Supporting Information

Hierarchical Fusiform Microrods Constructed by Parallelly Arranged Nanoplatelets of $LiCoO_2$ Material with Ultrahigh Rate Performance

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Calculation of the Warburg coefficient factor (σ)

Warburg coefficient factor can be calculated by following equation:

$$Z' = R_{ct} + R_e + \sigma\omega^{-1/2} \qquad (1)$$

The charge transfer resistance (R_{ct}) and the electrolyte resistance (R_e) are the kinetic parameters. From the plot of Z' against $\omega^{-1/2}$, the slope of the fitted line is Warburg coefficient factor (σ).

Calculation of the lithium ions diffusion coefficient (D_{Li}) based on EIS measurement

The diffusion coefficient of lithium ions (D_{Li}) can be obtained on the basis of the following equation:

$$D_{Li} = R^2T^2/2A^2F^4n^4C^2\sigma^2 \qquad (2)$$

R is the gas constant; T is the absolute temperature; A is the surface area of working cathode (1.54 cm^2), F is the Faraday constant; n is the number of electrons per reaction species; C is the concentration of lithium ions (0.02066 mol/cm^3); σ is the Warburg coefficient factor obtained by eq S1.

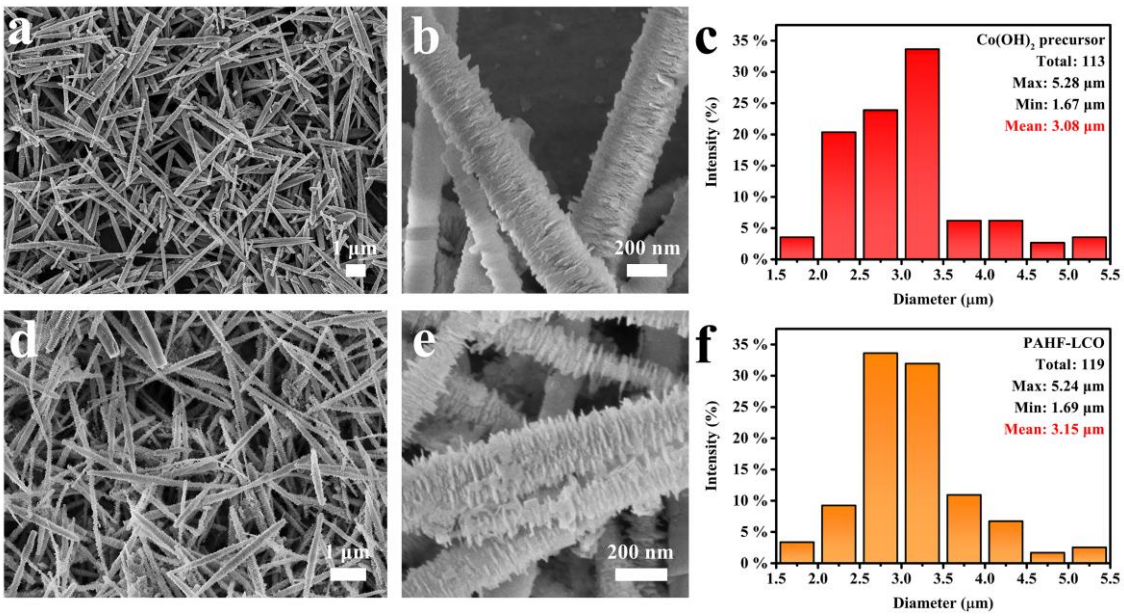

Figure S1 (a-c) SEM images and statistic of length distribution of the rod-like $Co(OH)_2$ precursor; (d-f) SEM images and statistic of length distribution of the PAHF-LCO cathode material.

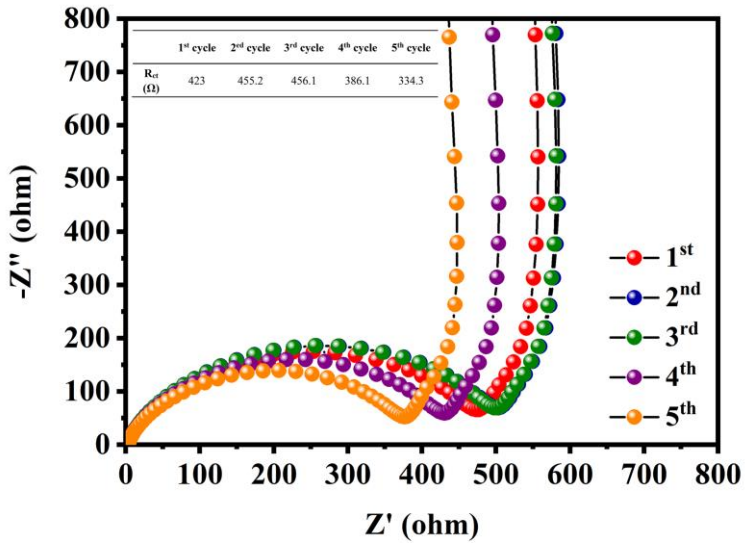

Figure S2 Nyquist plots of the commercial LCO cathode material before cycling test.

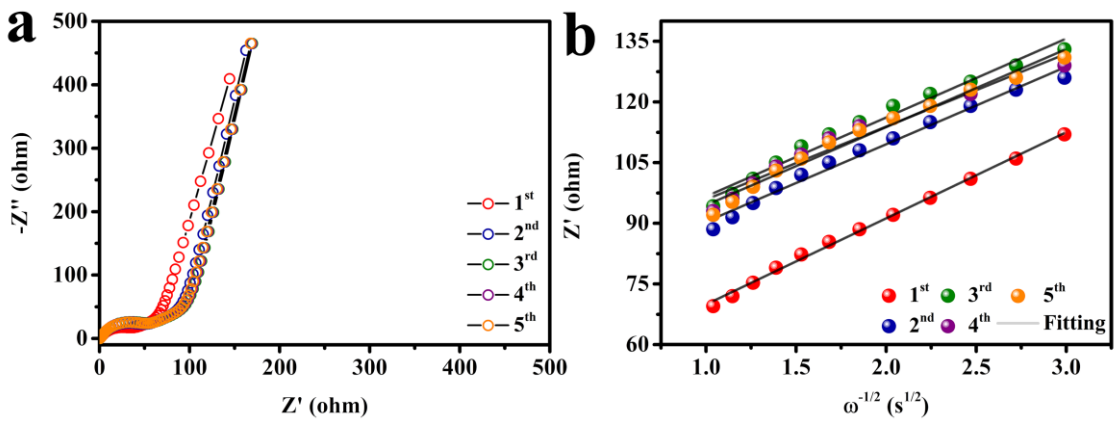

Figure S3 (a) The fitting curves of Nyquist plots of the PAHF-LCO cathode material; (b) the corresponding relationship between $\omega^{-1/2}$ and Z' in the low frequency range of the PAHF-LCO cathode material.

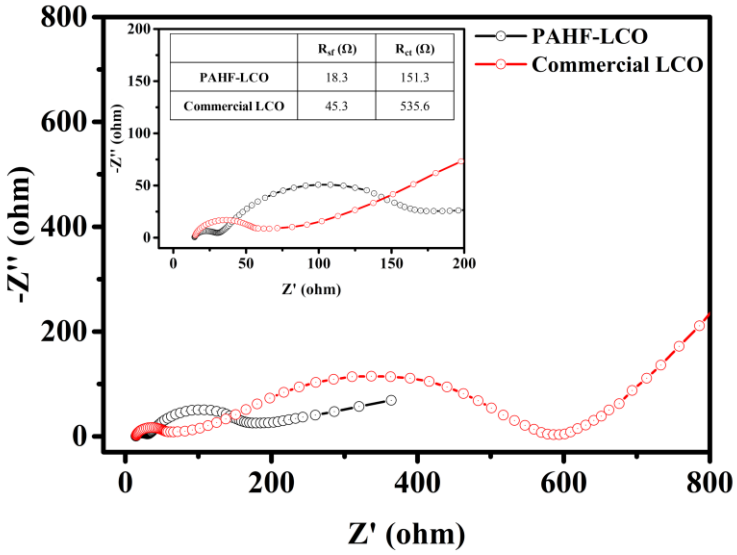

Figure S4 Nyquist plots of PAHF-LCO and commercial LCO electrodes after 100 cycles at 10 C at the charged state (4.3 V).

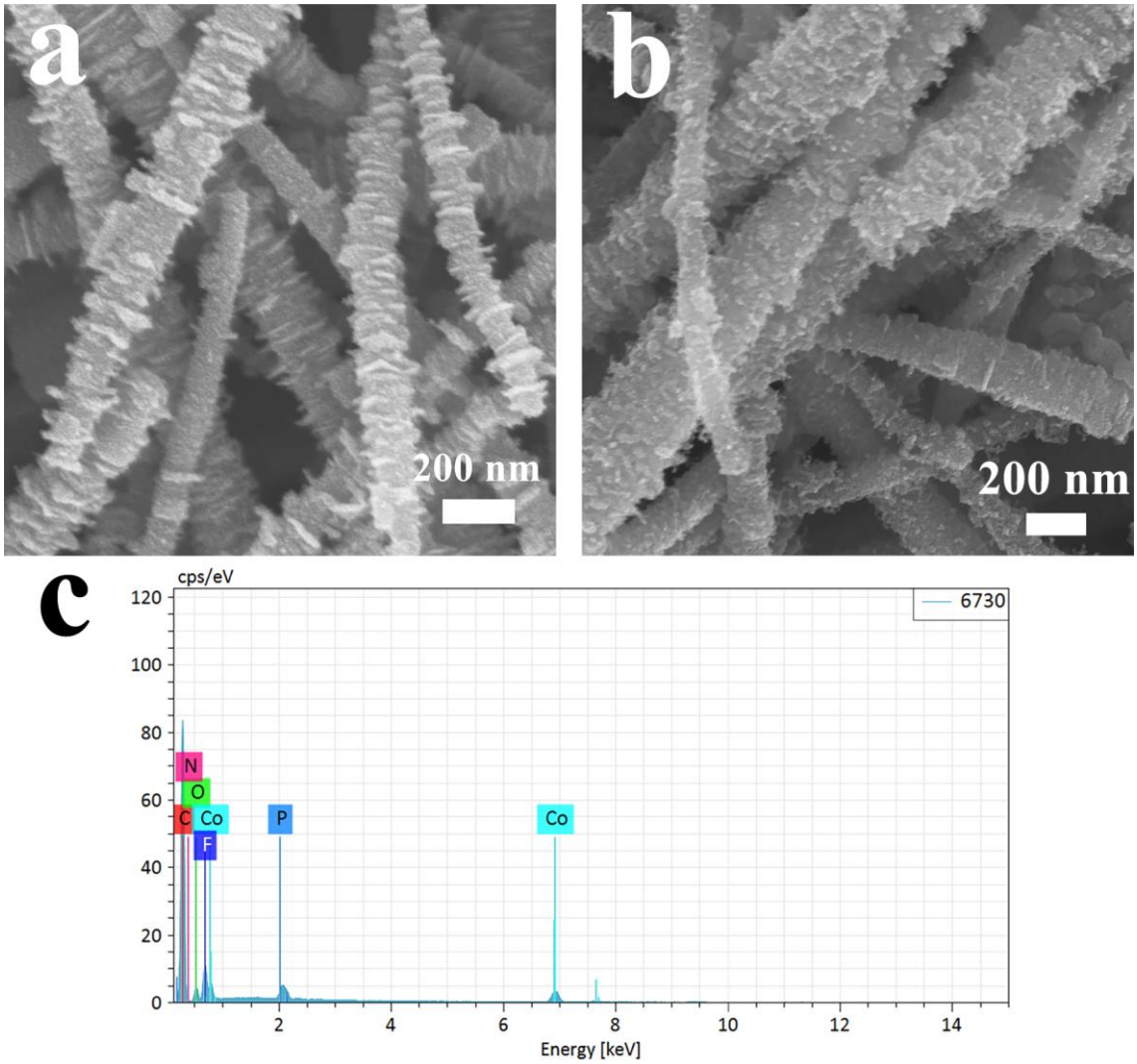

Figure S5 (a, b) SEM images of the PAHF-LCO cathode material after 100 and 200 cycles at 10 C; (c) EDS analyses of the PAHF-LCO cathode material after 200 cycles at 10 C.

The PAHF-LCO cathode materials after 100 and 200 cycles at 10 C were dissembled in the glovebox and the cathodes were washed with ethanol for several times. After drying in vacuum for 30 min, the electrodes were characterized by SEM under the protection of argon atmosphere for imaging.

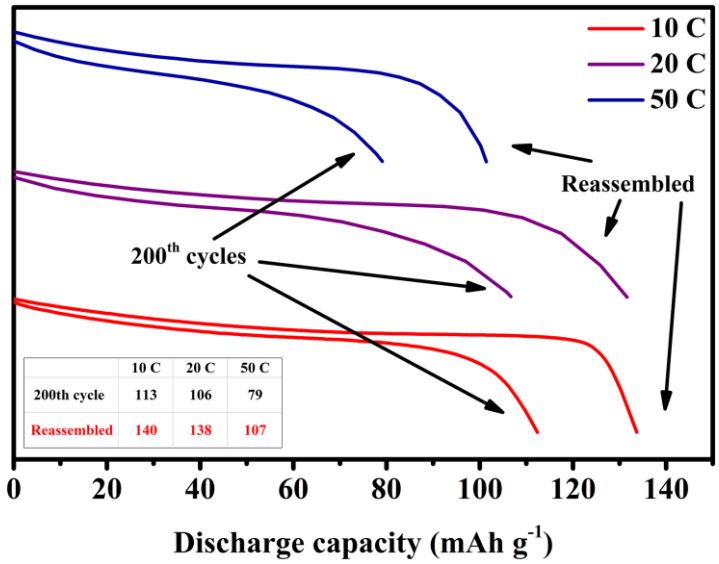

Figure S6 The comparison of discharge capacities between 200th cycled cells and reassembled cells under 10, 20 and 50 C for PAHF-LCO cathode material.

Table S1 Charge transfer resistance (R_{ct}), and Warburg efficient factor (σ) of the 1st, 2nd, 3rd, 4th and 5th cycled for the PAHF-LCO cathode material.

	1st cycle	**2ed cycle**	**3rd cycle**	**4th cycle**	**5th cycle**
R_{ct} (Ω)	63.52	84.74	91.97	92.64	91.20
σ ($\Omega\ s^{-1/2}$)	21.30	19.16	19.51	18.03	19.29
D_{Li} ($\times 10^{-9}\ cm^2\ s^{-1}$)	5.34	6.59	6.36	7.45	6.51

Table S2 A survey of electrochemical properties of the reported LCO cathode materials for LIBs.

Electrode description	Rate capability	Cycling stability	Voltage range	Ref.
$LiCoO_2$ Nanotubes	163 mAh g^{-1} at 0.3 C	164 mAh g^{-1} after 100 cycles 0.07 C	3.0-4.3 V	1
$LiCoO_2$ concaved cuboctahedra	141 mAh g^{-1} at 0.5 C	114 mAh g^{-1} after 100 cycles at 0.5 C	2.8-4.3 V	2
$LiCoO_2$ spheres	126 mAh g^{-1} 1 C	113 mAh g^{-1} after 100 cycles at 1 C	3.0-4.2 V	3
$LiCoO_2$ concaved cuboctahedrons	142 mAh g^{-1} at 1.5 C	127 mAh g^{-1} after 5 cycles at 1.5 C	2.5-4.3 V	4
Flake-like $LiCoO_2$	57 mAh g^{-1} 5 C	22 mAh g^{-1} after 30 cycles at 5 C	2.5-4.4 V	5
Chain-like $LiCoO_2$	120 mAh g^{-1} at 5 C	154 mAh g^{-1} after 200 cycles at 1 C	2.7-4.5 V	6
$LiCoO_2$ nanoparticles	150 mAh g^{-1} 7 C	135 mAh g^{-1} after 30 cycles at 7 C	3.0-4.5 V	7
$LiCoO_2$ nanowires	110 mAh g^{-1}at 7 C	100 mAh g^{-1} after 100 cycles at 7 C	3.0-4.3 V	8
$LiCoO_2$ nanoplates	123 mAh g^{-1} at 7 C	113 mAh g^{-1} after 100 cycles at 7 C	3.0-4.5 V	9
$LiCoO_2$ cubes	112 mAh g^{-1} at 7 C	131 mAh g^{-1} after 100 cycles at 0.7 C	3.0-4.3 V	10
$LiCoO_2$ sphere	124 mAh g^{-1} at 7 C	128 mAh g^{-1} after 100 cycles at 0.7 C		
$LiCoO_2$/Ag	136 mAh g^{-1} 8 C	119 mAh g^{-1} after 50 cycles at 8 C	3.0-4.4 V	11
Flake-like $LiCoO_2$	96 mAh g^{-1} at 10 C	149 mAh g^{-1} after 100 cycles at 1 C (55 °C)	2.7-4.5 V	12
$LiCoO_2$ nanomeshes	85 mAh g^{-1} at 21 C	130 mAh g^{-1} after 50 cycles at 1.4 C	3.0-4.3 V	13
$LiCoO_2$ desert-rose	155 mAh g^{-1} at 36 C	110 mAh g^{-1} after 15 cycles at 7 C 95 mAh g^{-1} after 15 cycles at 36 C	2.5-4.5 V	14
$LiCoO_2$ nanoparticles	100 mAh g^{-1} at 30 C 90 mAh g^{-1} at 50 C 75 mAh g^{-1} at 100 C	85 mAh g^{-1} after 20 cycles at 10 C	3.0-4.2 V	15
$LiCo_{0.75}B_{0.25}O_2$	130 mAh g^{-1} at 0.25 C	127 mAh g^{-1} after 16 cycles at 0.25 C	2.5-4.4 V	16
$LiCo_{0.97}Cr_{0.03}O_2$	155 mAh g^{-1} at 0.14 C	74 mAh g^{-1} after 30 cycles at 0.14 C	2.7-4.3 V	17
$LiCo_{0.90}Rh_{0.10}O_2$	144 mAh g^{-1} at 0.14 C	86 mAh g^{-1} after 18 cycles at 0.14 C	2.7-4.3 V	18
$LiCo_{0.95}Mn_{0.05}O_2$	195 mAh g^{-1} at 20 mA g^{-1}	195 mAh g^{-1} after 33 cycles at 20 mA g^{-1}	3.0-4.4 V	19

MgO-$LiCoO_2$	156 mAh g^{-1} at 0.2 C	132.5 mAh g^{-1} after 60 cycles at 0.2 C (81 °C)	3.0-4.35 V	20
P_2O_5-$LiCoO_2$	130 mAh g^{-1} at 1 C	98.8 mAh g^{-1} after 20 cycles at 1C	3.0-4.4 V	21
$Y_3Al_5O_{12}$-$LiCoO_2$	167 mAh g^{-1} at 0.2 C	134.2 mAh g^{-1} after 164 cycles at 0.2 C	2.75-4.4 V	22
$MgO/TiO_2/SiO_2$-$LiCoO_2$	165 mAh g^{-1} at 1 C	149.3 mAh g^{-1} after 250 cycles at 1 C	3.0-4.4 V	23
$FePO_4$-$LiCoO_2$	155 mAh g^{-1} at 3 C	127.9 mAh g^{-1} after 400 cycles at 3 C	2.75-4.4 V	24

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