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Full Paper

Synthesis of Metal-Free Nanoporous Carbon with Few-Layer Graphene Electrocatalyst for Electrochemical NO_2^- Oxidation

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Graphical Abstract

Electrochemical oxidation of nitrite (NO_2^-) is demonstrated using metal-free, porous, and electrochemically highly stable nanoporous carbon (NC) system.

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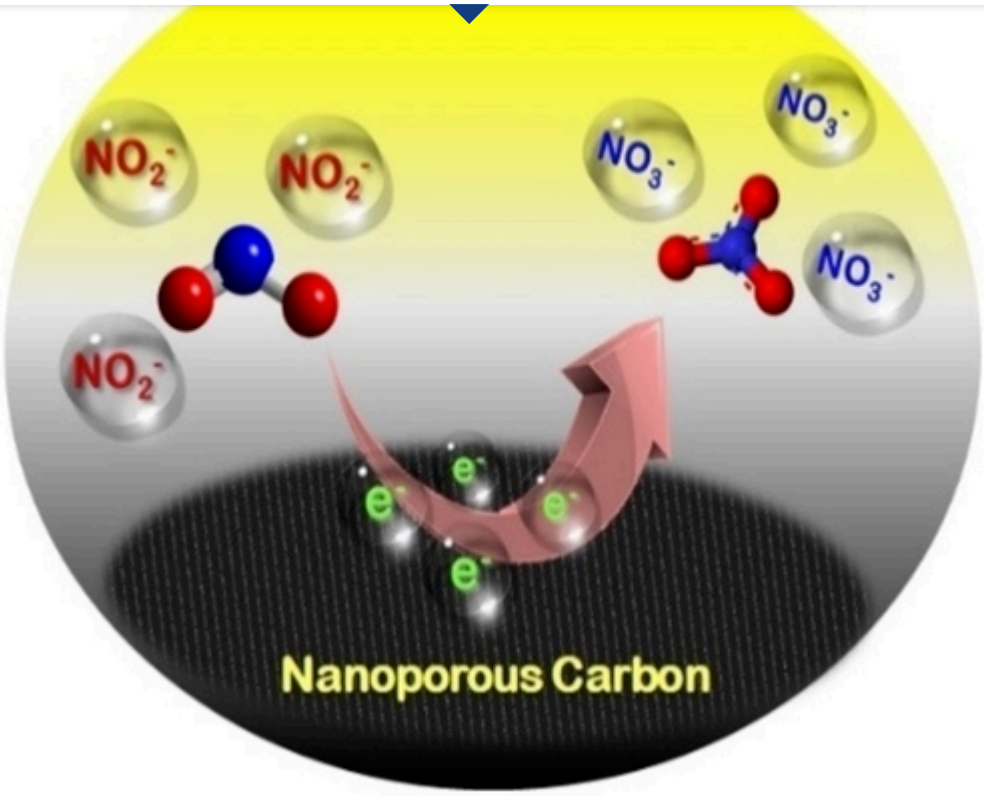

Abstract

Herein, electrochemical oxidation of nitrite (NO_2^-) is demonstrated using metal-free and electrochemically highly stable nanoporous carbon (NC) system. The surface features of nanoporous carbon were studied using both spectroscopic and microscopic techniques including scanning electron microscope (SEM), transmission electron microscope (TEM) and is having layered mesh-like features with a particle size of ~20 to ~100 nm. The as-synthesized electrocatalyst is found to be more active towards electrooxidation of nitrite (NO_2^-) at considerably low onset potential of 0.58 V vs SCE with a significantly high current density of 5.2 μA/cm^2 determined from linear sweep voltammetry (LSV), and cyclic voltammetry (CV) studies. The concentration and scan rate dependent studies confirm the nitrite oxidation is diffusion-controlled process. The interfacial electron transfer features and parameters involved are determined by electrochemical impedance spectroscopic (EIS) studies. Moreover, current stability at a nitrite oxidation (0.58 V vs SCE) potential is also tested by chronoamperometric (i-t) measurements and it demonstrates nanoporous carbon is having long term electrochemical stability. These studies establish the metal-free nanoporous carbon as an efficient electrocatalyst for nitrite oxidation and will be good futuristic electrode material for other energy and environmental based electrochemical monitoring studies.

Conflict of interest

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References

1 S. P. Gupta, A. S. Pawbake, B. R. Sathe, D. J. Late, P. S. Walke, *Sens. Actuators B* 2019, **293**, 83.

CAS | Web of Science® | Google Scholar

2 R. P. Dighole, A. V. Munde, B. B. Mulik, B. R. Sathe, *Front. Chem.* 2020, **8**, 1.

PubMed | Web of Science® | Google Scholar

3 B. B. Mulik, B. D. Bankar, A. V. Munde, P. P. Chavan, A. V. Biradar, B. R. Sathe, *Appl. Surf. Sci.* 2021, **538**, 148120.

CAS | Web of Science® | Google Scholar

4 M. A. L. R. M. Cortes, J. W. J. Hamilton, P. K. Sharma, A. Brown, M. Nolan, K. A. Gray, J. A. Byrne, *Catal. Today* 2019, **326**, 75.

CAS | Web of Science® | Google Scholar

5 A. J. L. Quist, M. Inoue-Choi, P. J. Weyer, K. E. Anderson, K. P. Cantor, S. Krasner, L. E. B. Freeman, M. H. Ward, R. R. Jones, *Int. J. Cancer* 2018, **142**, 251.

Back

6 P. P. Chavan, V. S. Sapner, B. R. Sathe, *ChemistrySelect* 2021, **6**, 6050.

CAS | Web of Science® | Google Scholar

7 N. Lavanya, N. Sudhan, P. Kanchana, S. Radhakrishnan, C. Sekar, *RSC Adv.* 2015, **5**, 52703.

CAS | Web of Science® | Google Scholar

8 X. Ma, T. Miao, W. Zhu, X. Gao, C. Wang, C. Zhao, H. Ma, *RSC Adv.* 2014, **4**, 57842.

CAS | Web of Science® | Google Scholar

9 Y. Ye, J. Ji, Z. Sun, P. Shen, X. Sun, *TrAC Trends Anal. Chem.* 2020, **122**, 115718.

CAS | Web of Science® | Google Scholar

10 W. Chen, L. Wang, M. Zhuo, Y. Wang, S. Fu, Y. Li, S. Wu, *RSC Adv.* 2014, **4**, 58778.

CAS | Web of Science® | Google Scholar

11 M. O. Guerrero-Pérez, M. J. Valero-Romero, S. Hernández, J. M. L. Nieto, J. Rodríguez-Mirasol, T. Cordero, *Catal. Today* 2012, **195**, 155.

CAS | Web of Science® | Google Scholar

12 J. M. Rosas, J. Bedia, J. Rodríguez-Mirasol, T. Cordero, *Fuel Process. Technol.* 2010, **91**, 1345.

CAS | Web of Science® | Google Scholar

13 C. Moreno-Castilla, M. López-Ramón, F. Carrasco-Marín, *Carbon N. Y.* 2000, **38**, 1995.

CAS | Web of Science® | Google Scholar

14 V. E. Diyuk, R. T. Mariychuk, V. V. Lisnyak, *Mater. Chem. Phys.* 2016, **184**, 138.

CAS | Web of Science® | Google Scholar

15 M. P. Doyle, S. N. Mahapatro, R. D. Broene, J. K. Guy, *J. Am. Chem. Soc.* 1988, **110**, 593.

Back

16 S. M. Mali, P. P. Chavan, Y. H. Navale, V. B. Patil, B. R. Sathe, *RSC Adv.* 2018, **8**, 11177.

CAS | Web of Science® | Google Scholar

17 Y. Xiao, W. Tian, S. Jin, Z. Gu, J. Zhang, *Small* 2020, **16**, 2005111.

CAS | Web of Science® | Google Scholar

18 H. Chen, Q.-H. Li, W. Yan, Z.-G. Gu, J. Zhang, *Chem. Eng. J.* 2020, **401**, 126149.

CAS | Web of Science® | Google Scholar

19 V. Mani, M. Govindasamy, S. M. Chen, T. W. Chen, A. S. Kumar, S. T. Huang, *Sci. Rep.* 2017, **7**, 1.

PubMed | Web of Science® | Google Scholar

20 M. M. Shahid, P. Rameshkumar, A. Pandikumar, H. N. Lim, Y. H. Ng, N. M. Huang, *J. Mater. Chem. A* 2015, **3**, 14458.

CAS | Web of Science® | Google Scholar

21 Y. Yang, Q. Wang, W. Qiu, H. Guo, F. Gao, *J. Phys. Chem. C* 2016, **120**, 9794.

CAS | Web of Science® | Google Scholar

22 D. Chen, J. Jiang, X. Du, *Talanta* 2016, **155**, 329.

CAS | PubMed | Web of Science® | Google Scholar

23 A. C. Ferrari, J. Robertson, *Philos. Trans. R. Soc. London* 2004, **362**, 2477.

CAS | PubMed | Web of Science® | Google Scholar

24 V. S. Sapner, P. P. Chavan, B. R. Sathe, *ACS Sustainable Chem. Eng.* 2020, **8**, 5524.

CAS | Web of Science® | Google Scholar

Back

CAS | Web of Science® | Google Scholar

26 V. S. Sapner, P. P. Chavan, R. V. Digraskar, S. S. Narwade, B. B. Mulik, S. M. Mali, B. R. Sathe, *ChemElectroChem* 2018, **5**, 3191.

CAS | Web of Science® | Google Scholar

27 A. V. Munde, B. B. Mulik, P. P. Chavan, B. R. Sathe, *Electrochim. Acta* 2020, **349**, 136386.

CAS | Google Scholar

28 W. Peng, S. Liu, H. Sun, Y. Yao, L. Zhi, S. Wang, *J. Mater. Chem. A* 2013, **1**, 5854.

CAS | Web of Science® | Google Scholar

29 S. S. Gunasekaran, S. K. Elumalali, T. K. Kumaresan, R. Meganathan, A. Ashok, V. Pawar, K. Vediappan, G. Ramasamy, S. Z. Karazhanov, K. Raman, R. Subashchandra Bose, *Mater. Lett.* 2018, **218**, 165.

CAS | Web of Science® | Google Scholar

30 R. V. Digraskar, V. S. Sapner, A. V. Ghule, B. R. Sathe, *ACS Omega* 2019, **4**, 18969.

CAS | PubMed | Web of Science® | Google Scholar

31 V. S. Sapner, P. P. Chavan, A V. Munde, U. S. Sayyad, B. R. Sathe, *Energy Fuels* 2021, **35**, 6823.

CAS | Web of Science® | Google Scholar

32 A. V. Munde, B. B. Mulik, P. P. Chavan, V. S. Sapner, S. S. Narwade, S. M. Mali, B. R. Sathe, *J. Phys. Chem. C* 2021, acs. jpcc. 0c10668.

Google Scholar

33 G. Bharath, R. Madhu, S. M. Chen, V. Veeramani, D. Mangalaraj, N. Ponpandian, *J. Mater. Chem. A* 2015, **3**, 15529.

CAS | Web of Science® | Google Scholar

Back

Actuators B 2018, **266**, 373.

CAS | Web of Science® | Google Scholar

35 R. Yue, Q. Lu, Y. Zhou, *Biosens. Bioelectron.* 2011, **26**, 4436.

CAS | PubMed | Web of Science® | Google Scholar

36 A. Gholizadeh, D. Voiry, C. Weisel, A. Gow, R. Laumbach, H. Kipen, M. Chhowalla, M. Javanmard, *Microsystems Nanoeng.* 2017, **3**, 17022.

CAS | PubMed | Web of Science® | Google Scholar

37 Y. Zhang, R. Yuan, Y. Chai, W. Li, X. Zhong, H. Zhong, *Biosens. Bioelectron.* 2011, **26**, 3977.

CAS | PubMed | Web of Science® | Google Scholar

38 A. S. Adekunle, J. Pillay, K. I. Ozoemena, *Electrochim. Acta* 2010, **55**, 4319.

CAS | Web of Science® | Google Scholar

39 P. Miao, M. Shen, L. Ning, G. Chen, Y. Yin, *Anal. Bioanal. Chem.* 2011, **399**, 2407.

CAS | PubMed | Web of Science® | Google Scholar

40 Y. Liu, H.-Y. Gu, *Microchim. Acta* 2008, **162**, 101.

CAS | Web of Science® | Google Scholar

41 A. Diouf, N. El Bari, B. Bouchikhi, *Talanta* 2020, **209**, 120577.

CAS | PubMed | Web of Science® | Google Scholar

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