Supplementary Information

Comprehensive utilization of lignocellulosic biomass for electrode and electrolyte in zinc-ion hybrid supercapacitor

Lvye Yang, Luan Yang, Dingliang Dai, Jianfeng Yao*

College of Chemical Engineering, Jiangsu Co-Innovation Center of Efficient Processing and Utilization of Forest Resources, Nanjing Forestry University, Nanjing, Jiangsu 210037, China.

*Corresponding author. Email: jfyao@njfu.edu.cn

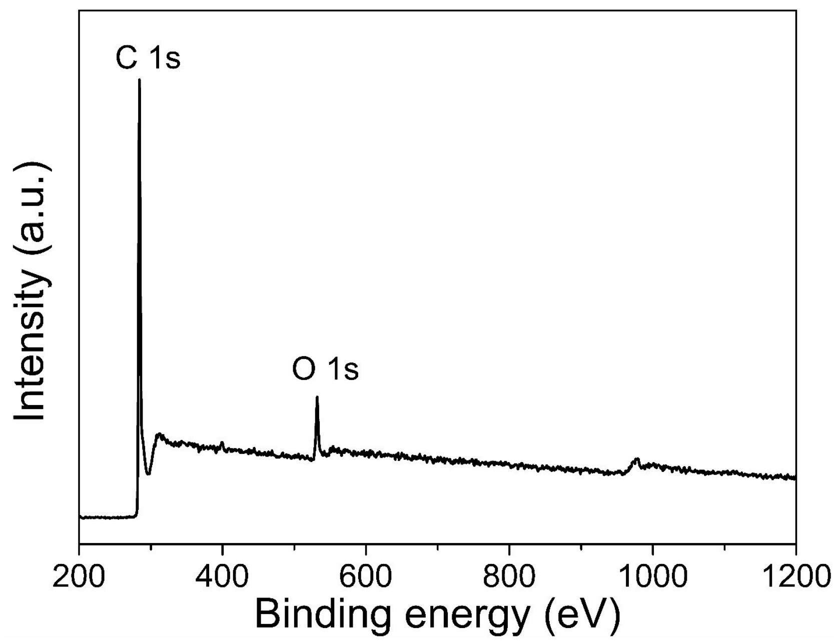

Fig. S1 XPS full-spectrum of LDC3.

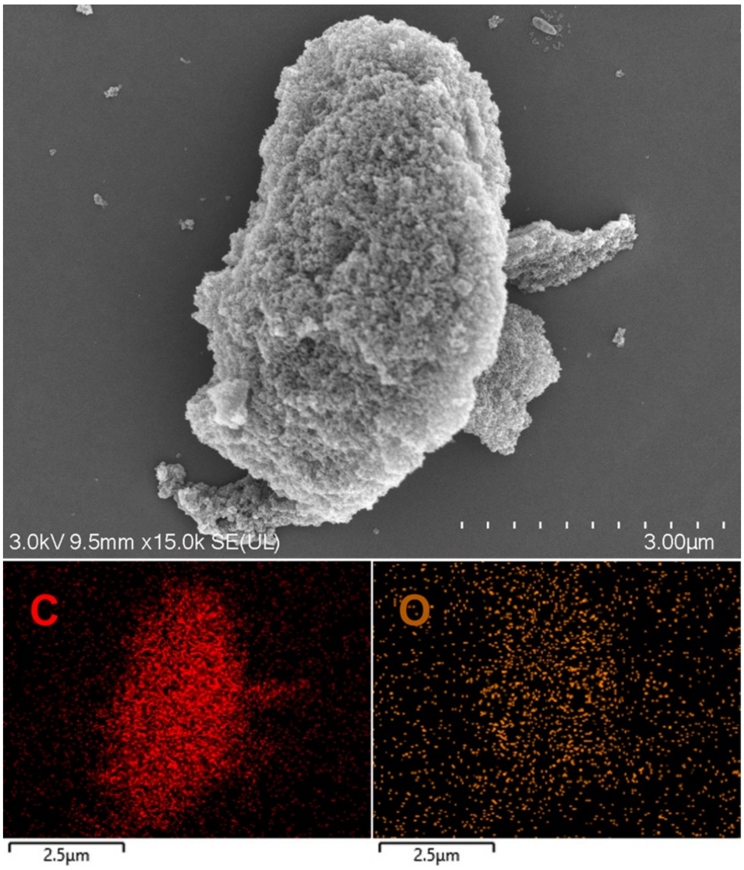

Fig. S2 SEM image and elemental mapping images of LDC3.

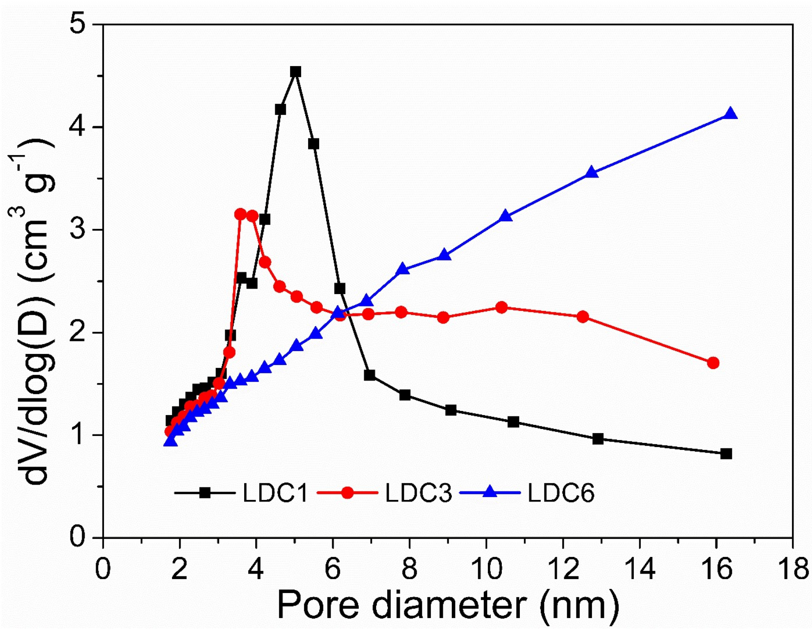

Fig. S3 BJH pore size distributions of carbon samples of LDCx.

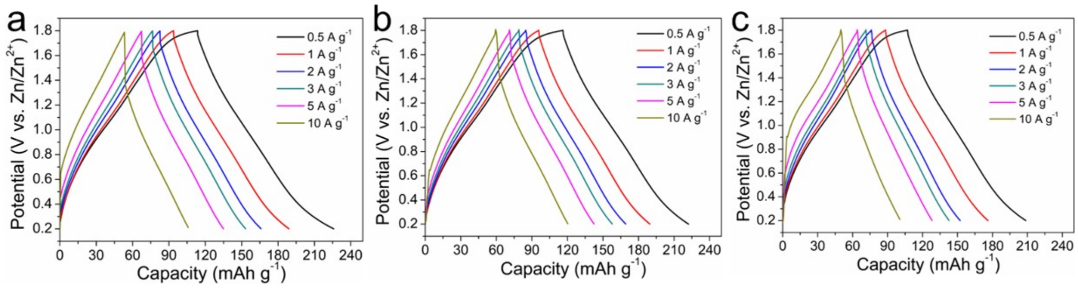

Fig. S4 GCD curves of LDC1 (a), LDC3 (b) and LDC6 (c) with a 73 wt% $ZnCl_2$ aqueous solution as electrolyte at different current densities.

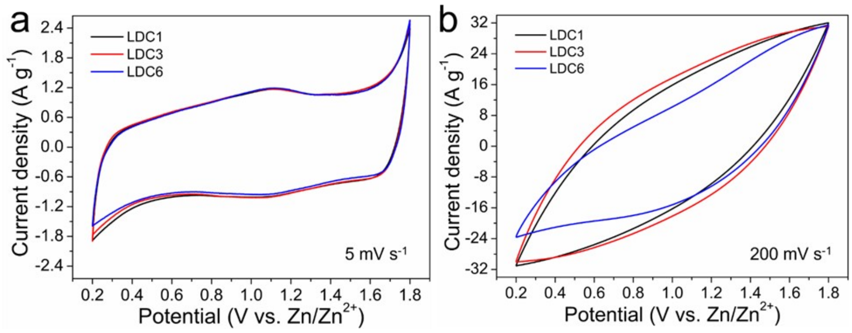

Fig. S5 CV curves of LDCx at the scan rates of 5 mV s^{-1} (a) and 200 mV s^{-1} (b) respectively.

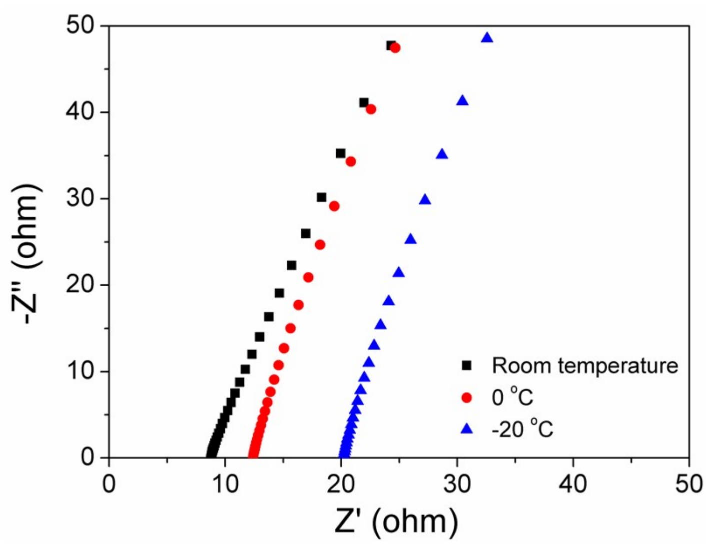

Fig. S6 Nyquist plots of LDH3 at different temperatures

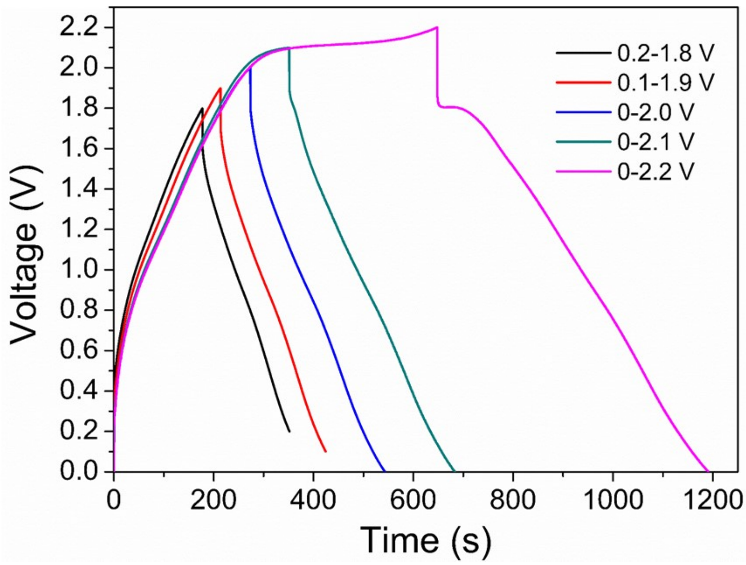

Fig. S7 GCD curves (2 A g^{-1}) of ZHS with LDC3 and LDH3 at different voltage windows.

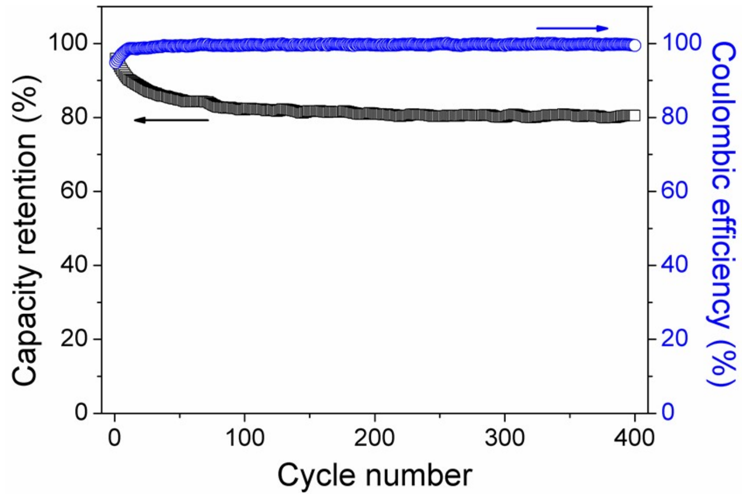

Fig. S8 GCD cycles of the zinc-ion hybrid supercapacitor (Zn/LDH3/LDC3) at 0.5 A g^{-1}.

Table S1 Components of sawdust and washed solid residues after hydrothermal treatment.

Sample	Solid yield	Cellulose	Hemicellulose	Lignin	Others
Sawdust	100%	41.3%	17.2%	34.6%	6.9%
WSR1	75%	40.7%	11.3%	45.3%	2.7%
WSR3	60%	43.2%	8.1%	46.6%	2.1%
WSR6	29%	45.6%	5.4%	47.2%	1.8%

Table S2 Comprehensive comparison of various zinc-ion hybrid supercapacitors.

Research in the main text	Cathode material	Electrolyte	Voltage	Energy density/ Power density	Capacity retention/ Cycle number/ Current density
This work	Lignocellulosic biomass-derived carbon	Lignocellulosic biomass-derived hydrogel with [$ZnCl_2$]	2 V	65 Wh kg^{-1} at 7.52 kW kg^{-1} and 226 Wh kg^{-1} at 492 W kg^{-1}	100%/ 30000/ 5 A g^{-1}
Ref. 3	Commercial activated carbon	2 M aqueous $ZnSO_4$	1.6 V	30 Wh kg-1 at 14.9 kW kg^{-1}	91%/ 10000/ 1 A g^{-1}
Ref. 5	Silk-derived activated carbon	PAM hydrogel with [$ZnCl_2$]	1.8 V	217 Wh kg^{-1} at 450 W kg^{-1}	95%/ 100000/ 5 A g^{-1}
Ref. 7	N/P co-doped graphene	1 M aqueous $ZnSO_4$	1.8 V	95 Wh kg^{-1} at 450 W kg^{-1}	82%/ 15000/ 10 A g^{-1}
Ref. 12	Coconut shell activated carbon	PVA/MMT hydrogel with [$Zn(ClO_4)_2$]	1.8 V	190 W h kg^{-1} at 90 W kg^{-1}	99%/ 10000/ 5 A g^{-1}
Ref. 25	Ethanol-derived porous carbon	Gelatin gel with [$ZnSO_4$]	1.6 V	82 W h kg^{-1} at 104 W kg^{-1}	88%/ 10000/ 1 A g^{-1}
Ref. 26	Porous carbon nanofiber	2 M aqueous $ZnCl_2$	1.6 V	143 Wh kg^{-1} at 367 W kg^{-1}	93%/ 10000/ 10 A g^{-1}
Ref. 28	Cross-linked porous carbon nanosheets	PVA gel with [$Zn(Ac)_2$/KOH]	1.6 V	89 Wh kg^{-1} at 79 W kg^{-1}	102 %/ 10000/ 5 A g^{-1}
Ref. 34	Potassium citrate derived carbon	1 M aqueous $Zn(CF_3SO_3)_2$	1.6 V	125 Wh kg^{-1} at 76 W kg^{-1}	93%/ 60000/ 10 A g^{-1}
Ref. 48	Chitosan derived porous carbon	2 M aqueous $ZnSO_4$	1.6 V	93 Wh kg^{-1} at 3633 W kg^{-1}	91%/ 5000/ 1 A g^{-1}

Ref. 3 L. Dong, X. Ma, Y. Li, L. Zhao, W. Liu, J. Cheng, C. Xu, B. Li, Q.-H. Yang and F. Kang, *Energy Storage Mater.*, 2018, **13**, 96-102.

Ref. 5 C. Wang, Z. Pei, Q. Meng, C. Zhang, X. Sui, Z. Yuan, S. Wang and Y. Chen, *Angew. Chem. Int. Edit.*, 2021, **60**, 990-997.

Ref. 7 Y. Zhao, H. Hao, T. Song, X. Wang, C. Li and W. Li, *J. Power Sources*, 2022, **521**, 230941.

Ref. 12 G. Yang, J. Huang, X. Wan, Y. Zhu, B. Liu, J. Wang, P. Hiralal, O. Fontaine, Y. Guo and H. Zhou, *Nano Energy*, 2021, **90**, 106500.

Ref. 25 Y. Zheng, W. Zhao, D. Jia, Y. Liu, L. Cui, D. Wei, R. Zheng and J. Liu, *Chem. Eng. J.*, 2020, **387**, 124161.

Ref. 26 A. Amiri, M. Naraghi and A. A. Polycarpou, *J. Energy Chem.*, 2022, **70**, 480-491.

Ref. 28 H. Zhang, Z. Chen, Y. Zhang, Z. Ma, Y. Zhang, L. Bai and L. Sun, *J. Mater. Chem. A*, 2021, **9**, 16565-16574.

Ref. 34 L. Wang, M. Huang, J. Huang, X. Tang, L. Li, M. Peng, K. Zhang, T. Hu, K. Yuan and Y. Chen, *J. Mater. Chem. A*, 2021, **9**, 15404-15414.

Ref. 48 P. Liu, Y. Gao, Y. Tan, W. Liu, Y. Huang, J. Yan and K. Liu, *Nano Res.*, 2019, **12**, 2835-2841.