Electronic Supplementary Material (ESI) for ChemComm.

Supporting information

High-performance $ZnCo_2O_4$microsheets as anode for lithium-ion batteries

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Experimental Section

Preparation of Zn-Co-MOFs

$Co(CH_2COO)_2 \cdot 4H_2O$ (2 mmol), $Zn(CH_2COO)_2 \cdot 2H_2O$ (1 mmol), $C_2H_4O_2$ (1 mmol) and pyrazole-3,5-dicarboxylic acid hydrate (2 mmol) were dissolved under stirring in 20 g deionized water to attain a turbid purple solution. Next, the solution was put into 100 mL Teflon-lined autoclave and reacted at 200°C for 48 h. After cooling to room temperature, the sample was collected by filtration and drying to obtain the Zn-Co-MOFs.

Preparation of $ZnCo_2O_4$

The mesoporous $ZnCo_2O_4$ was obtained by calcining Zn-Co-MOFs. In brief, Zn-Co-MOFs precursor was dispersed in a crucible and then calcined in air at 500 °C, 600 °C and 700 °C for 3 h to generate a black powder, respectively. Finally, the samples obtained were named $ZnCo_2O_4$-500, $ZnCo_2O_4$-600 and $ZnCo_2O_4$-700, respectively.

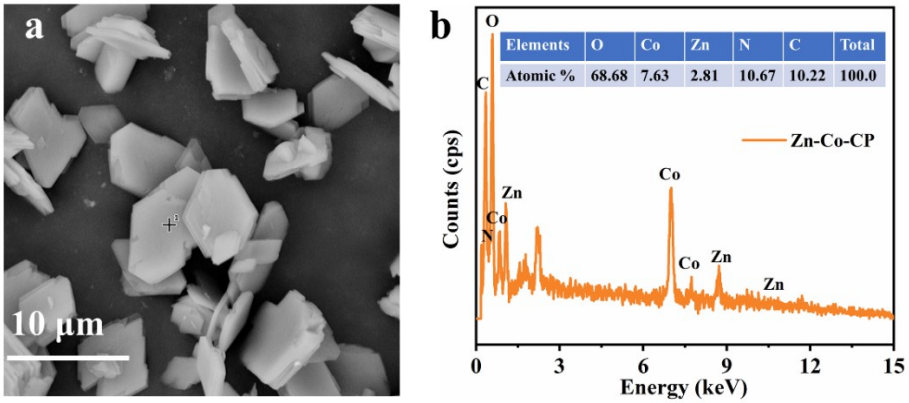
Material characterization

The morphology and elemental contentof obtained samples were observedby scanning electron microscopy (SEM, Phenom proX) withenergy dispersive spectrometer (EDS). The microscopic morphology and structure $ZnCo_2O_4$-600 was determined with transmission electron microscopy (TEM, Bruker Nano GmbH Berlin) and high-resolution electron microscopy (HRTEM). Powder X-ray diffraction (XRD) patterns of obtained samples were collected by a MiniFlex600 diffractometer to analyze the composition of the phase. X-ray photoelectron spectroscopy (XPS) was used to determine the chemical valence states of obtained samples by a scanning X-ray microprobe (Thermo SCIENTIFIC ESCALAB 250Xi). Nitrogen adsorption-desorption isotherms were obtained by an automated volumetric adsorption analyzer (Beijing JWGB Tech., JW-BK122W), and the specific surface area (SSA) was calculated by the Brunauer-Emmett-Teller (BET) method.

Electrochemical tests

The electrochemical performance of $ZnCo_2O_4$ anodes was evaluated by CR2032 half cells. The synthesized sample, conductive carbon black and polyvinylidene

fluoride(PVDF) binder were mixed in NMP solvent at a mass ratio of 7:2:1, and the resulting mixture was magnetized to form a uniform slurry.The slurry was coated on the copper foil and then vacuum dried at 80 ^{o}C for 10 h to remove the solvent. The weight of the active material and the geometric area of the electrode used in this study are about 1.4 mg and 1.13 cm^2, respectively. $LiPF_6$ dissolved in ethylene carbonate (EC)/dimethyl carbonate (DMC)/diethyl carbonate (DEC) (EC/DMC/DEC 1:1:1 v/v) was used as the electrolyte. Meanwhile, lithium metal and Celgard 2400 film were used as the counter electrode and separator, respectively. A battery testing system (LAND CT2001, Wuhan) was used to test the galvanostatic charge and discharge (GCD) of electrode materials at 0.01-3.0 V. An electrochemical workstation (CHI660E, Shanghai Chenhua) was used to test cyclic voltammetry (CV) curves from 0.01 to 3.00 V with 0.1 mV/s and electrochemical impedance spectroscopy (EIS) in the frequency range from 0.01 Hz to 100 KHz.



Elements	O	Co	Zn	N	C	Total
Atomic %	68.68	7.63	2.81	10.67	10.22	100.0

Fig. S1 (a) SEM and (b) EDS images of Zn-Co-MOFs.

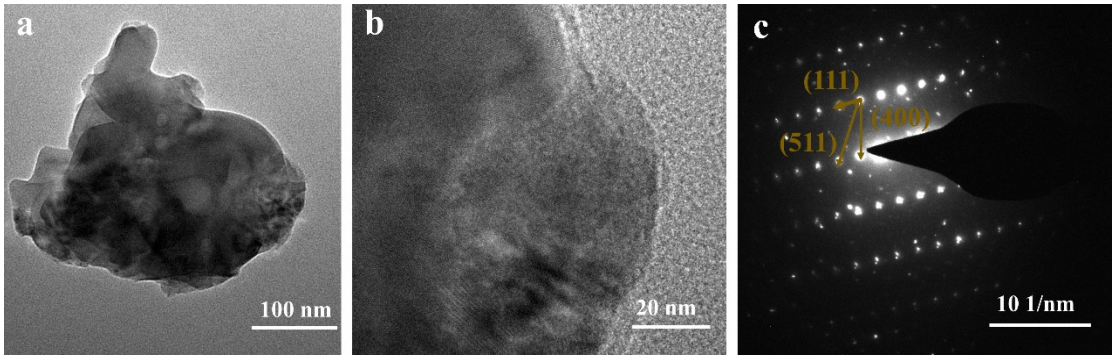


Fig. S2 (a) TEM, (b) HRTEM and (c) SAED patterns of $ZnCo_2O_4$-600.

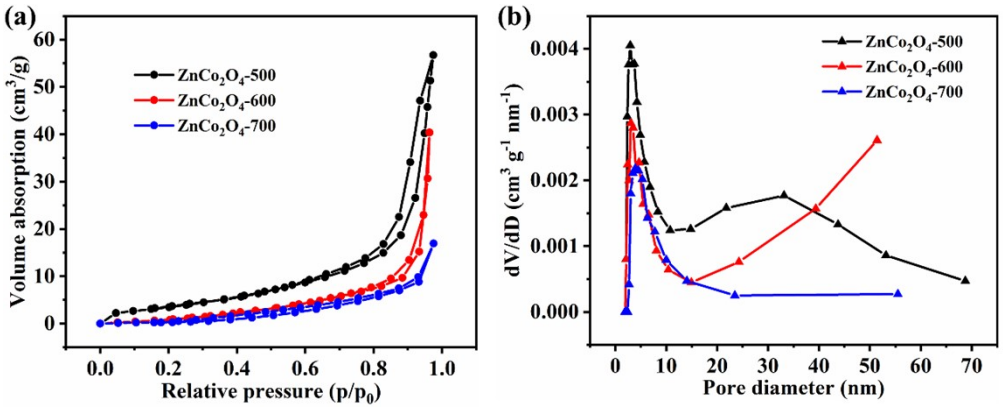


Fig. S3 (a) Nitrogen adsorption-desorption isotherm plots and (b) pore size distribution curves of three samples.

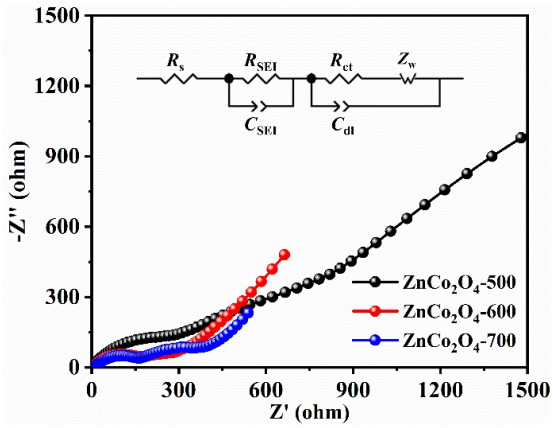


Fig. S4 EIS curves of as-obtained samples after 100 cycles and the equivalent circuit diagram of the cells.

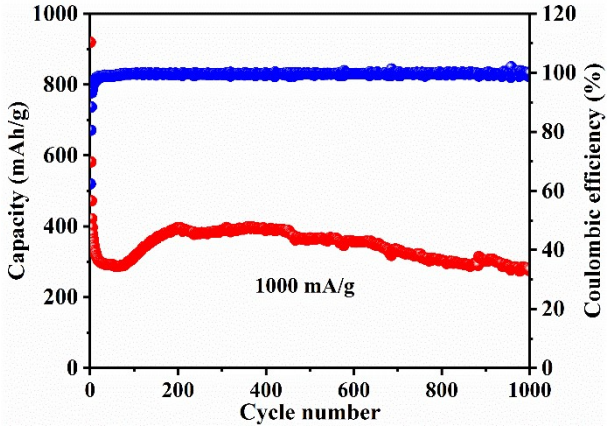


Fig. S5Cycling performance of $ZnCo_2O_4$-600 at 1000 mA/g.

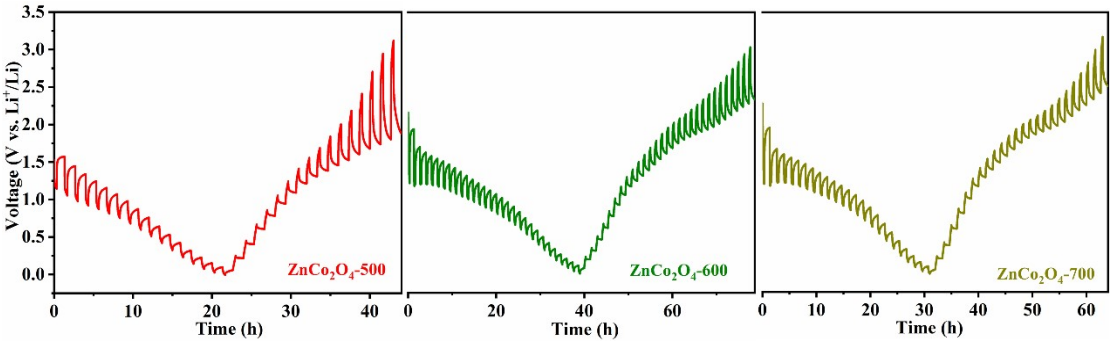


Fig. S6GITT curves of obtained three electrodes.

Table S1. Comparison of the electrochemical properties of $ZnCo_2O_4$ based anodes for LIBs.

Samples	Current density (mA/g)	Cycles	Capacity (mAh/g)	Refs.
3D $ZnCo_2O_4$nanocubes	500	100	775	S1
$ZnCo_2O_4$	100	100	382	S2
$ZnCo_2O_4$/Co_3O_4/CC	300	100	481.9	S3
$ZnCo_2O_4$nanosheets	250	500	773	S4
$ZnCo_2O_4$ nanospheres	100	50	625	S5
$ZnCo_2O_4$microsheets	100	100	816.2	This work

References

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