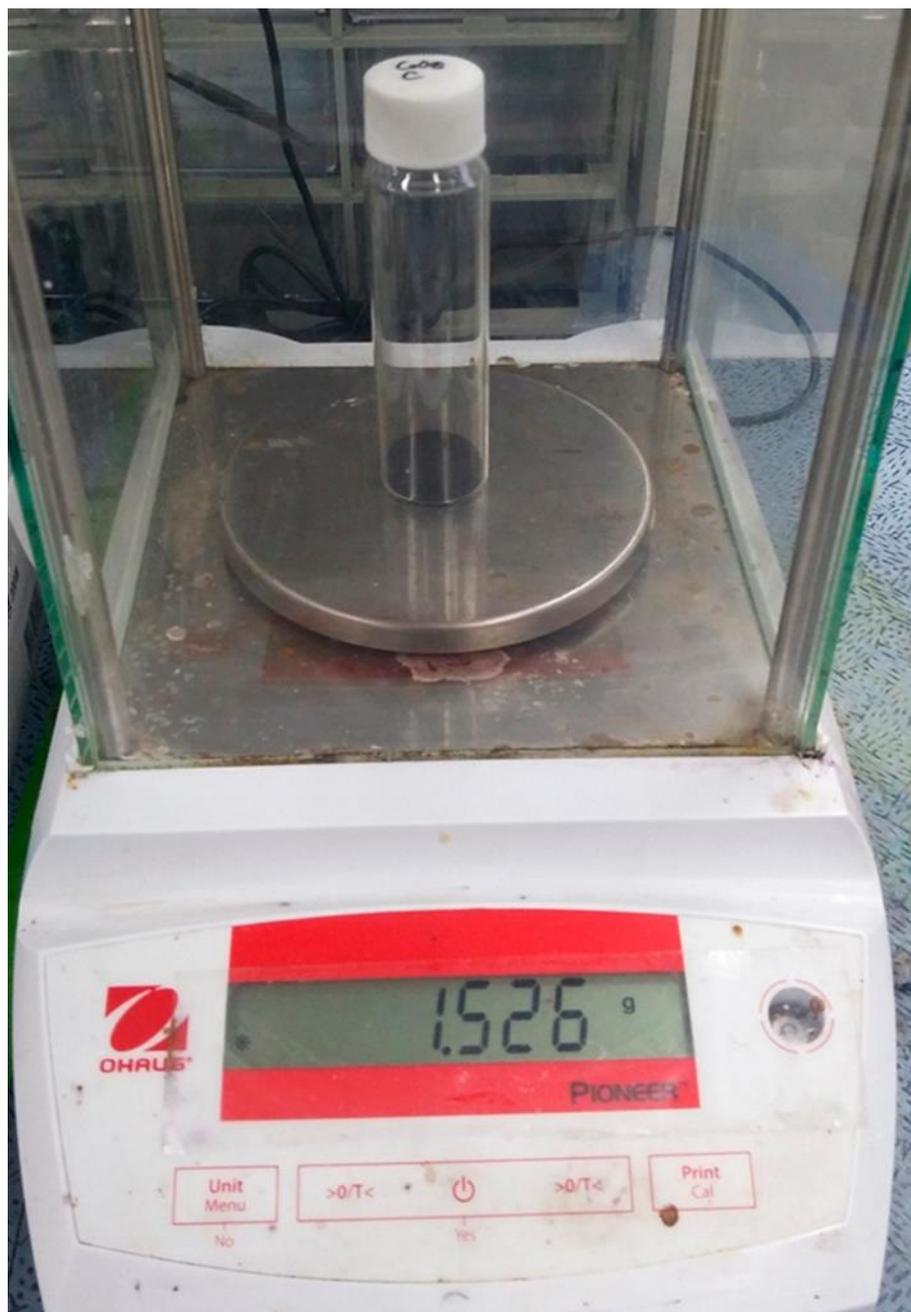
**Fig. S6** TEM image, SAED pattern, and corresponding EFTEM images of Mn-Fe-Mg (oxy)hydroxide nanoplate.



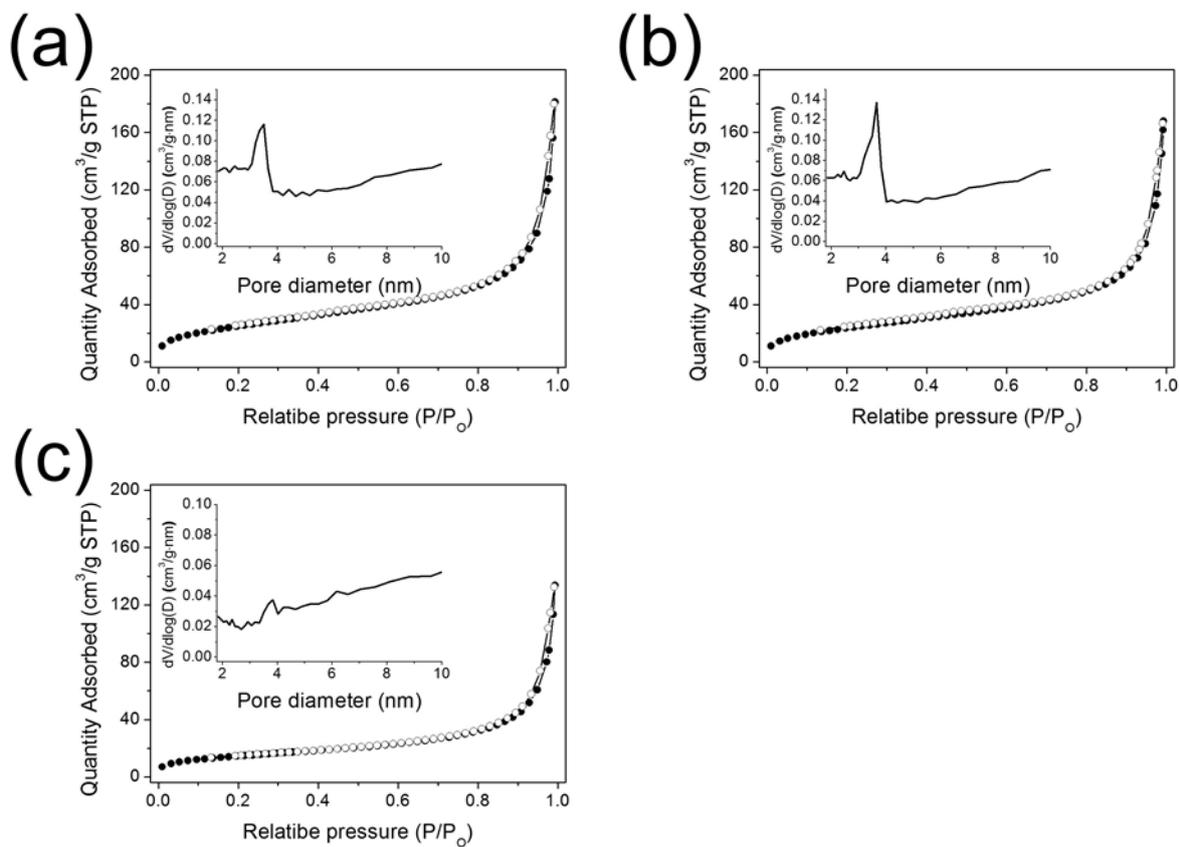
**Fig. S7** (a-f) TEM images of  $\text{Co(OH)}_2$ @polydopamine core-shell nanoplates with various thicknesses of the polydopamine shell. All scale bars are 50 nm.



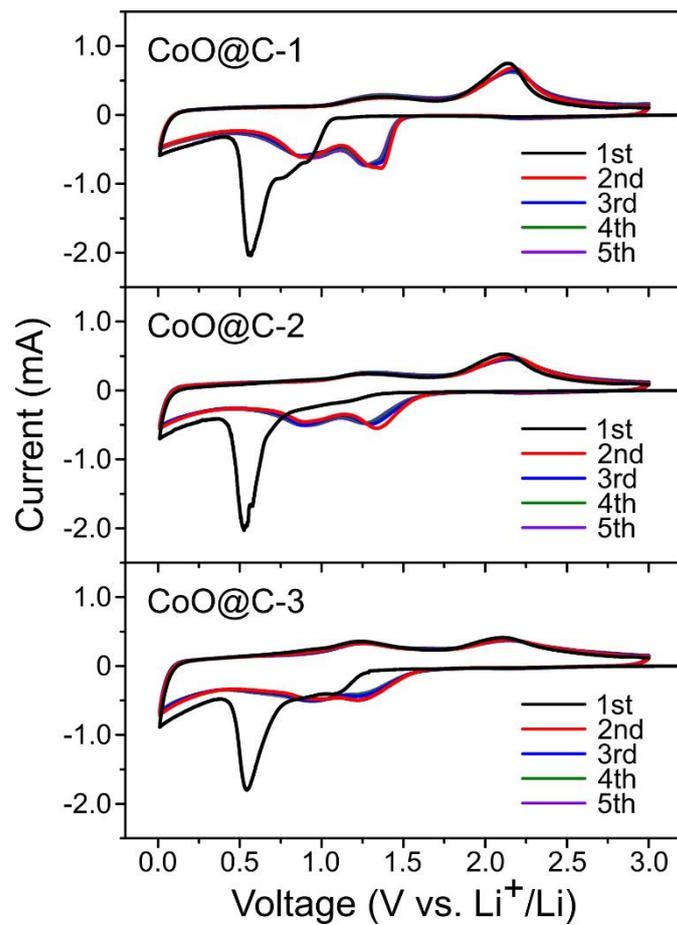
**Fig. S8** XRD patterns of CoO@C with various carbon shell thicknesses.



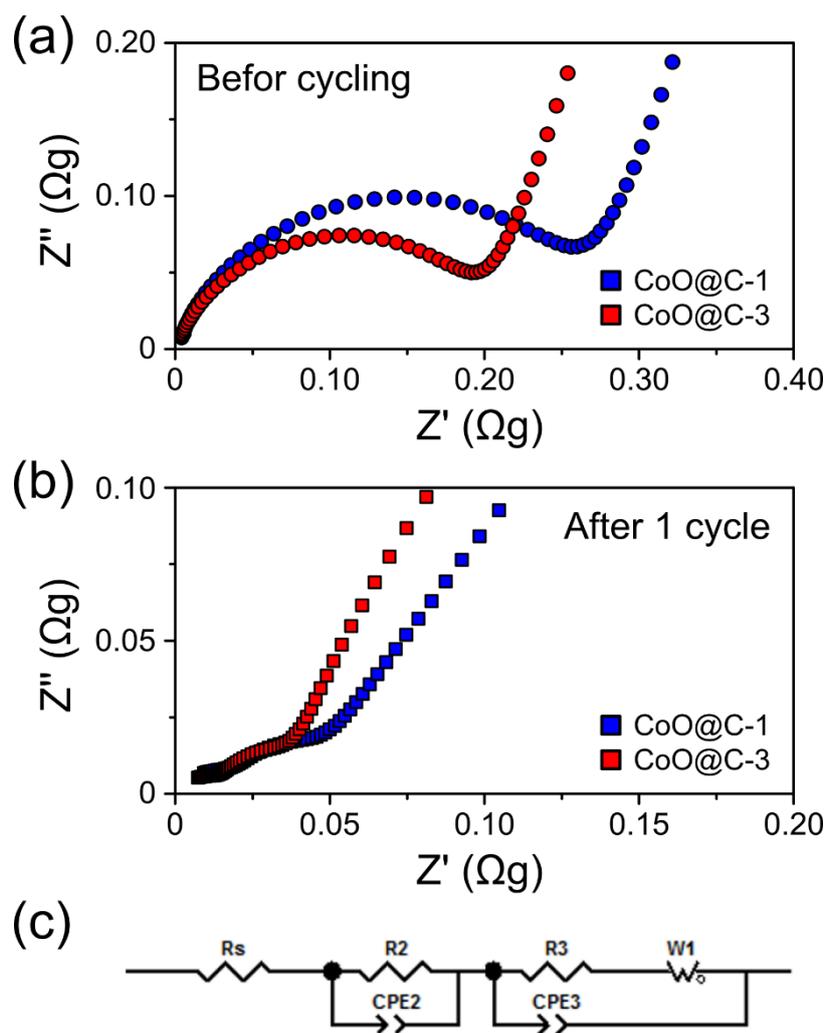
**Fig. S9** Large-scale synthesis of CoO@C-3. From a single batch, ~1.5 g of CoO@C was obtained.



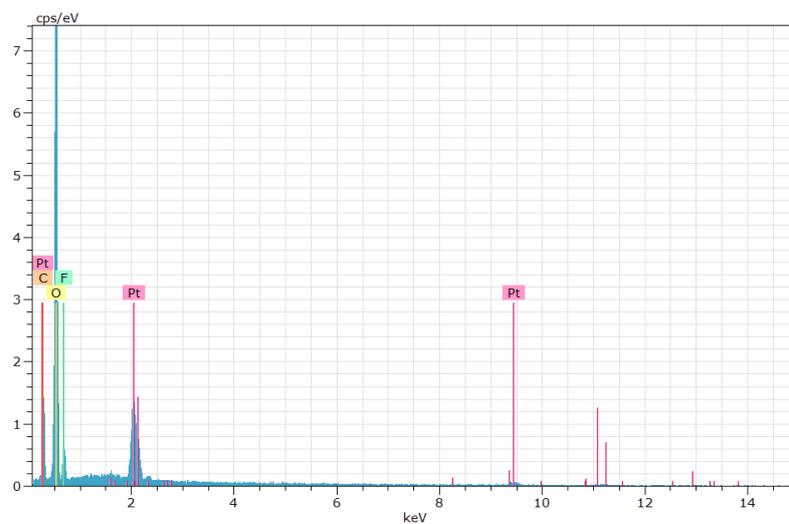
**Fig. S10**  $N_2$  adsorption and desorption isotherms and the corresponding pore size distribution of (a) CoO@C-1, (b) CoO@C-2, and (c) CoO@C-3.



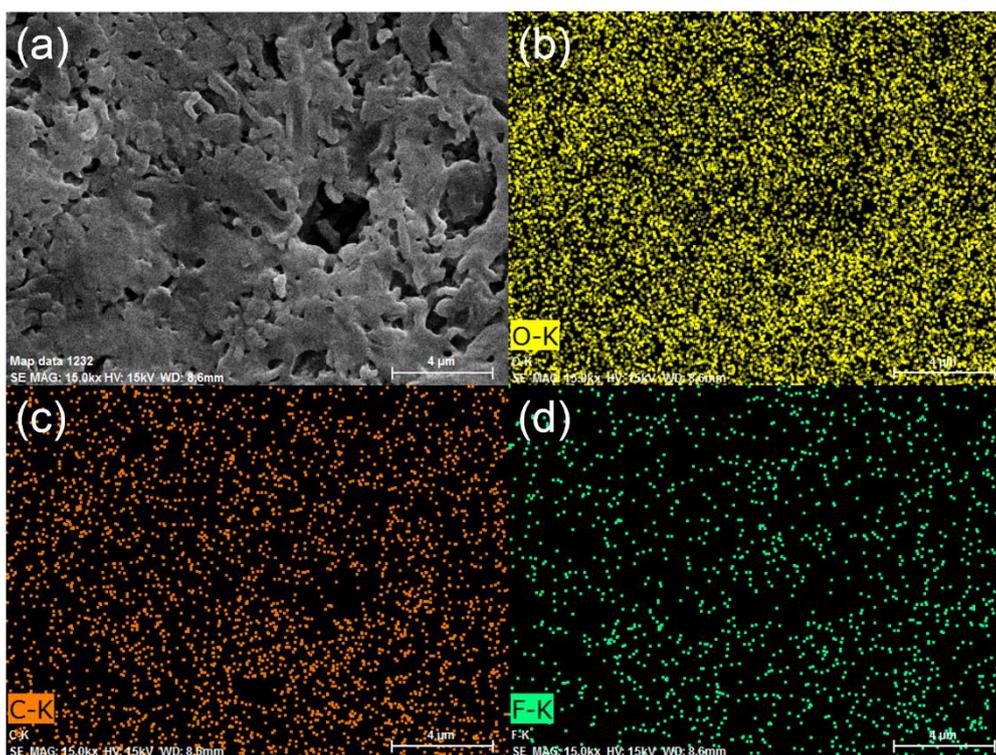
**Fig. S11** Cyclic voltammograms of CoO@C-1, CoO@C-2 and CoO@C-3 for the initial 5 cycles at a scan rate of 0.1 mV s<sup>-1</sup>.



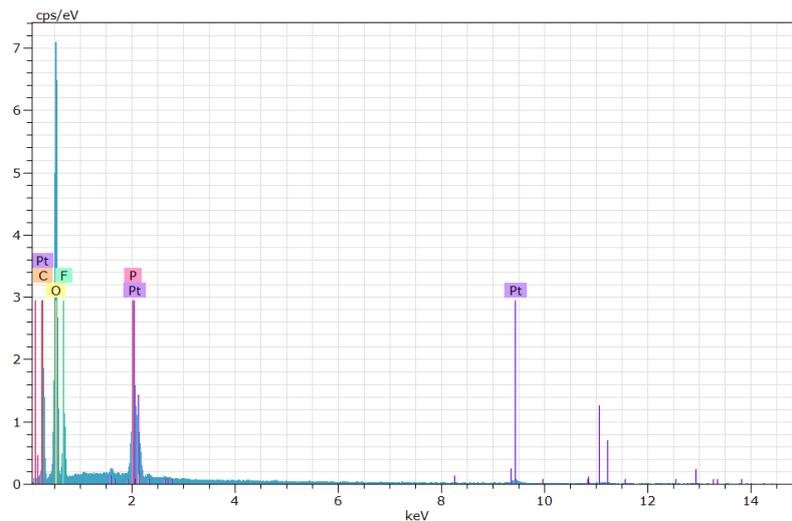
**Fig. S12** Impedance spectra of CoO@C-1 and CoO@C-3 (a) before cycling and (b) after 1 cycle. (c) The equivalent circuit for the fitting. The charge transfer resistance ( $R_{ct}$ ) of CoO@C-1 and CoO@C-3 before cycling are 0.248 and 0.192  $\Omega g$ , respectively. They significantly decreased after 1 cycle (0.045  $\Omega g$  for CoO@C-1 and 0.031  $\Omega g$  for CoO@C-3).



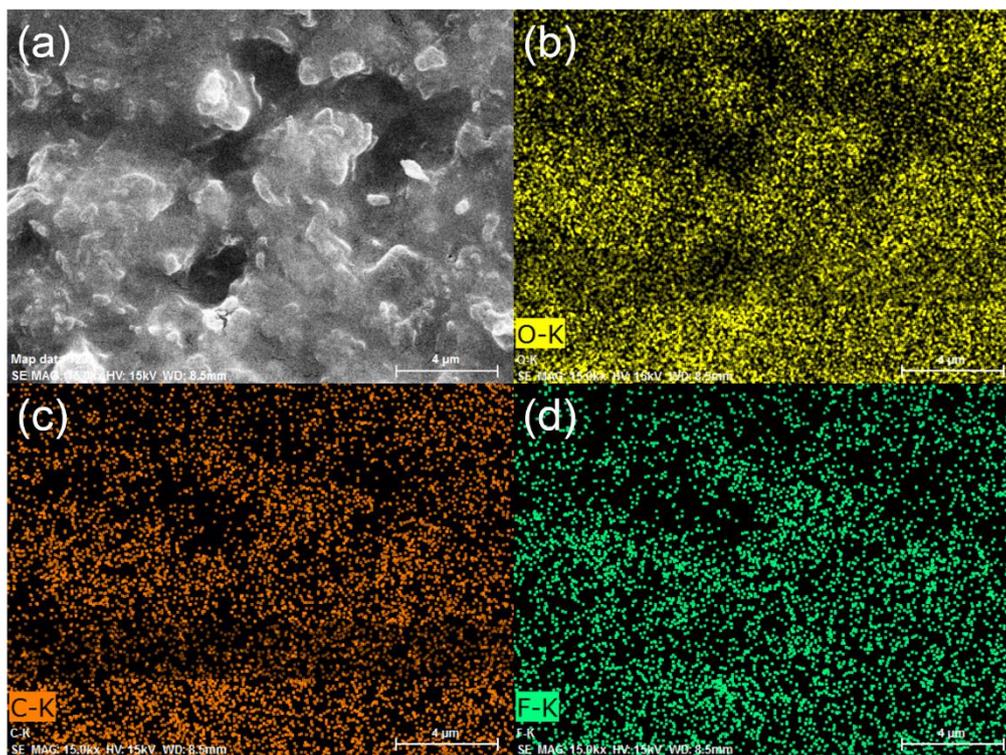
**Fig. S13** EDX spectrum of CoO@C-1/Li cell on the lithium electrode surface after 20 cycles.



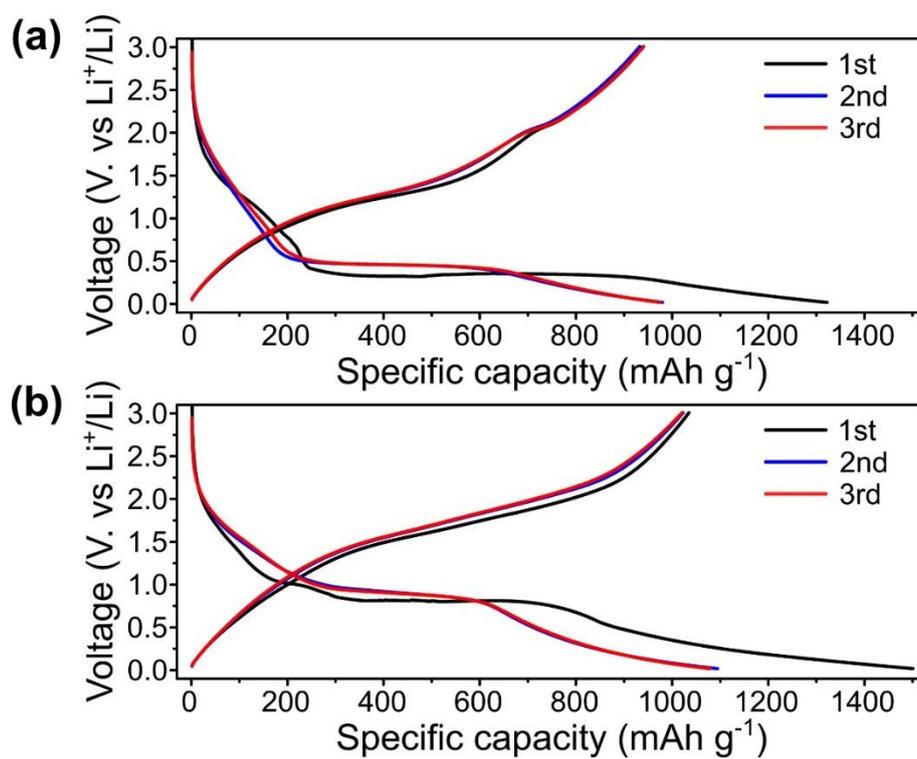
**Fig. S14** (a) SEM image and EDX maps of (b) O, (c) C and (d) Fe for CoO@C-1/Li cell on the lithium electrode surface after 20 cycles.



**Fig. S15** EDX spectrum of CoO@C-3/Li cell on the lithium electrode surface after 20 cycles.



**Fig. S16** (a) SEM image and EDX maps of (b) O, (c) C and (d) Fe for CoO@C-3/Li cell on the lithium electrode surface after 20 cycles.



**Fig. S17** Charge/discharge voltage profiles of (a) MnO@C, and (b) Fe<sub>3</sub>O<sub>4</sub>@C during the initial 3 cycles.

**Table S1.** CHN elemental analysis data for CoO@C.

	Carbon (wt%)	Hydrogen (wt%)	Nitrogen (wt%)	Total (wt%)
CoO@C-1	6.286	0.423	0.834	7.543
CoO@C-2	15.071	0.758	2.020	17.869
CoO@C-3	25.404	1.161	3.346	29.911

**Table S2.** Inductively coupled plasma (ICP) results of cobalt concentration in electrolyte after 20 cycles.

Samples	Cobalt concentration in electrolyte
Standard (blank)	0.008489
Standard (1)	0.248936
Standard (10)	2.20476
Standard (20)	4.21952
Standard (40)	8.43477
CoO@C-1	0 (ppm)
CoO@C-2	0 (ppm)
CoO@C-3	0 (ppm)

**Table S3.** EDX results of CoO@C-1/Li cell on the lithium electrode surface after 20 cycle test.

Element	Series	Concentration norm. (wt%)	Concentration atom. (at%)	Concentration error. (wt%)
Oxygen	K-series	52.62	57.07	17.80
Carbon	K-series	19.40	28.02	7.96
Fluorine	K-series	13.73	12.54	5.99
Platinum	M-series	11.90	1.06	1.38
Phosphorous	K-series	2.35	1.31	0.35

**Table S4.** EDX results of CoO@C-3/Li cell on the lithium electrode surface after 20 cycle test.

Element	Series	Concentration norm. (wt%)	Concentration atom. (at%)	Concentration error. (wt%)
Oxygen	K-series	63.56	69.81	25.81
Carbon	K-series	15.08	22.07	8.47
Fluorine	K-series	7.42	6.86	5.22
Platinum	M-series	13.94	1.26	1.87