Document details

Journal of Electroanalytical Chemistry
Volume 799, 15 August 2017, Pages 609-616

A scalable and facile synthesis of carbon nanospheres as a metal free electrocatalyst for oxidation of L-ascorbic acid: Alternate fuel for direct oxidation fuel cells (Article)

Sathe, B.R.

Department of Chemistry, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, MH 431 004, India

Abstract

Large-scale, highly crystalline, high surface area carbon nanospheres (CNSs; ~ 250 nm) were synthesized on Cu substrate by optimized two step chemical vapor deposition (CVD) approach from a mixture of camphor and naphthalene as a source of carbon at 950 °C using Ar as a carrier gas. On the basis of host of characterization techniques the mechanistic pathway proposed for the formation of CNSs having ordered graphite crystal structure. The present approach is capable of producing monodispersed, high yield and ultra-high purity (no other carbon impurities) nanospheres. This work further report on the electrocatalytic performance of as-synthesized CNSs and acid treated CNSs for the ascorbic acid (AA) oxidation reaction as a model reaction for direct oxidation fuel cells. These CNSs based electrocatalytic systems exhibits enhanced current densities and lower oxidation overvoltages response, demonstrating excellent catalytic activities towards AA oxidation could be due to their advantageous structural features. © 2017 Elsevier B.V.

SciVal Topic Prominence

Topic: Carbonization | Thermochemistry | hydrothermal carbonization

Prominence percentile: 99.375

Reaxys Database Information

View Compounds

Author keywords

Acid functionalized carbon nanospheres (F-CNSs) | Carbon nanospheres (CNSs) | Cyclic voltammetry | Direct oxidation fuel cells | L-Ascorbic acid oxidation | Metal-free electrocatalysis

Indexed keywords

Engineering controlled terms: Catalyst activity | Catalytic oxidation | Chemical vapor deposition | Crystal impurities | Crystal structure | Cyclic voltammetry | Electrocatalysis | Electrocatalysts | Fuel cells | Gas fuel purification | Ionic liquids | Nanospheres | Naphthalene | Organic acids | Oxidation

Engineering uncontrolled terms: Carbon nanosphere | Direct oxidation | Functionalized | L-ascorbic acid | Metal free

Engineering main heading: Ascorbic acid

Cited by 3 documents

Tyramine Functionalized Graphene: Metal-Free Electrochemical Non-Enzymatic Biosensing of Hydrogen Peroxide

Sapner, V.S. , Chavan, P.P. , Digraskar, R.V.
(2018) ChemElectroChem

The hydrophilicity of carbon for the performance enhancement of direct ascorbic acid fuel cells

Qiu, C. , Chen, H. , Liu, H.
(2018) International Journal of Hydrogen Energy

Enhanced electrocatalytic hydrogen generation from water: Via cobalt-doped Cu2ZnSnS4 nanoparticles

Digraskar, R.V. , Sapner, V.S. , Narwade, S.S.
(2018) RSC Advances

Related documents

Effects of copper ions and chelate agent on output of ascorbic acid fuel cell

Furugori, R. , Ikeda, S. , Tanaka, M.
(2011) American Society of Mechanical Engineers, Power Division (Publication) POWER

l-Ascorbic acid as an alternative fuel for direct oxidation fuel cells

ISSN: 15726657
CODEN: JECHE
Source Type: Journal
Original language: English

DOI: 10.1016/j.jelechem.2017.03.049
Document Type: Article
Publisher: Elsevier B.V.

References (60)

View in search results format >

All Export Print E-mail Save to PDF Create bibliography

1 Li, Q., Miao, X., Wang, C., Yin, L.
Three-dimensional Mn-doped Zn_2GeO_4 nanosheet array hierarchical nanostructures anchored on porous Ni foam as binder-free and carbon-free lithium-ion battery anodes with enhanced electrochemical performance

(2015) *Journal of Materials Chemistry A*, 3 (42), pp. 21328-21336. Cited 27 times.
http://pubs.rsc.org/en/journals/journalissues/ta
doi: 10.1039/c5ta04648c

View at Publisher

2 Janani, M., Srikrishnarka, P., Nair, S.V., Nair, A.S.
An in-depth review on the role of carbon nanostructures in dye-sensitized solar cells

(2015) *Journal of Materials Chemistry A*, 3 (35), pp. 17914-17938. Cited 43 times.
http://pubs.rsc.org/en/journals/journal/ta
doi: 10.1039/c5ta03644e

View at Publisher

3 Jiménez, V., Muñoz, A., Sánchez, P., Valverde, J.L., Romero, A.
Pilot plant scale synthesis of CNS: Influence of the operating conditions

(2012) *Industrial and Engineering Chemistry Research*, 51 (19), pp. 6745-6752. Cited 5 times.
doi: 10.1021/ie300254w

View at Publisher

4 Qu, L., Zhang, H., Zhu, J., Dai, L.
Tunable assembly of carbon nanospheres on single-walled carbon nanotubes

(2010) *Nanotechnology*, 21 (30), art. no. 305602. Cited 8 times.
doi: 10.1088/0957-4484/21/30/305602

View at Publisher

5 Pan, K., Ming, H., Liu, Y., Kang, Z.
Large scale synthesis of carbon nanospheres and their application as electrode materials for heavy metal ions detection

(2012) *New Journal of Chemistry*, 36 (1), pp. 113-118. Cited 24 times.
www.rsc.org/njc
doi: 10.1039/c1nj20756c

View at Publisher

6 Tang, K., Fu, L., White, R.J., Yu, L., Titirici, M.-M., Antonietti, M., Maier, J.
Hollow carbon nanospheres with superior rate capability for sodium-based batteries

(2012) *Advanced Energy Materials*, 2 (7), pp. 873-877. Cited 600 times.
doi: 10.1002/aenm.201100691

View at Publisher

7 Lawrenceville, N.J.
Hard Waters Technology Innovation, LLC; (U.S. Patents)
(2012) , 7, p. 718.
(155–160)

8 Yoo, E., Nakamura, J., Zhou, H.
N-Doped graphene nanosheets for Li-air fuel cells under acidic conditions

(2012) *Energy and Environmental Science*, 5 (5), pp. 6928-6932. Cited 108 times.
doi: 10.1039/c2ee02830a

View at Publisher

9 Hourani, R., Zhang, C., Van Der Weegen, R., Ruiz, L., Li, C., Keten, S., Helms, B.A., (...), Xu, T.
Processable cyclic peptide nanotubes with tunable interiors

(2011) *Journal of the American Chemical Society*, 133 (39), pp. 15296-15299. Cited 79 times.
doi: 10.1021/ja2063082

View at Publisher

10 Luo, Xiangcheng, Chung, D.D.L.
Graphite-graphite electrical contact under dynamic mechanical loading

(2001) *Carbon*, 39 (4), pp. 615-618. Cited 7 times.
doi: 10.1016/S0008-6223(00)00262-1

View at Publisher

11 Wu, C., Zhu, X., Ye, L., OuYang, C., Hu, S., Lei, L., Xie, Y.
Necklace-like hollow carbon nanospheres from the pentagon-including reactants: Synthesis and electrochemical properties

(2006) *Inorganic Chemistry*, 45 (21), pp. 8543-8550. Cited 60 times.
doi: 10.1021/ic060827f

View at Publisher

12 Allen, M.J., Tung, V.C., Kaner, R.B.
Honeycomb carbon: A review of graphene

(2010) *Chemical Reviews*, 110 (1), pp. 132-145. Cited 3692 times.
http://pubs.acs.org/doi/pdfplus/10.1021/cr900070d
doi: 10.1021/cr900070d

View at Publisher

13 Zobir, S.A.M., Abdullah, S., Zainal, Z., Sarijo, S.H., Rusop, M.
Synthesis of carbon nano- and microspheres using palm olein as the carbon source

(2012) *Materials Letters*, 78, pp. 205-208. Cited 6 times.
doi: 10.1016/j.matlet.2012.03.032

View at Publisher

14 Chen, L.S., Wang, C.J.
Synthesis of carbon spheres with controllable size distribution by chemical vapor deposition
(2012) *Adv. Mater. Res.*, 3807, pp. 490-495.

15 Hammershøj, P., Bomans, P.H.H., Lakshminarayanan, R., Fock, J., Jensen, S.H., Jespersen, T.S., Brock-Nannestad, T., (...), Christensen, J.B.
A triptycene-based approach to solubilising carbon nanotubes and C_{60}

(2012) *Chemistry - A European Journal*, 18 (28), pp. 8716-8723. Cited 13 times.
doi: 10.1002/chem.201101189

View at Publisher

16 Shaikjee, A., Coville, N.J.
The role of the hydrocarbon source on the growth of carbon materials

(2012) *Carbon*, 50 (10), pp. 3376-3398. Cited 51 times.
doi: 10.1016/j.carbon.2012.03.024

View at Publisher

17 Velíšek, J., Cejpek, K.
Biosynthesis of food constituents: Vitamins. 2. Water-soluble vitamins: Part 1 - A review

(2007) *Czech Journal of Food Sciences*, 25 (2), pp. 49-64. Cited 12 times.

18 Liu, J., Lu, S., Liang, X., Gan, Q., Wang, Y., Li, H.
Photoelectrocatalytic oxidation of ascorbic acid and electrocatalytic reduction of dioxygen by polyaniline films for renewable energy conversion

(2016) *Journal of Electroanalytical Chemistry*, 764, pp. 15-22. Cited 8 times.
doi: 10.1016/j.jelechem.2016.01.006

View at Publisher

19 Martin, D.W.
(1983) *Harper's Review of Biochemistry*. Cited 250 times.
D.W. Martin Jr. P.A. Mayer V.W. Rodwell 19th ed. Lange Los Altos, CA

20 Koshiishi, I., Imanari, T.
Measurement of ascorbate and dehydroascorbate contents in biological fluids

(1997) *Analytical Chemistry*, 69 (2), pp. 216-220. Cited 102 times.
doi: 10.1021/ac960704k

View at Publisher

21 Fujiwara, N., Yamazaki, S.-i., Siroma, Z., Ioroi, T., Yasuda, K.
l-Ascorbic acid as an alternative fuel for direct oxidation fuel cells

(2007) *Journal of Power Sources*, 167 (1), pp. 32-38. Cited 34 times.
doi: 10.1016/j.jpowsour.2007.02.023

View at Publisher

22 Kokoh, K.B, Hahn, F., Métayer, A., Lamyl, C.
FTIR spectroelectrochemical investigation of the electrocatalytic oxidation of ascorbic acid at platinum electrodes in acid medium

(2002) *Electrochimica Acta*, 47 (24), pp. 3965-3969. Cited 14 times.
doi: 10.1016/S0013-4686(02)00368-7

View at Publisher

23 Rueda, M., Aldaz, A., Sanchez-Burgos, F.
Oxidation of L-ascorbic acid on a gold electrode

(1978) *Electrochimica Acta*, 23 (5), pp. 419-424. Cited 121 times.
doi: 10.1016/0013-4686(78)87040-6

View at Publisher

24 Ruiz, J.J., Aldaz, A., Dominguez, M.

Mechanism of L ascorbic acid oxidation and dehydro L ascorbic acid reduction on a mercury electrode. I. Acid medium

(1977) *Canadian Journal of Chemistry*, 55 (15), pp. 2799-2806. Cited 97 times.
doi: 10.1139/v77-389

View at Publisher

25 Deakin, M.R., Kovach, P.M., Stutts, K.J., Wightman, R.M.

Heterogeneous Mechanisms of the Oxidation of Catechols and Ascorbic Acid at Carbon Electrodes

(1986) *Analytical Chemistry*, 58 (7), pp. 1474-1480. Cited 185 times.
doi: 10.1021/ac00298a046

View at Publisher

26 Hu, I.-F., Kuwana, T.

Oxidative Mechanism of Ascorbic Acid at Glassy Carbon Electrodes

(1986) *Analytical Chemistry*, 58 (14), pp. 3235-3239. Cited 159 times.
doi: 10.1021/ac00127a069

View at Publisher

27 Fujiwara, N., Yamazaki, S.-i., Siroma, Z., Ioroi, T., Yasuda, K.

Direct oxidation of l-ascorbic acid on a carbon black electrode in acidic media and polymer electrolyte fuel cells

(2006) *Electrochemistry Communications*, 8 (5), pp. 720-724. Cited 31 times.
doi: 10.1016/j.elecom.2006.02.021

View at Publisher

28 Walter, M.G., Warren, E.L., McKone, J.R., Boettcher, S.W., Mi, Q., Santori, E.A., Lewis, N.S.

Solar water splitting cells

(2010) *Chemical Reviews*, 110 (11), pp. 6446-6473. Cited 4427 times.
doi: 10.1021/cr1002326

View at Publisher

29 Cook, T.R., Dogutan, D.K., Reece, S.Y., Surendranath, Y., Teets, T.S., Nocera, D.G.

Solar energy supply and storage for the legacy and nonlegacy worlds

(2010) *Chemical Reviews*, 110 (11), pp. 6474-6502. Cited 1362 times.
doi: 10.1021/cr100246c

View at Publisher

30 Zheng, Y., Jiao, Y., Zhu, Y., Li, L.H., Han, Y., Chen, Y., Du, A., (...), Qiao, S.Z.

Hydrogen evolution by a metal-free electrocatalyst (Open Access)

(2014) *Nature Communications*, 5, art. no. 3783. Cited 698 times.
http://www.nature.com/ncomms/index.html
doi: 10.1038/ncomms4783

View at Publisher

31 Kakade, B.A., Allouche, H., Mahima, S., Sathe, B.R., Pillai, V.K.

High-purity synthesis of scrolled mats of multi-walled carbon nanotubes using temperature modulation

(2008) *Carbon*, 46 (4), pp. 567-576. Cited 15 times.
doi: 10.1016/j.carbon.2007.12.020

View at Publisher

32 Sathe, B.R.
Rhodium nanoparticle-carbon nanosphere hybrid material as an electrochemical hydrogen sensor

(2013) *RSC Advances*, 3 (16), pp. 5361-5365. Cited 13 times.
doi: 10.1039/c3ra00105a

View at Publisher

33 Boukhvalov, D.W., Katsnelson, M.I.
Chemical functionalization of graphene with defects

(2008) *Nano Letters*, 8 (12), pp. 4374-4379. Cited 215 times.
doi: 10.1021/nl802234n

View at Publisher

34 Nieto-Márquez, A., Romero, R., Romero, A., Valverde, J.L.
Carbon nanospheres: Synthesis, physicochemical properties and applications

(2011) *Journal of Materials Chemistry*, 21 (6), pp. 1664-1672. Cited 134 times.
doi: 10.1039/c0jm01350a

View at Publisher

35 Deshmukh, A.A., Mhlanga, S.D., Coville, N.J.
Carbon spheres

(2010) *Materials Science and Engineering R: Reports*, 70 (1-2), pp. 1-28. Cited 175 times.
doi: 10.1016/j.mser.2010.06.017

View at Publisher

36 Kumar, M., Ando, Y.
Chemical vapor deposition of carbon nanotubes: A review on growth mechanism and mass production

(2010) *Journal of Nanoscience and Nanotechnology*, 10 (6), pp. 3739-3758. Cited 640 times.
doi: 10.1166/jnn.2010.2939

View at Publisher

37 Prasek, J., Drbohlavova, J., Chomoucka, J., Hubalek, J., Jasek, O., Adam, V., Kizek, R.
Methods for carbon nanotubes synthesis - Review

(2011) *Journal of Materials Chemistry*, 21 (40), pp. 15872-15884. Cited 284 times.
doi: 10.1039/c1jm12254a

View at Publisher

38 Nerushev, O.A., Dittmar, S., Morjan, R.-E., Rohmund, F., Campbell, E.E.B.
Particle size dependence and model for iron-catalyzed growth of carbon nanotubes by thermal chemical vapor deposition

(2003) *Journal of Applied Physics*, 93 (7), pp. 4185-4190. Cited 78 times.
doi: 10.1063/1.1559433

View at Publisher

39 Morjan, R.E., Nerushev, O.A., Sveningson, M., Rohmund, F., Falk, L.K.L., Campbell, E.E.B.
Growth of carbon nanotubes from C_{60}

(2004) *Applied Physics A: Materials Science and Processing*, 78 (3), pp. 253-261. Cited 29 times.
doi: 10.1007/s00339-003-2297-z

View at Publisher

40 Andrews, R.J., Smith, C.F., Alexander, A.J.
Mechanism of carbon nanotube growth from camphor and camphor analogs by chemical vapor deposition

(2006) *Carbon*, 44 (2), pp. 341-347. Cited 40 times.
doi: 10.1016/j.carbon.2005.07.025

View at Publisher

41 Somani, P.R., Somani, S.P., Umeno, M.
Planer nano-graphenes from camphor by CVD

(2006) *Chemical Physics Letters*, 430 (1-3), pp. 56-59. Cited 192 times.
doi: 10.1016/j.cplett.2006.06.081

View at Publisher

42 Cho, H.-H., Smith, B.A., Wnuk, J.D., Fairbrother, D.H., Ball, W.P.
Influence of surface oxides on the adsorption of naphthalene onto multiwalled carbon nanotubes

(2008) *Environmental Science and Technology*, 42 (8), pp. 2899-2905. Cited 218 times.
doi: 10.1021/es702363e

View at Publisher

43 Miao, J.-Y., Hwang, D.W., Narasimhulu, K.V., Lin, P.-I., Chen, Y.-T., Lin, S.-H., Hwang, L.-P.
Synthesis and properties of carbon nanospheres grown by CVD using Kaolin supported transition metal catalysts

(2004) *Carbon*, 42 (4), pp. 813-822. Cited 116 times.
doi: 10.1016/j.carbon.2004.01.053

View at Publisher

44 Charinpanitkul, T., Sano, N., Puengjinda, P., Klanwan, J., Akrapattangkul, N., Tanthapanichakoon, W.
Naphthalene as an alternative carbon source for pyrolytic synthesis of carbon nanostructures

(2009) *Journal of Analytical and Applied Pyrolysis*, 86 (2), pp. 386-390. Cited 17 times.
doi: 10.1016/j.jaap.2009.08.001

View at Publisher

45 Kumar, M., Ando, Y.
A simple method of producing aligned carbon nanotubes from an unconventional precursor - Camphor

(2003) *Chemical Physics Letters*, 374 (5-6), pp. 521-526. Cited 111 times.
doi: 10.1016/S0009-2614(03)00742-5

View at Publisher

46 Mattevi, C., Kim, H., Chhowalla, M.
A review of chemical vapour deposition of graphene on copper

(2011) *Journal of Materials Chemistry*, 21 (10), pp. 3324-3334. Cited 803 times.
doi: 10.1039/c0jm02126a

View at Publisher

47 Narwade, S.S., Mulik, B.B., Mali, S.M., Sathe, B.R.
Silver nanoparticles sensitized C_{60}($Ag@C_{60}$) as efficient electrocatalysts for hydrazine oxidation: Implication for hydrogen generation reaction

(2017) *Applied Surface Science*, 396, pp. 939-944. Cited 13 times.
http://www.journals.elsevier.com/applied-surface-science/
doi: 10.1016/j.apsusc.2016.11.065

View at Publisher