# Electronic Supplementary Information (ESI)

# Metal-organic frameworks derived $Fe_2O_3$@$NiCo_2O_4$ porous nanocages as anode materials for Li-ion batteries

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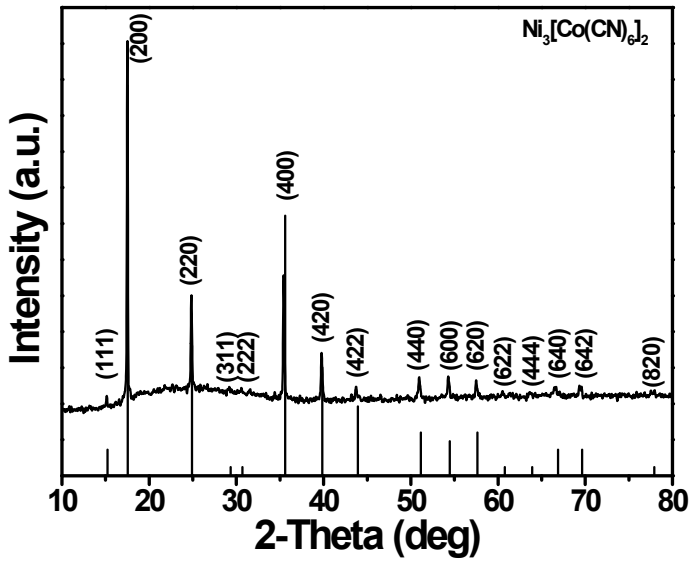


**Fig. S1** XRD pattern of the as-prepared $Ni_3[Co(CN)_6]_2$·nanocubes.

The average crystallite size of NiCo is calculated to be 48.96 nm by the Debye–Scherrer formula, *i.e.* eqn (1) and (2), based on the three strongest peaks ($2\theta$ =17.50°, 24.84°, 35.42°), while the crystallite size of CoFe is 21.24 nm based on the peaks at $2\theta$ =17.68°, 25.22°, 35.80°, separately.

$$D=k\lambda/(\beta cos\theta) \quad (1)$$

$$\beta=B-b \quad (2)$$

where $D$ is the average crystallite size, $k$ is the Scherrer constant (0.89), $\lambda$ is the wave length of X-ray radiation (1.5406 Å), $\beta$ and $B$ is the full width at half maximum for the tested sample and the experimental measured value, $b$ is the instrument width factor, $\theta$ is the Bragg angle of diffraction.

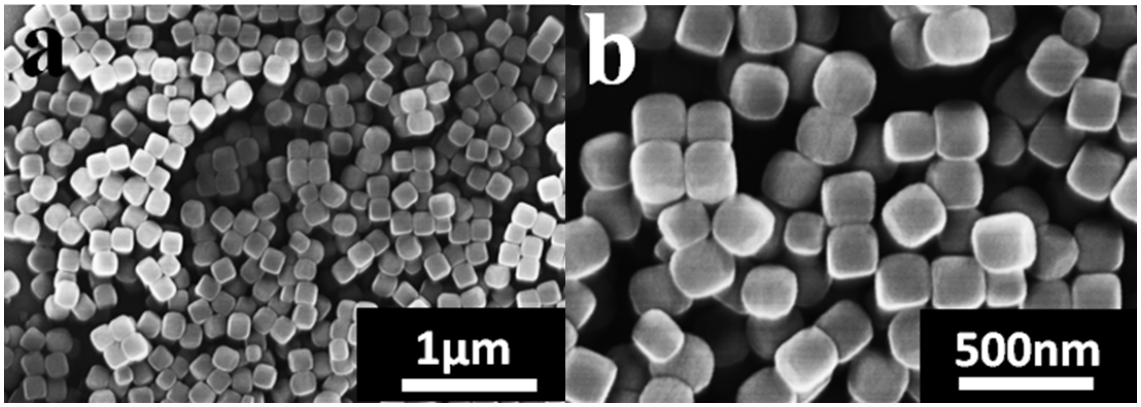


**Fig. S2** SEM images of the as-prepared $Ni_3[Co(CN)_6]_2$·nanocubes.

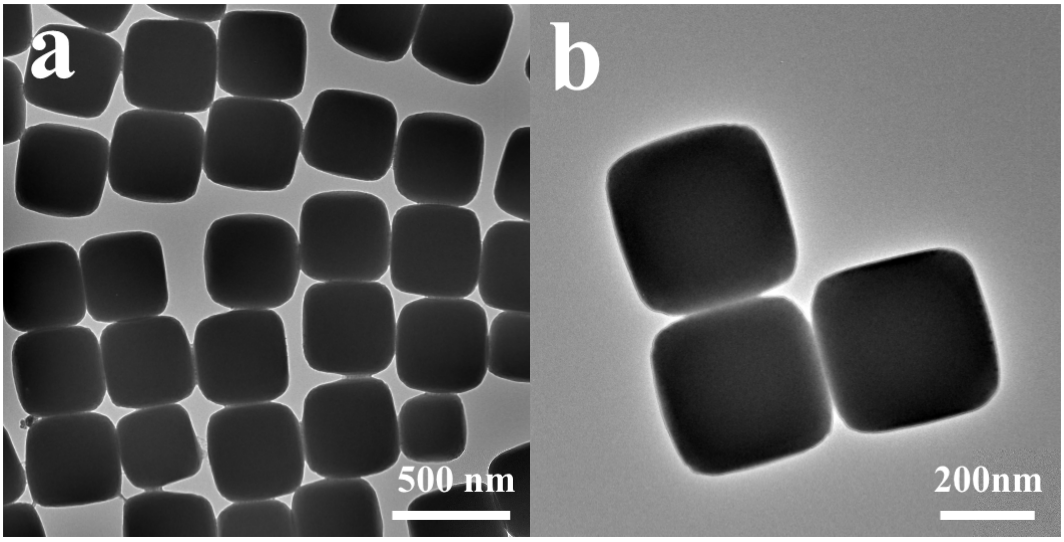


**Fig. S3** TEM images of the as-prepared $Ni_3[Co(CN)_6]_2$·nanocubes.

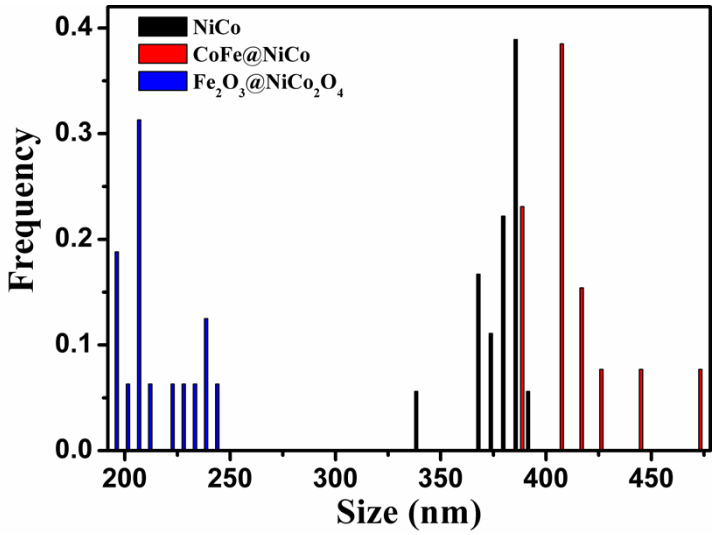


**Fig. S4** Particle size distribution derived from SEM images.

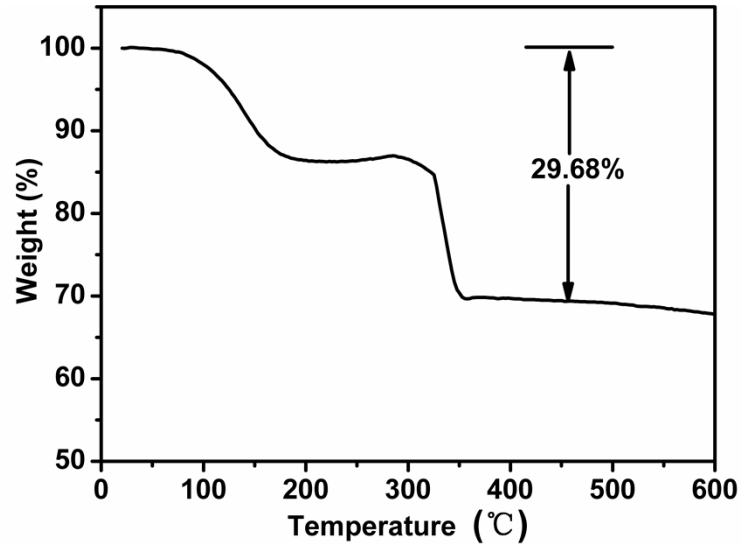

**Fig. S5** TG curve of the as-prepared CoFe@NiCo nanocubes.

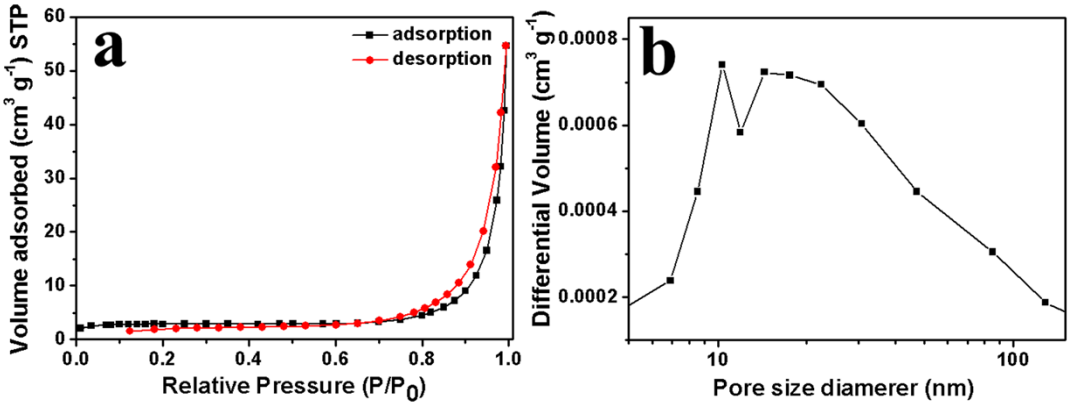


**Fig. S6** (a) $N_2$ adsorption-desorption isotherms and (b) pore size distribution of $Fe_2O_3$@$NiCo_2O_4$ nanocages.

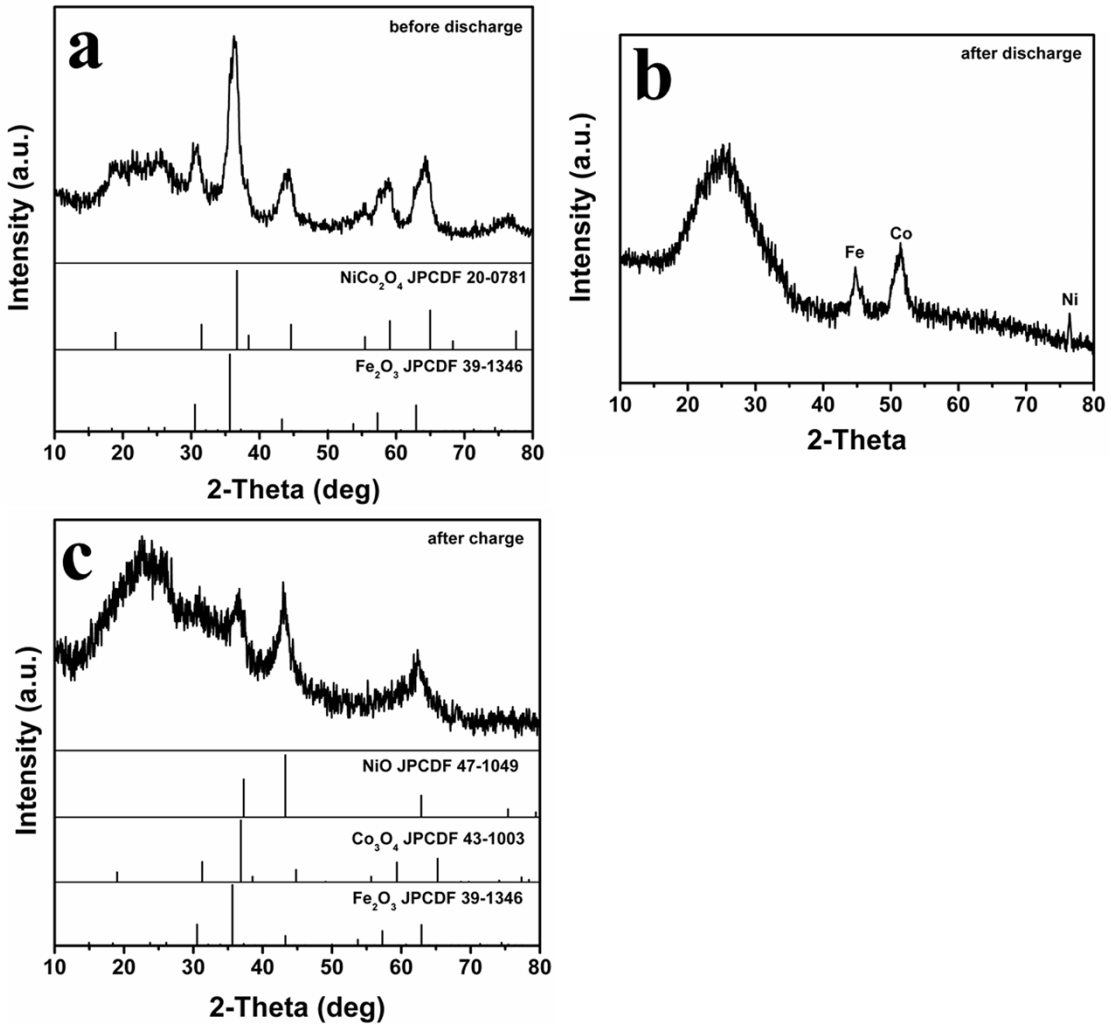


**Fig. S7** Ex XRD patterns of the $Fe_2O_3$@$NiCo_2O_4$ electrodes before cycling and after the initial discharge/charge processes.

The broad peak around 20~30° in the ex XRD patterns of the $Fe_2O_3$@$NiCo_2O_4$ electrode is resulting from the lithiated-carbon materials and the SEI.[1]

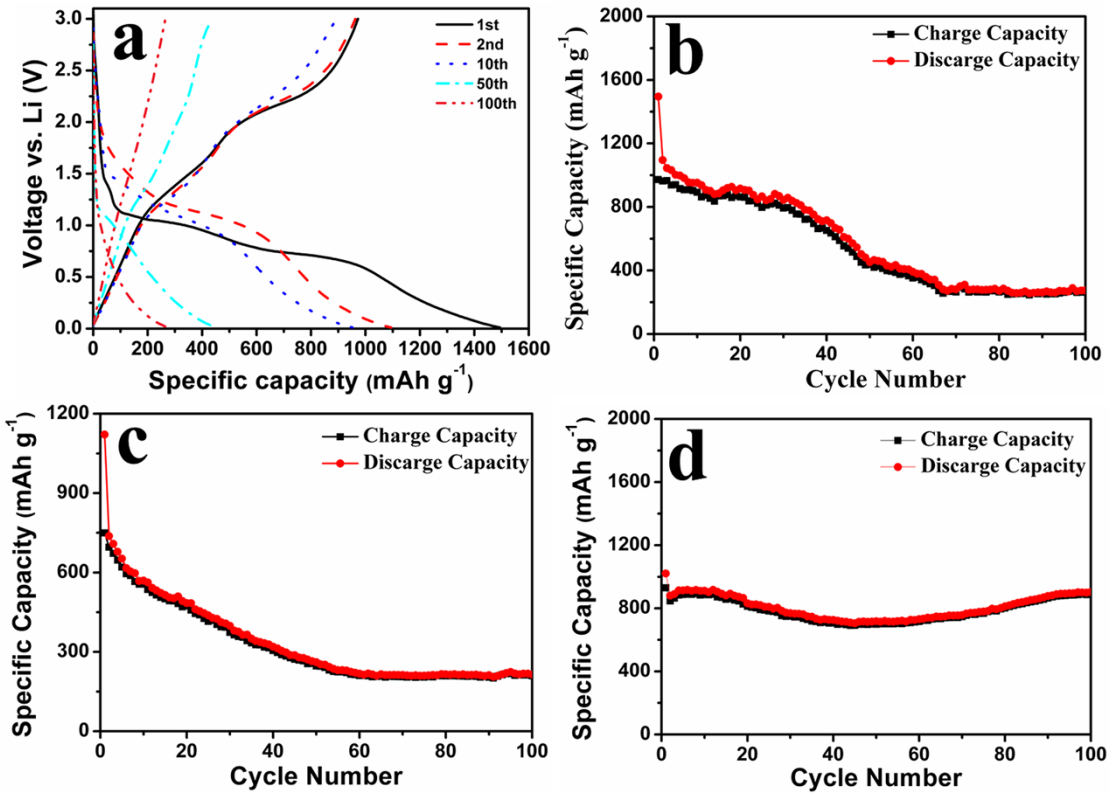


**Fig. S8** (a) Charge–discharge voltage profiles of the $NiCo_2O_4$ electrode for the 1st, 2nd, 10th, 50th and 100th cycles in the voltage range of 0.01-3.0 V at a current rate of 100 mA $g^{-1}$ (0.1 C) (b) Capacity *vs*. cycle number of the $NiCo_2O_4$ at a current rate of 100 mA $g^{-1}$ (0.1 C). (c) Capacity *vs*. cycle number of the M-$Fe_2O_3$@$NiCo_2O_4$ at a current rate of 100 mA $g^{-1}$ (0.1 C). (d) Capacity *vs*. cycle number of the $Fe_2O_3$@$NiCo_2O_4$ (70:20:10) at a current rate of 200 mA $g^{-1}$ (0.2 C).

**Table S1 Particle size of the obtained products**

| | Max size (nm) | Min size (nm) | Average size (nm) |
|---|---|---|---|
| **NiCo** | 395 | 337 | 378 |
| **CoFe@NiCo** | 447 | 384 | 413 |
| **$Fe_2O_3$@$NiCo_2O_3$** | 244 | 192 | 213 |

**References:**

1. L. W. Su, Y. Y. Zhong and Z. Zhou, *J. Mater. Chem. A*, 2013, **1**, 15158.