

## *Supporting information*

### **Porous Quasi-graphitic Carbon Sheets for Unprecedented Sodium Storage**

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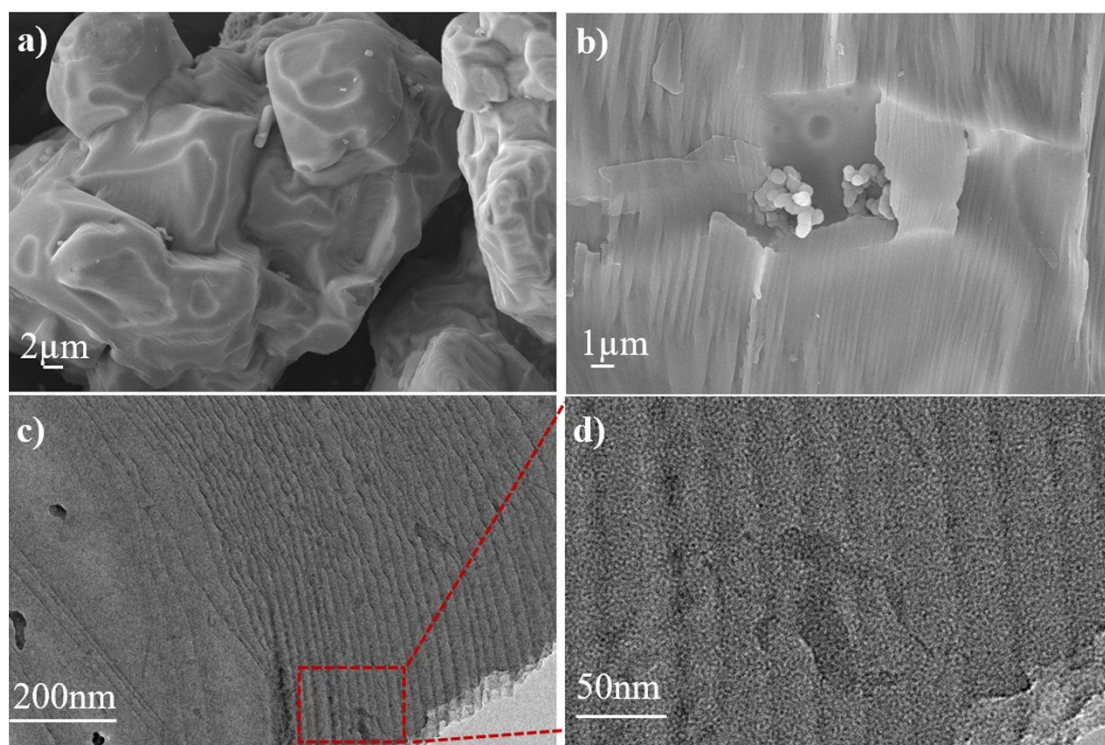
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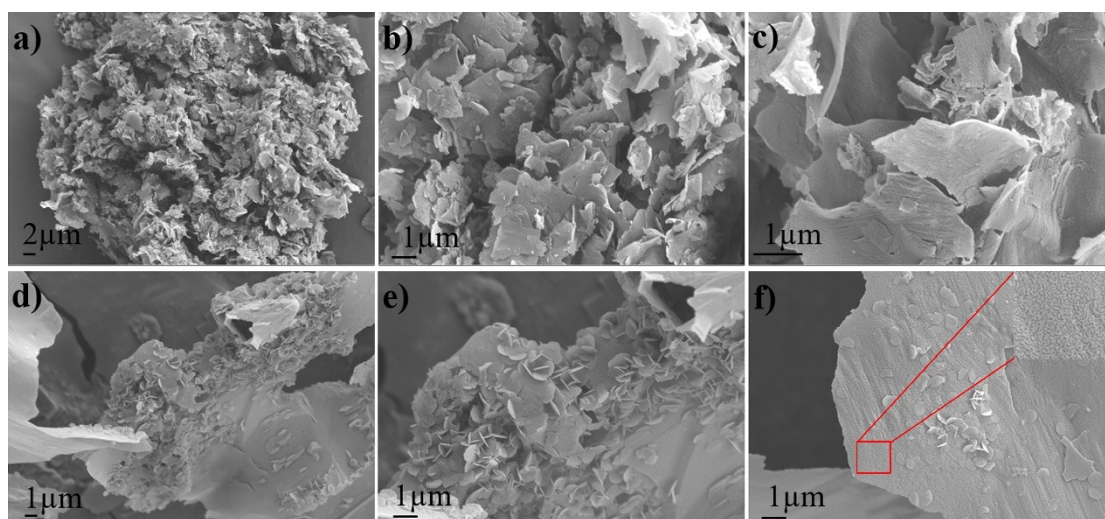
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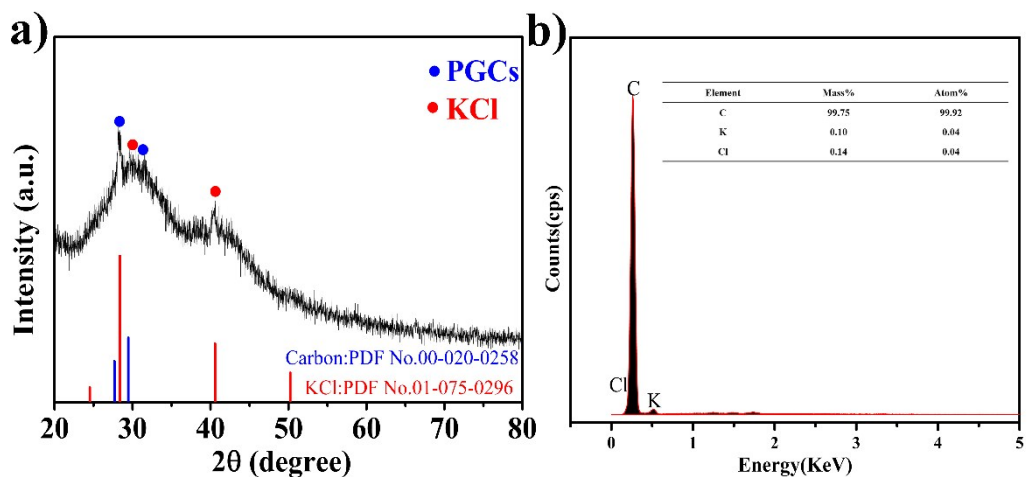
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**Figure S1.** (a-b) SEM image and (c-d) TEM images of PGCs formed on the surface of KCl prepared at 650 °C.

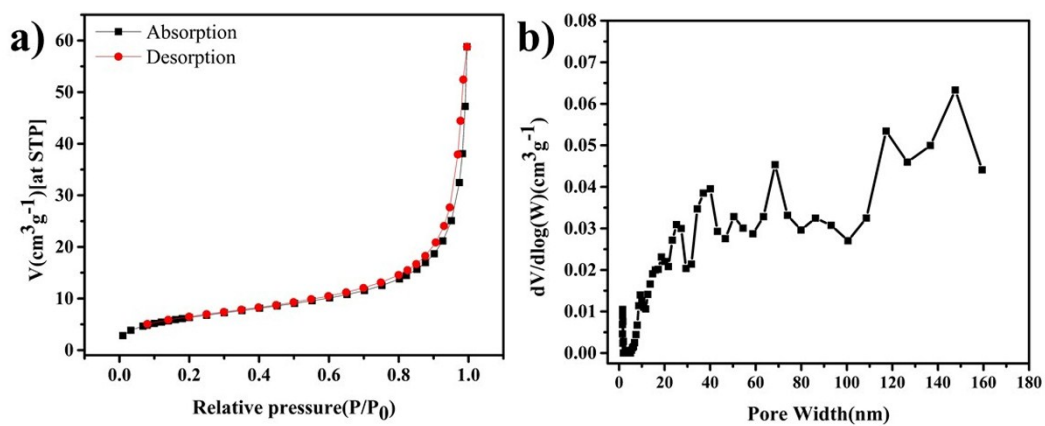


**Figure S2.** SEM images of PGCs prepared at (a-c) 600 °C and (d-f) 650 °C (the inside shows the micro and macro pores from the partial enlarged image).



**Figure S3.** (a)XRD and (b) EDS patterns of PGCs prepared at 650 °C, inside shows the masses and atoms

percentage for C, K, and Cl.



**Figure S4.** N<sub>2</sub> adsorption-desorption isotherms and pore size distribution of the PGCs.

**Table.S1.** Comparison of the electrochemical properties of active anode materials fabricated by carbon

element with different structures

Anode materials	Current density	Special capacity	capacity retention	Refs.
PGCs	0.1A g <sup>-1</sup>	237 mAh g <sup>-1</sup>	83.5 %	This work
	0.5A g <sup>-1</sup>	159 mAh g <sup>-1</sup>	74.6 %	
Hard carbon	0.5 A g <sup>-1</sup>	135 mAh g <sup>-1</sup>		1
Graphene nanosheets	0.1 A g <sup>-1</sup>	189 mAh g <sup>-1</sup>	80%	2
	0.5 A g <sup>-1</sup>	159 mAh g <sup>-1</sup>	80%	
Carbon nanotubes	0.1 A g <sup>-1</sup>	68 mAh g <sup>-1</sup>	80%	2
	0.5 A g <sup>-1</sup>	48 mAh g <sup>-1</sup>	80%	
Carbon Quantum Dot-derived 3D Porous Carbon	0.1 A g <sup>-1</sup>	303mAh g <sup>-1</sup>	85%	3
Porous carbon aerogels	0.05 A g <sup>-1</sup>	287 mAh g <sup>-1</sup>	67.4 %	4

	0.5 A g <sup>-1</sup>	154 mAh g <sup>-1</sup>	73.3 %	
Tire-derived carbon	0.02 A g <sup>-1</sup>	203 mAh g <sup>-1</sup>	-	5
Pitch-derived amorphous carbon	0.03 A g <sup>-1</sup>	284 mAh g <sup>-1</sup>	94%	6
Rice husk-derived hard carbons	0.025 A g <sup>-1</sup>	346 mAh g <sup>-1</sup>	93%	7
Mesoporous soft carbon	0.03 A g <sup>-1</sup>	331 mAh g <sup>-1</sup>	-	8
	0.5 A g <sup>-1</sup>	103 mAh g <sup>-1</sup>	-	
Mesoporous Wood Carbon	0.15 A g <sup>-1</sup>	80 mAh g <sup>-1</sup>	95%	9
3D amorphous carbon	0.03 A g <sup>-1</sup>	280 mAh g <sup>-1</sup>	-	10
3D hard carbon	0.5 A g <sup>-1</sup>	90 mAh g <sup>-1</sup>	78%	11
Pitch and lignin-driven Amorphous carbon	0.03 A g <sup>-1</sup>	254 mAh g <sup>-1</sup>	97%	12
Hollow Carbon Nanowires	0.05 A g <sup>-1</sup>	251 mAh g <sup>-1</sup>	82.2 %	13
	0.5 A g <sup>-1</sup>	149 mAh g <sup>-1</sup>	-	

## References

1. S. Alvin, D. Yoon, C. Chandra, R. F. Susanti, W. Chang, C. Ryu and J. Kim, Extended flat voltage profile of hard carbon synthesized using a two-step carbonization approach as an anode in sodium ion batteries, *Journal of Power Sources*, 2019, **430**, 157-168.
2. X.-F. Luo, C.-H. Yang, Y.-Y. Peng, N.-W. Pu, M.-D. Ger, C.-T. Hsieh and J.-K. Chang, Graphene nanosheets, carbon nanotubes, graphite, and activated carbon as anode materials for sodium-ion batteries, *Journal of Materials Chemistry A*, 2015, **3**, 10320-10326.
3. H. Hou, C. E. Banks, M. Jing, Y. Zhang and X. Ji, Carbon Quantum Dots and Their Derivative 3D Porous Carbon Frameworks for Sodium-Ion Batteries with Ultralong Cycle Life, *Advanced materials*, 2015, **27**, 7861-7866.
4. Y. Chen, Z. Zhang, Y. Lai, X. Shi, J. Li, X. Chen, K. Zhang and J. Li, Self-assembly of 3D neat porous carbon aerogels with NaCl as template and flux for sodium-ion batteries, *Journal of Power Sources*, 2017, **359**, 529-538.
5. Y. Li, M. P. Paranthaman, K. Akato, A. K. Naskar, A. M. Levine, R. J. Lee, S.-O. Kim, J. Zhang, S. Dai and A. Manthiram, Tire-derived carbon composite anodes for sodium-ion batteries, *Journal of Power Sources*, 2016, **316**, 232-238.
6. Y. Li, L. Mu, Y.-S. Hu, H. Li, L. Chen and X. Huang, Pitch-derived amorphous carbon as high performance anode for sodium-ion batteries, *Energy Storage Materials*, 2016, **2**, 139-145.
7. Q. Wang, X. Zhu, Y. Liu, Y. Fang, X. Zhou and J. Bao, Rice husk-derived hard carbons as high-performance anode materials for sodium-ion batteries, *Carbon*, 2018, **127**, 658-666.
8. B. Cao, H. Liu, B. Xu, Y. Lei, X. Chen and H. Song, Mesoporous soft carbon as an anode material for sodium ion batteries with superior rate and cycling performance, *Journal of Materials Chemistry A*, 2016, **4**, 6472-6478.
9. F. Shen, W. Luo, J. Dai, Y. Yao, M. Zhu, E. Hitz, Y. Tang, Y. Chen, V. L. Sprenkle, X. Li and L. Hu, Low-Tortuosity, and Mesoporous Wood Carbon

- Anode for High-Performance Sodium-Ion Batteries, *Advanced Energy Materials*, 2016, **6**, 1600377.
10. P. Lu, Y. Sun, H. Xiang, X. Liang and Y. Yu, 3D Amorphous Carbon with Controlled Porous and Disordered Structures as a High-Rate Anode Material for Sodium-Ion Batteries, *Advanced Energy Materials*, 2018, **8**, 1702434.
  11. Z. Yuan, L. Si and X. Zhu, Three-dimensional hard carbon matrix for sodium-ion battery anode with superior-rate performance and ultralong cycle life, *Journal of Materials Chemistry A*, 2015, **3**, 23403-23411.
  12. Y. Li, Y.-S. Hu, H. Li, L. Chen and X. Huang, A superior low-cost amorphous carbon anode made from pitch and lignin for sodium-ion batteries, *Journal of Materials Chemistry A*, 2016, **4**, 96-104.
  13. Y. Cao, L. Xiao, M. L. Sushko, W. Wang, B. Schwenzer, J. Xiao, Z. Nie, L. V. Saraf, Z. Yang and J. Liu, Sodium ion insertion in hollow carbon nanowires for battery applications, *Nano letters*, 2012, **12**, 3783-3787.