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Facile one - step preparation and characterization of graphene quantum dots suspension via electrochemical exfoliation

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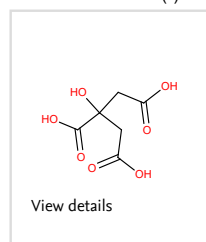
This study reports on the production of graphene quantum dots (GQDs) suspension using a simple electrochemical setup which involved an electrolyte solution, consisting of citric acid and sodium hydroxide (NaOH) mixture, and pristine graphite rods for the electrode without any heating treatment (calcination), thus avoiding any high energy consumption. The balanced reaction mixture of citric acid and NaOH was used to investigate the effects of reaction time and voltage used towards the production of GQDs. UV-Vis spectroscopy analysis revealed significant UV absorption around 240-255 nm which depicted $\pi \rightarrow \pi^*$ transition of aromatic sp² C-C bonds while FTIR analysis showed the significant C=C stretching band around 1635 cm⁻¹ attributed by the aromatic ring. The exfoliation of the GQDs was increased as the concentration of NaOH in the electrolyte, time taken and voltage were increased. The optimum GQDs suspension can be obtained using a balanced ratio of citric acid and NaOH with a voltage of 10 V for 2 hours reaction time. TEM analysis confirmed the presence of the GQDs obtained with an average size of ~5 nm for the optimum GQDs suspension. The exfoliation of GQDs via the electrochemical technique may pave the way towards upscale and sustainable production of the nanomaterial. © 2021 Malaysian Institute of Chemistry. All rights reserved.

Author keywords

Electrochemical; Exfoliation; Graphene; Graphene quantum dots; Suspension

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Ahmad Noorden, A.F.

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 (2013) *Materials Letters*
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References (22)

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- 1 Novoselov, K.S., Geim, A.K., Morozov, S.V., Jiang, D., Zhang, Y., Dubonos, S.V., Grigorieva, I.V., (...), Firsov, A.A.

Electric field in atomically thin carbon films ([Open Access](#))

(2004) *Science*, 306 (5696), pp. 666-669. Cited 45465 times.
doi: 10.1126/science.1102896

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- 2 Phiri, J., Gane, P., Maloney, T.C.

General overview of graphene: Production, properties and application in polymer composites ([Open Access](#))

(2017) *Materials Science and Engineering B: Solid-State Materials for Advanced Technology*, 215, pp. 9-28. Cited 171 times.
doi: 10.1016/j.mseb.2016.10.004

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- 3 Ponomarenko, L.A., Schedin, F., Katsnelson, M.I., Yang, R., Hill, E.W., Novoselov, K.S., Geim, A.K.

Chaotic dirac billiard in graphene quantum dots ([Open Access](#))

(2008) *Science*, 320 (5874), pp. 356-358. Cited 1685 times.
doi: 10.1126/science.1154663

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- 4 Zhu, S., Song, Y., Zhao, X., Shao, J., Zhang, J., Yang, B.

The photoluminescence mechanism in carbon dots (graphene quantum dots, carbon nanodots, and polymer dots): current state and future perspective

(2015) *Nano Research*, 8 (2), pp. 355-381. Cited 1329 times.
<http://www.springer.com.ezlib.iium.edu.my/materials/nanotechnology/journal/12274>
doi: 10.1007/s12274-014-0644-3

[View at Publisher](#)

- 5 Ozhukil Valappil, M., K. Pillai, V., Alwarappan, S.

Spotlighting graphene quantum dots and beyond: Synthesis, properties and sensing applications

(2017) *Applied Materials Today*, 9, pp. 350-371. Cited 41 times.
<http://www.journals.elsevier.com/applied-materials-today/>
doi: 10.1016/j.apmt.2017.09.002

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- 6 Pan, D., Zhang, J., Li, Z., Wu, M.

Hydrothermal route for cutting graphene sheets into blue-luminescent graphene quantum dots

(2010) *Advanced Materials*, 22 (6), pp. 734-738. Cited 2035 times.
<http://www3.interscience.wiley.com.ezlib.iium.edu.my/cgi-bin/fulltext/123209479/PDFSTART>
doi: 10.1002/adma.200902825

[View at Publisher](#)

- 7 Peng, J., Gao, W., Gupta, B.K., Liu, Z., Romero-Aburto, R., Ge, L., Song, L., (...), Ajayan, P.M.
Graphene quantum dots derived from carbon fibers
(2012) *Nano Letters*, 12 (2), pp. 844-849. Cited 1619 times.
doi: 10.1021/nl2038979
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-
- 8 Shin, Y., Lee, J., Yang, J., Park, J., Lee, K., Kim, S., Park, Y., (...), Lee, H.
Mass production of graphene quantum dots by one-pot synthesis directly from graphite in high yield
(2014) *Small*, 10 (5), pp. 866-870. Cited 84 times.
doi: 10.1002/smll.201302286
View at Publisher
-
- 9 Fu, Y., Gao, G., Zhi, J.
Electrochemical synthesis of multicolor fluorescent N-doped graphene quantum dots as a ferric ion sensor and their application in bioimaging
(2019) *Journal of Materials Chemistry B*, 7 (9), pp. 1494-1502. Cited 33 times.
<http://pubs.rsc.org/en/journals/journal/tb>
doi: 10.1039/c8tb03103g
View at Publisher
-
- 10 Dong, Y., Shao, J., Chen, C., Li, H., Wang, R., Chi, Y., Lin, X., (...), Chen, G.
Blue luminescent graphene quantum dots and graphene oxide prepared by tuning the carbonization degree of citric acid
(2012) *Carbon*, 50 (12), pp. 4738-4743. Cited 1138 times.
doi: 10.1016/j.carbon.2012.06.002
View at Publisher
-
- 11 Yan, X., Cui, X., Li, L.-S.
Synthesis of large, stable colloidal graphene quantum dots with tunable size
(2010) *Journal of the American Chemical Society*, 132 (17), pp. 5944-5945. Cited 591 times.
doi: 10.1021/ja1009376
View at Publisher
-
- 12 Lu, J., Yeo, P.S.E., Gan, C.K., Wu, P., Loh, K.P.
Transforming C 60 molecules into graphene quantum dots
(2011) *Nature Nanotechnology*, 6 (4), pp. 247-252. Cited 491 times.
<http://www.nature.com/nnano/index.html>
doi: 10.1038/nnano.2011.30
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-
- 13 Tan, X., Li, Y., Li, X., Zhou, S., Fan, L., Yang, S.
Electrochemical synthesis of small-sized red fluorescent graphene quantum dots as a bioimaging platform
(2015) *Chemical Communications*, 51 (13), pp. 2544-2546. Cited 207 times.
<http://pubs.rsc.org/en/journals/journal/cc>
doi: 10.1039/c4cc09332a
View at Publisher
-
- 14 Muthurasu, A., Dhandapani, P., Ganesh, V.
Facile and simultaneous synthesis of graphene quantum dots and reduced graphene oxide for bio-imaging and supercapacitor applications
(2016) *New Journal of Chemistry*, 40 (11), pp. 9111-9124. Cited 29 times.
<http://pubs.rsc.org/en/journals/journal/nj>
doi: 10.1039/c6nj00586a
View at Publisher

- 15 Li, Y., Li, S., Wang, Y., Wang, J., Liu, H., Liu, X., Wang, L., (...), Ma, N.
Electrochemical synthesis of phosphorus-doped graphene quantum dots for free radical scavenging
(2017) *Physical Chemistry Chemical Physics*, 19 (18), pp. 11631-11638. Cited 76 times.
<http://www.rsc.org/Publishing/Journals/CP/index.asp>
doi: 10.1039/c6cp06377b
View at Publisher
-
- 16 Ahirwar, S., Mallick, S., Bahadur, D.
Electrochemical Method to Prepare Graphene Quantum Dots and Graphene Oxide Quantum Dots (Open Access)
(2017) *ACS Omega*, 2 (11), pp. 8343-8353. Cited 73 times.
pubs.acs.org/journal/acsodf
doi: 10.1021/acsomega.7b01539
View at Publisher
-
- 17 Danial, W.H., Chutia, A., Majid, Z.A., Sahnoun, R., Aziz, M.
Electrochemical synthesis and characterization of stable colloidal suspension of graphene using two-electrode cell system
(2015) *AIP Conference Proceedings*, 1669, art. no. 4919158. Cited 2 times.
<http://scitation.aip.org/content/aip/proceeding/aipcp>
ISBN: 978-073541316-0
doi: 10.1063/1.4919158
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-
- 18 Zhu, S., Song, Y., Zhao, X., Shao, J., Zhang, J., Yang, B.
The photoluminescence mechanism in carbon dots (graphene quantum dots, carbon nanodots, and polymer dots): current state and future perspective
(2015) *Nano Research*, 8 (2), pp. 355-381. Cited 1329 times.
<http://www.springer.com.ezlib.iium.edu.my/materials/nanotechnology/journal/12274>
doi: 10.1007/s12274-014-0644-3
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-
- 19 Šileikaite, A., Puišo, J., Prosyčėvas, I., Tamulevičius, S.
Investigation of silver nanoparticles formation kinetics during reduction of silver nitrate with sodium citrate
(2009) *Medžiagotyra*, 15 (1), pp. 21-27. Cited 80 times.
[http://internet.ktu.lt/lt/mokslas/zurnalai/medz/pdf/medz0-96/05%20Electronic.../pp.21-27\).pdf](http://internet.ktu.lt/lt/mokslas/zurnalai/medz/pdf/medz0-96/05%20Electronic.../pp.21-27).pdf)
-
- 20 Kim, J.K., Kim, S.J., Park, M.J., Bae, S., Cho, S.-P., Du, Q.G., Wang, D.H., (...), Hong, B.H.
Surface-Engineered Graphene Quantum Dots Incorporated into Polymer Layers for High Performance Organic Photovoltaics (Open Access)
(2015) *Scientific Reports*, 5, art. no. 14276. Cited 42 times.
www.nature.com/srep/index.html
doi: 10.1038/srep14276
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-
- 21 Kim, K.-W., Kim, B.S., Lee, S.W., Chung, D.C., Kim, B.-J.
Effects of synthesis pressure conditions on the preparation of graphene-like carbonaceous materials from organic liquid precursors by a solvothermal method
(2017) *Carbon Letters*, 23 (3), pp. 74-78.
[http://carbonlett.org/Upload/files/CARBONLETT/\[074-078\]-11.pdf](http://carbonlett.org/Upload/files/CARBONLETT/[074-078]-11.pdf)
doi: 10.5714/CL.2017.23.074
View at Publisher

□ 22 Pedrero, M., Campuzano, S., Pingarrón, J.M.

Quantum dots as components of electrochemical sensing platforms for the detection of environmental and food pollutants: A review

(2017) *Journal of AOAC International*, 100 (4), pp. 950-961. Cited 23 times.

[http://www.ingentaconnect.com/search/download?](http://www.ingentaconnect.com/search/download?pub=infobike%3a%2f%2faoc%2fjaoac%2f2017%2f00000100%2f00000004%2fart00016&mimetype=application%2fpdf&exitTargetId=1500538954605)

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