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Supporting Information for

3D Hierarchical Porous $ZnO/ZnCo_2O_4$ Nanosheets as High-Rate Anode Material for Lithium-Ion Batteries

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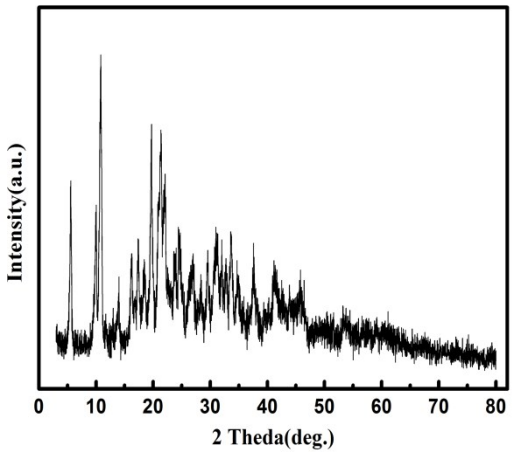

Fig. S1 XRD for the Zn-Co-MOF precursor.

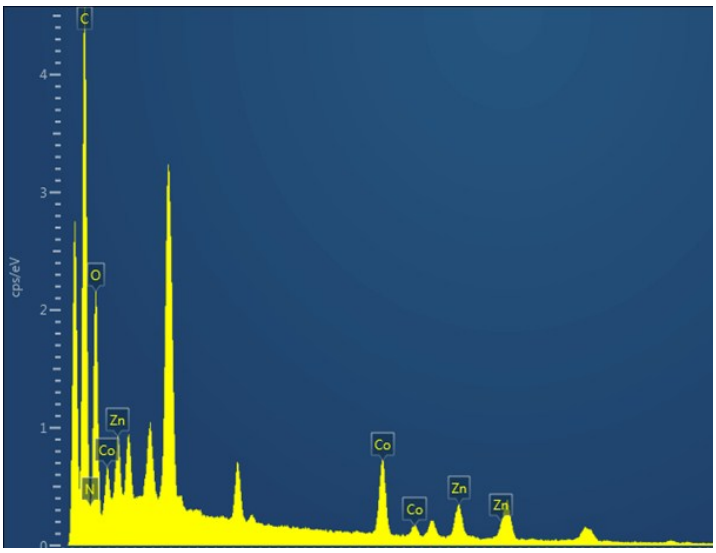

Fig. S2 EDS spectrum of the Zn-Co-MOF precursor.

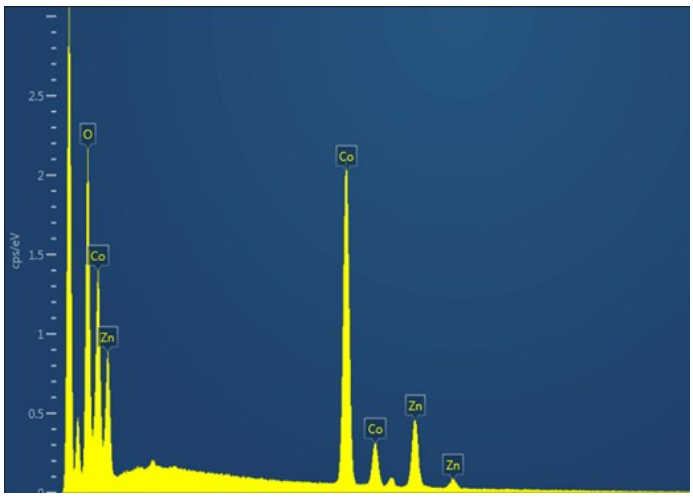

Fig. S3 EDS spectrum of the ZCO nanoparticles.

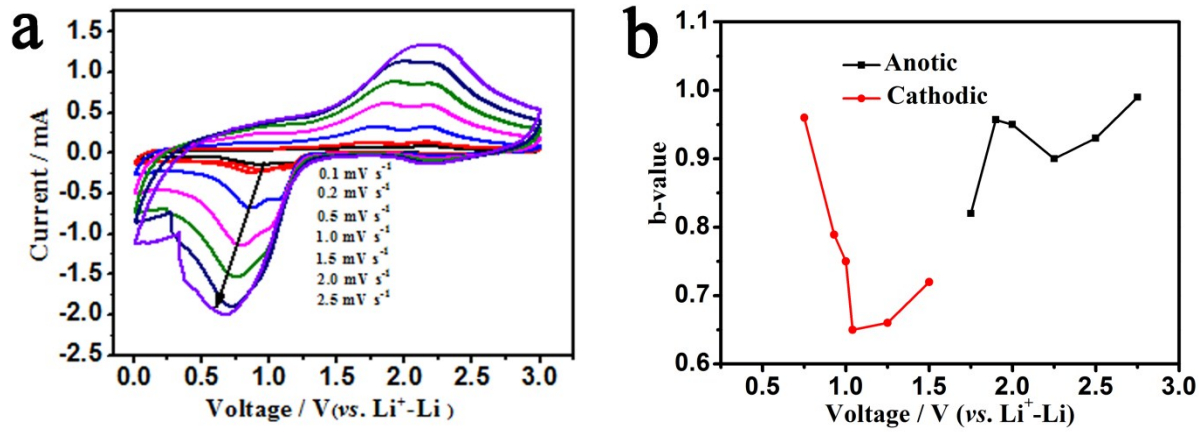

Fig. S4 (a) Typical CV curves at various sweep rates and (b) calculated b-values as a function of voltage for cathodic and anodic sweeps for the hierarchical ZZCO electrode.

In order to understand the origin of the extra capacity, we performed CV measurements at various scan rates from 0.1 to 2.5 mV s^{-1} in the Fig. S4a. Initially, the total capacity of an electrode with the conversion mechanism can be separated into three parts: the capacity caused by the conversion reaction, the faradaic contribution from the charge transfer with surface atoms, and the nonfaradaic contribution from the double-layer effect. The latter two parts cannot be separated and are usually characterized by analyzing the relationship between the measured current (i) and the scan rate (v) from the cyclic voltammetry (CV) data[1, 2].The equations are listed as follows:

$$i(V) = av^b \quad (1)$$

$$\lg i(V) = b \lg v + \lg a \quad (2)$$

In the equations, the measured current i obeys a power low relationship with the sweep rate v, a and b are the adjustable parameters. The b values can be determined from the slope of the plots of log i versus log v, according to Equation (2). As reported by previous works,[3] the electrode is controlled by the diffusion process when the b-value is 0.5, while a capacitive response is dominant when the b-value is 1.0. The CV curves at various sweep rates and the

calculated b-values for the hierarchical ZZCO nanosheet electrode are shown in Fig. S4 a,b. At the potential of 1.04 and 1.25 for the cathodic process, the b values are 0.65 and 0.66, close to the 0.5, which indicates that the charge transfer mainly comes from the conversion reaction. At the lower or higher potentials, the b-values are within the limits of 0.75-1.0. This indicates that a part of capacity comes from pesudocapacitive effects. During the anodic process, the b -values are in the range of 0.80–0.98, which suggests that the pseudocapacitance and conversion reaction both contribute to the capacity. Thus, pesudocapacitance plays an important role in the total capacity.

Table S1 ICP-AES results of the hierarchical porous ZZCO nanosheets.

Sample	Zn/Co（molar ratio）	ZnO Wt (%)
ZZCO	1.09	23%

Table S2 The cycling performance of other ZZCO or ZCO-based anode materials in lithium-ion batteries.

Active material	Current density mA g^{-1}	Reversible capacity (Nth) mA h g^{-1}	Active material loading mg cm^{-2}	Ref.
ZnO-$ZnCo_2O_4$ microspheres	200	1199 (200)	1.0	4
ZnO nanosheet-$ZnCo_2O_4$ nanorod	45	900(30)	--	5
$ZnCo_2O_4$ microsphere	900	856(1000)	--	6
$ZnCo_2O_4$ nanowire-like	500	1089(50)	--	7
$ZnCo_2O_4$ microphere	400	835(50)	--	8
$ZnCo_2O_4$ microphere	100	721(80)	1.0	9
ZnO-$ZnCo_2O_4$/C core-shell structure	500	699(250)	--	10
ZnO-$ZnCo_2O_4$ nanosheet	**2000**	**1016(250)**	**0.76**	**This work**

Supplementary References

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