

*Supporting information for*

**Hydrothermal synthesis of Co<sub>3</sub>O<sub>4</sub> with different morphologies towards efficient Li-ion storage**

Lingling Jin,<sup>ab</sup> Xiaowei Li,<sup>\*a</sup> Hai Ming,<sup>ab</sup> Haohe Wang,<sup>ab</sup> Zhenyong Jia,<sup>ab</sup> Yu Fu,<sup>ab</sup> Jason Adkins,<sup>a</sup> Qun Zhou<sup>b</sup> and Junwei Zheng.<sup>\*ab</sup>

<sup>a</sup> Institute of Chemical Power Sources, Soochow University, Suzhou 215006 (P. R. China).  
E-mail: jwzheng@suda.edu.cn; lixiaowei@suda.edu.cn.

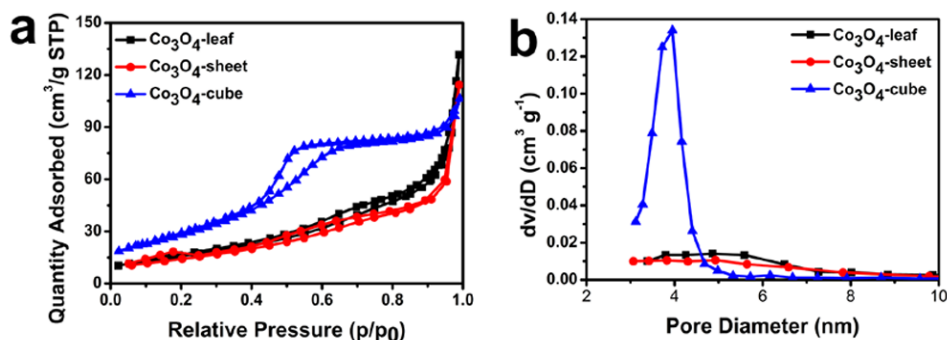
<sup>b</sup> College of Chemistry, Chemical Engineering and Materials Science, Soochow University, Suzhou 215123, PR China;

Based on our experimental results, the mechanism of the Co<sub>3</sub>O<sub>4</sub> growth was proposed as follows:

For leaf samples: Firstly, the Co(Ac)<sub>2</sub> reacted with NH<sub>3</sub>·H<sub>2</sub>O forming α-Co(OH)<sub>2</sub>. Secondly, the CO(NH<sub>2</sub>)<sub>2</sub> began to decompose into NH<sub>4</sub><sup>+</sup> and CO<sub>3</sub><sup>2-</sup> (reaction 1) or NH<sub>3</sub>·H<sub>2</sub>O and CO<sub>2</sub> (reaction 2), and the reaction (2) is the main reaction. Thirdly, part of the α-Co(OH)<sub>2</sub> transform to CoCO<sub>3</sub> after reacting with CO<sub>3</sub><sup>2-</sup>. The precursor before therm calcination is the mixture of 2CoCO<sub>3</sub>·3Co(OH)<sub>2</sub>·H<sub>2</sub>O and Co<sub>3</sub>O<sub>4</sub> (partly decomposition product of CoCO<sub>3</sub>·Co(OH)<sub>2</sub>).

For sheet samples: Firstly, the Co(Ac)<sub>2</sub> reacted with NH<sub>3</sub>·H<sub>2</sub>O forming α-Co(OH)<sub>2</sub>. Secondly, α-Co(OH)<sub>2</sub> was oxidized into CoOOH. Thirdly, a part of CoOOH converted to Co<sub>3</sub>O<sub>4</sub> by high temperature and pressure. The final precursor is the mixture of CoOOH and Co<sub>3</sub>O<sub>4</sub>.

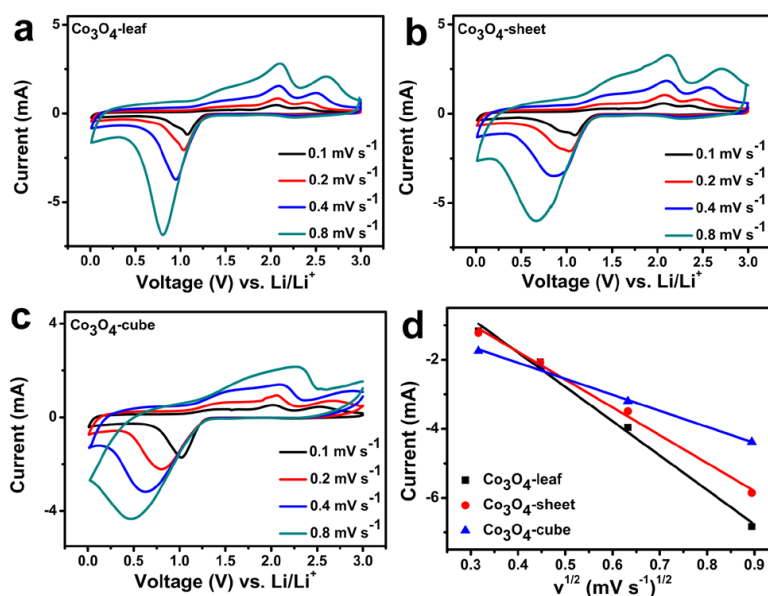
The preparing procedure of cube samples is similar to leaf samples with only the amount of adding ammonia being different. Therefore, the reaction (1) is the main reaction, and all the α-Co(OH)<sub>2</sub> converted into the CoCO<sub>3</sub>. The final precursor is the CoCO<sub>3</sub> and Co<sub>3</sub>O<sub>4</sub> (partly decomposition product of CoCO<sub>3</sub>).



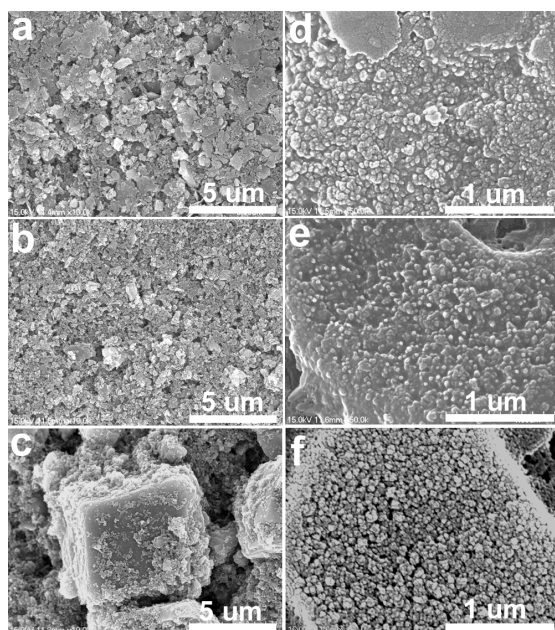
**Fig. S1** (a) The  $N_2$  adsorption/desorption isotherm loop and (b) BJH the pore size distribution plots of the different morphologies of the  $Co_3O_4$ .

**Table S1** The average parameters of the surface area and pore diameter with different morphologies

Morphology	Surface Area ( $m^2 g^{-1}$ )	Pore Diameter (nm)
$Co_3O_4$ -leaf	59.443	4.863
$Co_3O_4$ -sheet	53.067	4.932
$Co_3O_4$ -cube	107.92	3.952



**Fig. S2** CV curves of (a)  $Co_3O_4$ -leaf (b)  $Co_3O_4$ -sheet (c)  $Co_3O_4$ -cube at scan rates ranging from 0.1 to 0.8  $mV s^{-1}$  (d) The peak current vs. the square root of the scan rate after 3 cycles.



**Fig. S3** SEM images of (a) Co<sub>3</sub>O<sub>4</sub>-leaf (b) Co<sub>3</sub>O<sub>4</sub>-sheet (c) Co<sub>3</sub>O<sub>4</sub>-cube fresh electrodes and (d) Co<sub>3</sub>O<sub>4</sub>-leaf (e) Co<sub>3</sub>O<sub>4</sub>-sheet (f) Co<sub>3</sub>O<sub>4</sub>-cube electrodes after 3 cycles.