

Electronic Supplementary Material (ESI) for Nanoscale.
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Supporting Information

Role of flower-like ultrathin Co₃O₄ nanosheets in water splitting and non-aqueous Li-O₂ batteries

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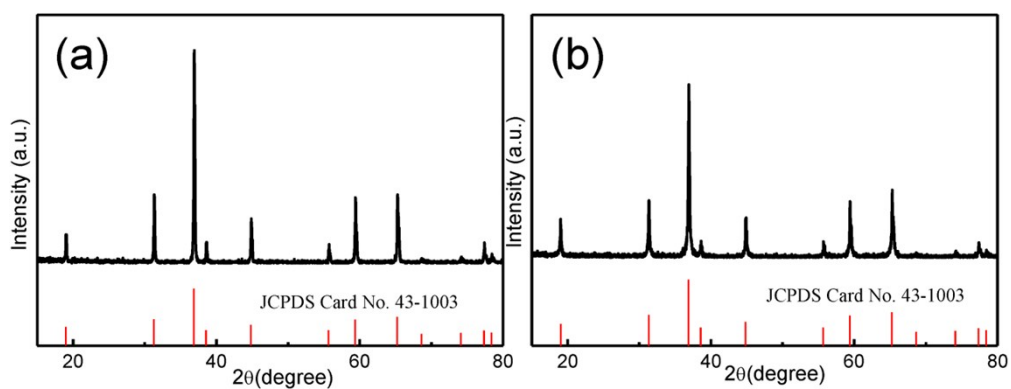


Fig. S1 XRD patterns of Co_3O_4 bulks (a) and Co_3O_4 nanoparticles (b).

Table S1. Pore parameters of Co_3O_4 based samples.

Sample	S_{BET} ($\text{m}^2 \text{g}^{-1}$) ^{a)}	V_{T} ($\text{cm}^3 \text{g}^{-1}$) ^{b)}
Co_3O_4 sheets	63.4	0.28
Co_3O_4 nanoparticles	33.9	0.19
Co_3O_4 bulks	8.2	0.05

^{a)} S_{BET} : calculated specific surface area; ^{b)} V_{T} : pore volume.

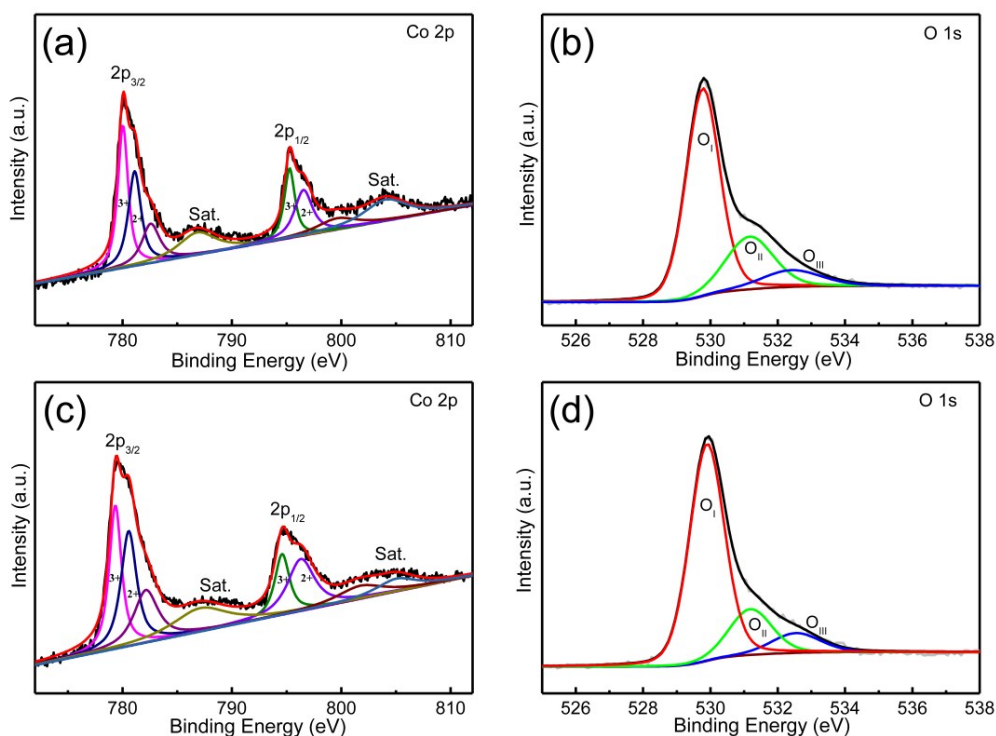


Fig. S2 (a) XPS spectra of Co 2p for Co_3O_4 nanoparticles, (b) XPS spectra of O 1s for Co_3O_4 nanoparticles, (c) XPS spectra of Co 2p for Co_3O_4 bulks, and (d) XPS spectra of O 1s for Co_3O_4 bulks.

Table S2. The analysis of the Co 2p and O 1s XPS spectra.

Catalyst	Co^{3+} peak area (%)	Co^{2+} peak area (%)	$\text{Co}^{3+}/\text{Co}^{2+}$	O_{II} peak area (%)
Co_3O_4 nanosheets	58.1	41.9	1.39	34.0
Co_3O_4 nanoparticles	52.1	47.9	1.09	24.0
Co_3O_4 bulks	45.4	54.6	0.83	18.7

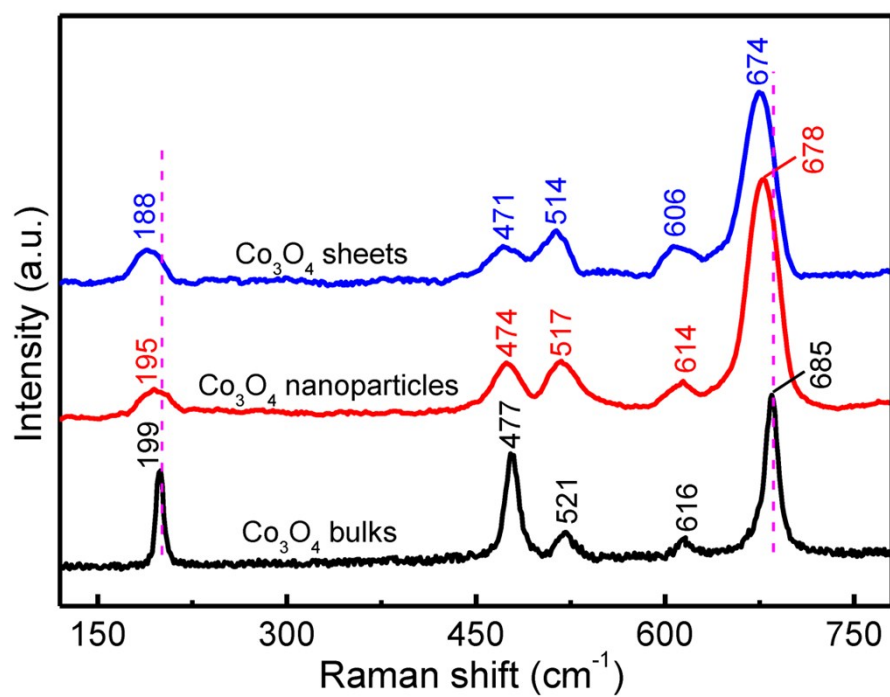


Fig. S3 Raman spectroscopy of Co_3O_4 bulks, Co_3O_4 nanoparticles, and Co_3O_4 nanosheets.

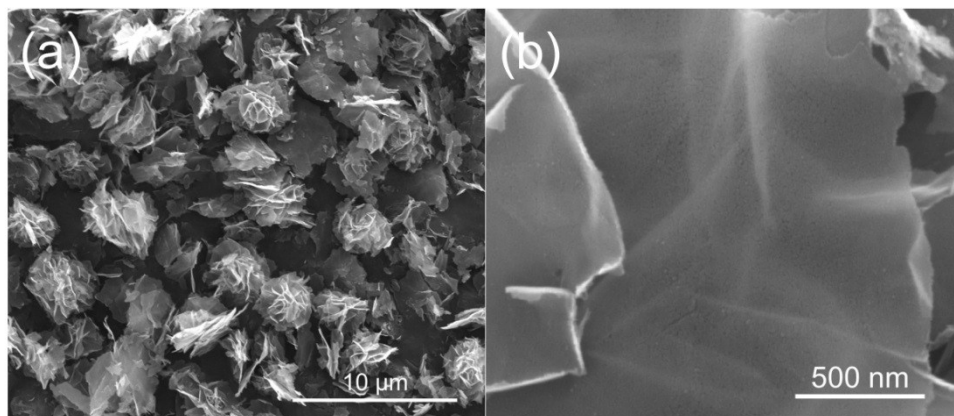


Fig. S4 Low (a) and high (b) magnification SEM images of the Co_3O_4 nanosheets.

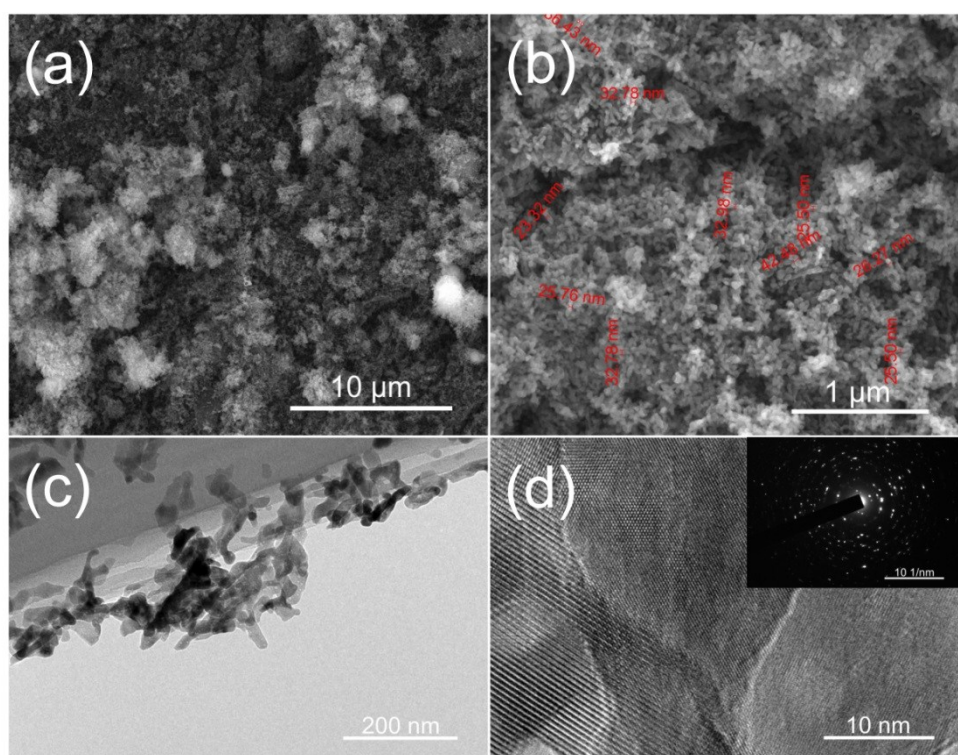


Fig. S5 Low (a) and high (b) magnification SEM images, TEM micrograph (c), and HR-TEM micrograph (d) and SAED pattern (inset) of the Co_3O_4 nanoparticles.

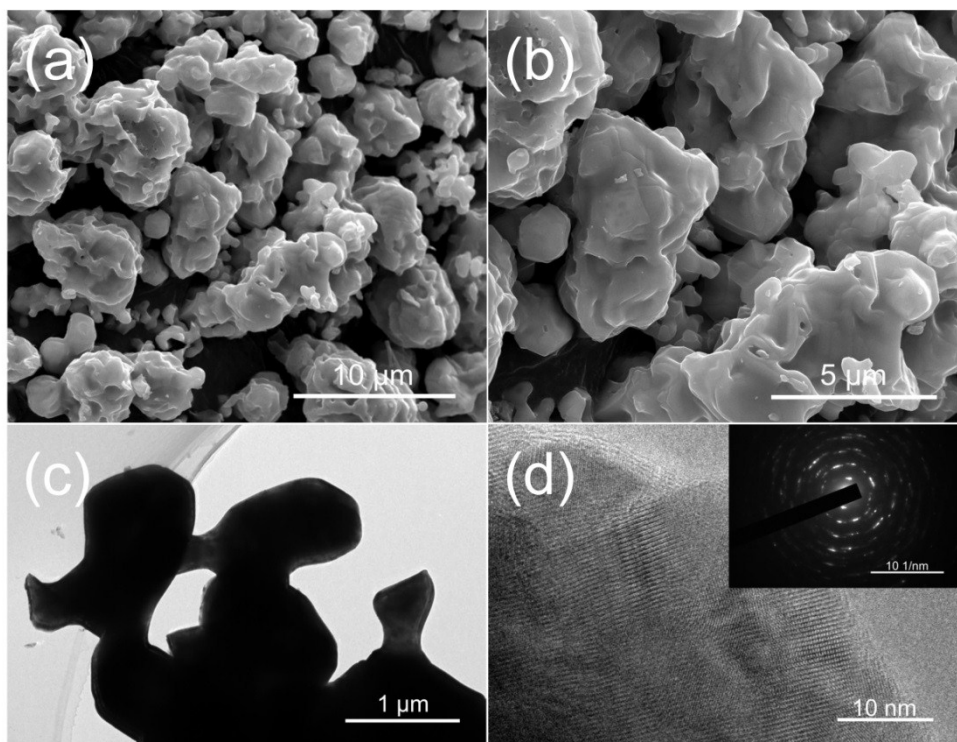


Fig. S6 Low (a) and high (b) magnification SEM images, TEM micrograph (c), HR-TEM micrograph (d), and SAED pattern (inset) of the Co_3O_4 bulks.

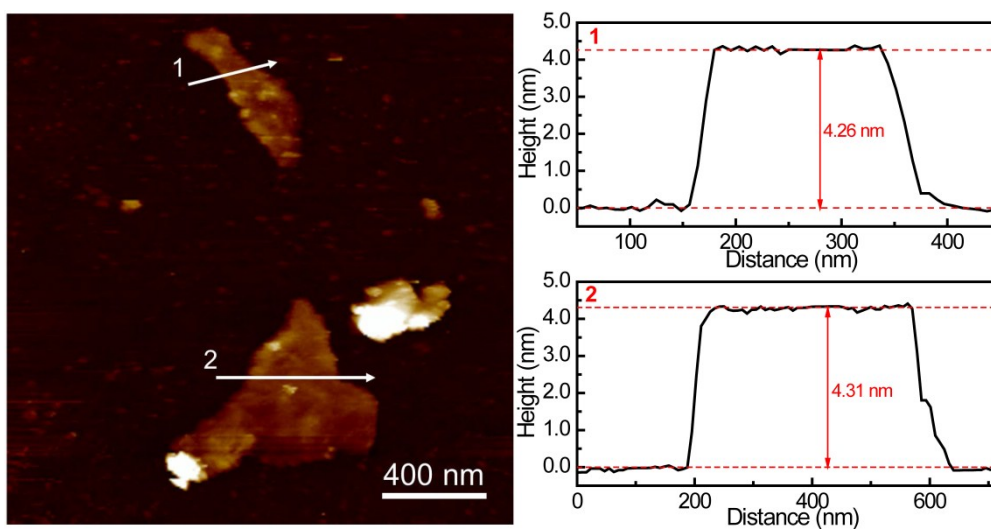


Fig. S7 (a) AFM image and (b) the corresponding height profiles for ultrathin Co_3O_4 nanosheets with an average thickness of 4.3 nm.

Table S3. Comparison of the CV, ORR, and OER of the Co₃O₄ sheets, Co₃O₄ nanoparticles, Co₃O₄ bulks, commercial Pt/C, and RuO₂ catalysts.

Catalyst	CV		ORR		OER	
	E _{peak} (V)	I _{peak} (mA cm ⁻²)	E _{onset} (V)	I _{limiting} (mA cm ⁻²)	E _{half-wave} (V)	I _{max} (mA cm ⁻²)
Pt/C	-	-	0.021	-5.50	-	-
Co ₃ O ₄ sheets	-0.199	-0.48	-0.046	-5.12	0.843	21.32
Co ₃ O ₄ nanoparticles	-0.236	-0.45	-0.095	-4.60	0.926	14.49
Co ₃ O ₄ bulks	-0.244	-0.39	-0.16	-3.80	0.971	11.67
RuO ₂	-	-	-	-	0.807	21.70

E_{onset} (V) at I=-0.07 mA cm⁻²

I_{limiting} at E=-0.8 V

I_{max} at E=1.0 V

E_{half-wave} (V) at I=10 mA cm⁻²

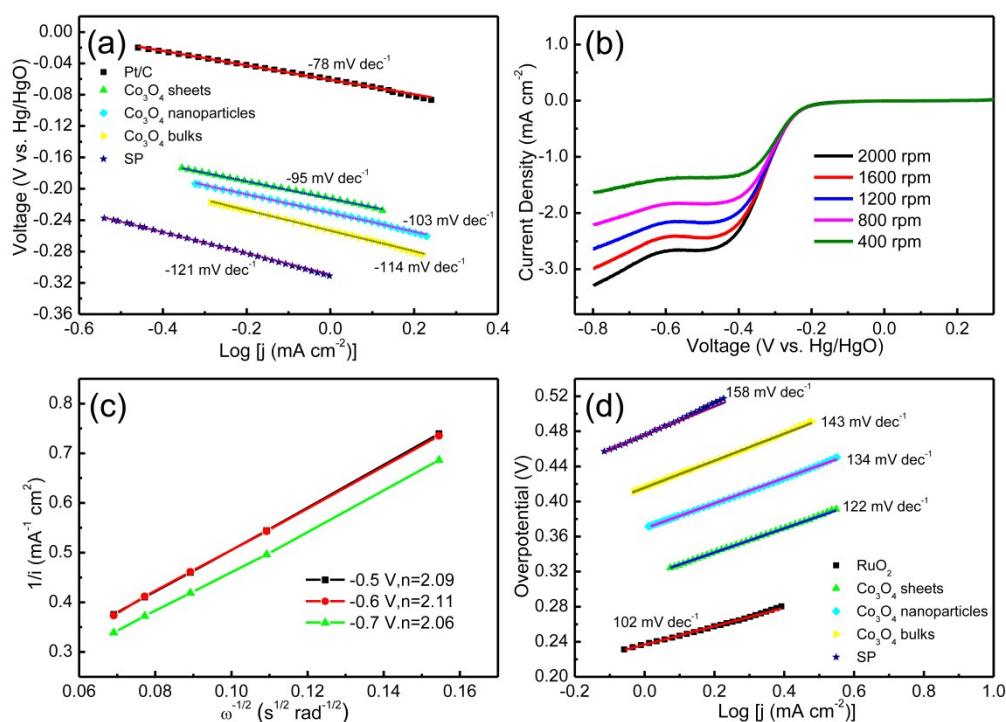


Fig. S8 (a) ORR Tafel plots. (b) Rotating-disk voltammograms of the pure Super P (SP) at different rotating speeds and (c) the corresponding K-L plots. (d) OER Tafel plots.

Table S4. Comparison of the Tafel slope and TOF for the different catalysts.

catalyst	ORR Tafel slope	OER Tafel slope	TOF at $\eta = 0.450$ V
	(mV dec ⁻¹)	(mV dec ⁻¹)	(s ⁻¹)
Pt/C	-78	-	-
Co ₃ O ₄ sheets	-95	122	0.0246
Co ₃ O ₄ nanoparticles	-103	134	0.0135
Co ₃ O ₄ bulks	-114	143	0.0081
SP	-121	158	0.0035
RuO ₂ catalysts	-	102	0.0323

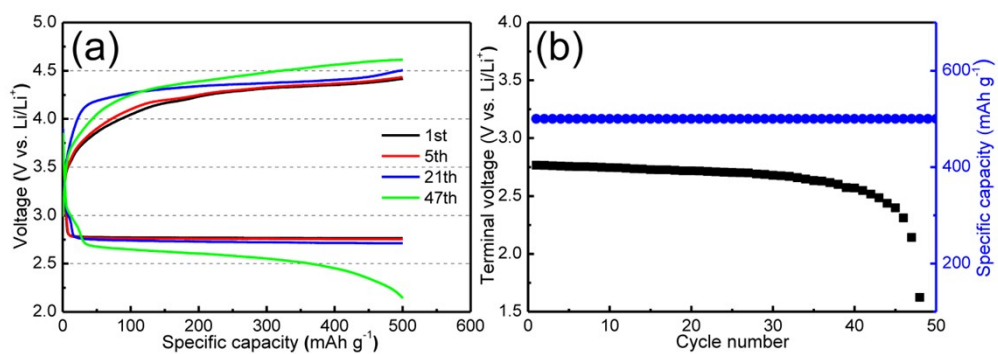


Fig. S9 (a) Cyclic performance of the Li-O₂ cell with pure Super P-based electrodes at 500 mA g⁻¹. (b) Corresponding voltage of the terminal discharge vs. the cycle number.

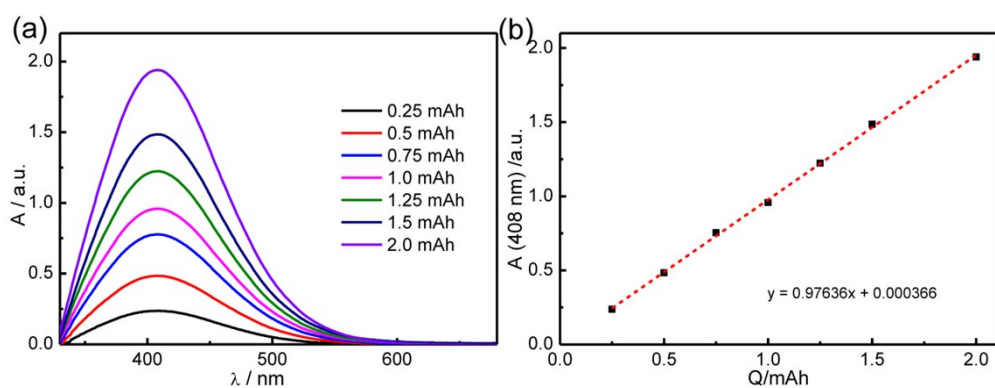


Fig. S10 The extinction of the TiOSO_4 solutions for used Li_2O_2 , corresponding different theoretical discharge capacities ranging from 0.25 mAh to 2.0 mAh. (b) Lambert-Beer type data presentation of the maximum extinction normalized to the amount of used Li_2O_2 in a certain amount of TiOSO_4 solution (in cm^3). The red dashed line results from a linear fit to the data points.

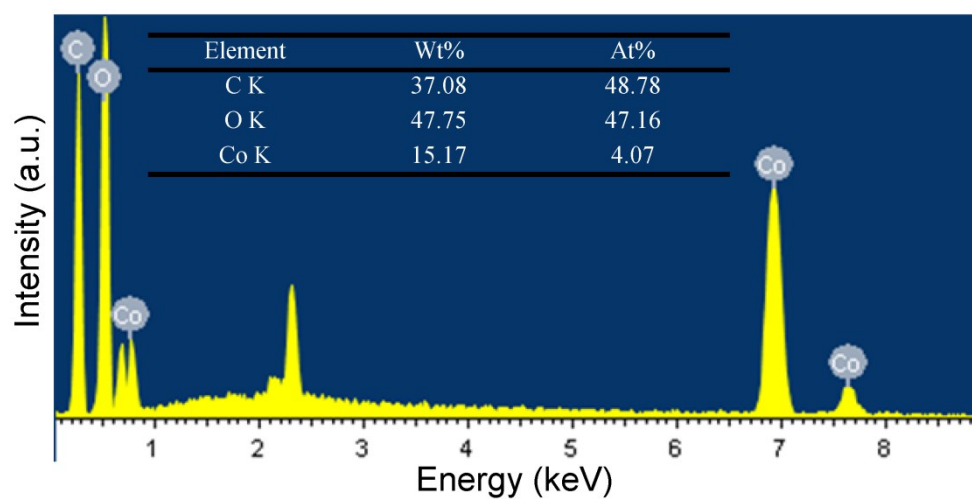


Fig. S11 EDS survey spectra and the corresponding atomic/mass percentage of discharge products on a Co_3O_4 nanosheet-based cathode (inset).