

Supporting Information

Molten-salt-assisted synthesis of nitrogen-doped carbon nanosheets derived from biomass waste of ginkgo shells as efficient catalyst for oxygen reduction reaction

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Table S1 Comparison of electrocatalytic ORR performance between N-pC and state-of-the-art metal-free catalysts reported in the literatures in alkaline electrolyte.

Electrocatalysts	$E_{1/2}$ (V vs. RHE)	E_{onset} (V vs. RHE)	J_d (mA·cm ⁻²)	Ref.
N-pC	0.863	1.020	5.93	This work
CN-nanosh (suc)	0.764	~0.914	5.56	1
NPCTC	0.88	0.99	5.43	2
NPCTC-850	0.83	0.92	5.35	3
NDGs-800	0.85	0.98	5.6	4
NrGO800	0.76	0.88	4.0	5
IRnG-A2	~0.744	0.844	3.11	6
OAB-N	~0.851	1.00	~5.51	7
NB-CN	0.835	0.92	~4.9	8

Table S2 Comparison of the performance of primary Zn-air batteries assembled with various cathodic electrocatalysts.

Electrocatalysts	OCV (V)	Power density (mW·cm ⁻²)	Specific capacity (mAh·g ⁻¹)	Ref.
N-pC	1.5	223	755	This work
CN-nanosh (suc)	1.46	201.33	740	1
1100-CNS	1.49	151	-	9
NDGs-800	1.45	115.2	750.8	4
NPCTC-850	1.47	74	730	3
P, S-CNS	1.51	198	830	10
PS-CNF	1.49	231	698	11
FeCo@MNC	1.41	115	-	12
CoNi/BCF	1.44	155.1	710.9	13
NGM-Co	1.44	152	750	14

References

- [1] Yang, X.-K.; Chen, A.L.; Yi, Q.-F. Easy preparation of N-doped graphene-like nanosheets as excellent metal-free cathodic electrocatalysts of Zn-air battery. *Chinese Journal of Inorganic Chemistry* 2021, *37*, 157-170.
- [2] Wang, Y.; Zhou, J.; He, Y.; Liu, Y.; Xu, C. Highly performed nitrogen-doped porous carbon electrocatalyst for oxygen reduction reaction prepared by a simple and slight regulation in hydrolyzing process of ZIF-8. *Journal of Solid State Chemistry* 2021, *302*, 122415.
- [3] Wang, Q.; Ji, Y.; Lei, Y.; Wang, Y.; Wang, Y.; Li, Y.; Wang, S. Pyridinic-N-dominated doped defective graphene as a superior oxygen electrocatalyst for ultrahigh-energy-density Zn-Air batteries. *ACS Energy Letters* 2018, *3*, 1183.
- [4] Li, Y.; Yan, Z.; Wang, Q.; Ye, H.; Li, M.; Zhu, L.; Cao, X. Ultrathin, highly branched carbon nanotube cluster with outstanding oxygen electrocatalytic performance. *Electrochimica Acta* 2018, *282*, 224-232.
- [5] Lemes, G.; Sebastian, D.; Pastor, E.; Lazard, M.J. N-doped graphene catalysts with high nitrogen concentration for the oxygen reduction reaction. *Journal of Power Sources* 2019, *438*, 227036.
- [6] Lee, M.S.; Whang, D.R.; Choi, H.-J.; Yang, M.H.; Kim, B.-G.; Baek, J.-B.; Chang, D.W. A facile approach to tailoring electrocatalytic activities of imine-rich nitrogen-doped graphene for oxygen reduction reaction. *Carbon* 2017, *122*, 515-523.
- [7] Si, Y.; Park, M.G.; Cano, Z.P.; Xiong, Z.; Chen, Z. Heavily nitrogen-doped acetylene black as a high-performance catalyst for oxygen reduction reaction. *Carbon* 2017, *117*, 12-19.
- [8] Lu, Z.; Wang, J.; Huang, S.; Hou, Y.; Li, Y.; Zhao, Y.; Mu, S.; Zhang, J.; Zhao, Y. N,B-codoped defect-rich graphitic carbon nanocages as high performance multifunctional electrocatalysts. *Nano Energy* 2017, *42*, 334-340.
- [9] Pei, Z.; Li, H.; Huang, Y.; Xue, Q.; Huang, Y.; Zhu, M.; Wang, Z.; Zhi, C. Texturing in situ: N, S-enriched hierarchically porous carbon as a highly active

reversible oxygen electrocatalyst. *Energy & Environmental Science* 2017, *10*, 742-749.

- [10] Shinde, S.S.; Lee, C.-H.; Sami, A.; Kim, D.-H.; Lee, S.-U.; Lee, J.-H. Scalable 3-D carbon nitride sponge as an efficient metal-free bifunctional oxygen electrocatalyst for rechargeable Zn-air batteries. *ACS Nano* 2017, *11*, 347-357.
- [11] Shinde, S.S.; Yu, J.-Y.; Song, J.-W.; Nam, Y.-H.; Kim, D.-H.; Lee, J.-H. Highly active and durable carbon nitride fibers as metal-free bifunctional oxygen electrodes for flexible Zn-air batteries. *Nanoscale Horizons* 2017, *2*, 333-341.
- [12] Li, C.; Wu, M.; Liu, R. High-performance bifunctional oxygen electrocatalysts for zinc-air batteries over mesoporous Fe/Co-N-C nanofibers with embedding FeCo alloy nanoparticles. *Applied Catalysis B-Environmental* 2019, *244*, 150-158.
- [13] Wan, W.; Liu, X.; Li, H.; Peng, X.; Xi, D.; Luo, J. 3D carbon framework-supported CoNi nanoparticles as bifunctional oxygen electrocatalyst for rechargeable Zn-air batteries. *Applied Catalysis B-Environmental* 2019, *240*, 193-200.
- [14] Tang, C.; Wang, B.; Wang, H.-F.; Zhang, Q. Defect engineering toward atomic Co-N-x-C in hierarchical graphene for rechargeable flexible solid Zn-Air batteries. *Advanced Materials* 2017, *29*, 1703185.