

This document is confidential and is proprietary to the American Chemical Society and its authors. Do not copy or disclose without written permission. If you have received this item in error, notify the sender and delete all copies.

Development of Green Carbon Dots for the detection of emerging contaminants in wastewater

Journal:	<i>ACS Books</i>
Manuscript ID	bk-2024-00492m
Manuscript Type:	Symposium Series Book Proposal
Date Submitted by the Author:	25-Sep-2024
Complete List of Authors:	Ahmad, Nafees; Integral University, Department of Chemistry Afreen, Neda; Integral University, Chemistry Khan, Mohsin ; Integral University Faculty of Architecture Planning and Design, 2Department of Biosciences Khan, Saima; Integral University, Department of Chemistry Ahmad, Naseem; Integral University, 1Department of Chemistry Shahadat, Mohammad; Universiti Sains Malaysia, School of Chemical Sciences Azam, Ameer; Islamic University of Madinah, Applied Physics

Development of Green Carbon Dots for the detection of emerging contaminants in wastewater

Nafees Ahmad¹, Neda Afreen¹, Mohsin Wahid Khan², Saimah Khan¹, Naseem Ahmad¹,
Mohammad Shahadat^{3,4}, Ameer Azam⁵

¹Department of Chemistry, Integral University, Lucknow-226026, India

²Department of Biosciences, Integral University, Lucknow-226026, India

³Department of Textile and Fiber Engineering, Indian Institute of Technology, New Delhi
110016, India

⁴Department of Physics, Swami Vivekanand Subharti University Meerut-250005, UP, India

⁵Department of Physics, Faculty of Science, Islamic University of Madinah, Madinah
42351, Saudi Arabia

*E-mail: mdshahadat93@gmail.com

Abstract

The rapid industrialization and urbanization have led to the emergence of various contaminants in wastewater, posing significant environmental and health concerns. This chapter explores the development of Green Carbon Dots (GCDs) as a novel and sustainable nanomaterial for the detection of emerging contaminants in wastewater. Green synthesis methods, emphasizing environmentally friendly approaches, are discussed, highlighting the importance of tailoring GCD properties for efficient sensing applications. The optical properties, surface chemistry, and biocompatibility of GCDs are elucidated, showcasing their potential as versatile nanoproboscopes. The chapter provides an overview of common emerging contaminants in wastewater, discussing their environmental impact and the limitations of traditional detection methods. The detection mechanisms involving the interaction between GCDs and emerging contaminants are detailed, focusing on the principles of sensitivity and selectivity for accurate analysis. Applications of GCDs in detecting pharmaceuticals, personal care products, endocrine-disrupting chemicals, and microplastics are explored through case studies, emphasizing successful real-world implementations and comparative analyses with traditional methods. Challenges in the use of GCDs for wastewater sensing are addressed, along with strategies for overcoming limitations and improving performance. Furthermore, the chapter delves into the environmental and regulatory considerations associated with the detection of emerging contaminants, discussing the implications

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
72. Brown, K. D., Kulis, J., Thomson, B., Chapman, T. H., & Mawhinney, D. B. (2006). Occurrence of antibiotics in hospital, residential, and dairy effluent, municipal wastewater, and the Rio Grande in New Mexico. *Science of the Total Environment*, 366(2-3), 772-783.
73. Jiang, J. Q., Zhou, Z., & Sharma, V. K. (2013). Occurrence, transportation, monitoring and treatment of emerging micro-pollutants in waste water—A review from global views. *Microchemical Journal*, 110, 292-300.
74. Gurr, C. J., & Reinhard, M. (2006). Harnessing natural attenuation of pharmaceuticals and hormones in rivers.
75. Pal, A., Gin, K. Y. H., Lin, A. Y. C., & Reinhard, M. (2010). Impacts of emerging organic contaminants on freshwater resources: review of recent occurrences, sources, fate and effects. *Science of the total environment*, 408(24), 6062-6069.
76. Barnes, K. K., Kolpin, D. W., Furlong, E. T., Zaugg, S. D., Meyer, M. T., & Barber, L. B. (2008). A national reconnaissance of pharmaceuticals and other organic wastewater contaminants in the United States—I) Groundwater. *Science of the total environment*, 402(2-3), 192-200.
77. Lapworth, D. J., Baran, N., Stuart, M. E., & Ward, R. S. (2012). Emerging organic contaminants in groundwater: a review of sources, fate and occurrence. *Environmental pollution*, 163, 287-303.
78. Carey, R. O., & Migliaccio, K. W. (2009). Contribution of wastewater treatment plant effluents to nutrient dynamics in aquatic systems: a review. *Environmental management*, 44, 205-217.
79. Iloms, E., Ololade, O. O., Ogola, H. J., & Selvarajan, R. (2020). Investigating industrial effluent impact on municipal wastewater treatment plant in Vaal, South Africa. *International journal of environmental research and public health*, 17(3), 1096.
80. Kümmerer, K. (2010). Pharmaceuticals in the environment. *Annual review of environment and resources*, 35, 57-75.
81. Ternes, T. A., & Hirsch, R. (2000). Occurrence and behavior of X-ray contrast media in sewage facilities and the aquatic environment. *Environmental science & technology*, 34(13), 2741-2748.
82. Sacher, F., Lange, F. T., Brauch, H. J., & Blankenhorn, I. (2001). Pharmaceuticals in groundwaters: analytical methods and results of a monitoring program in Baden-Württemberg, Germany. *Journal of chromatography A*, 938(1-2), 199-210.
83. Topp, E., Monteiro, S. C., Beck, A., Coelho, B. B., Boxall, A. B., Duenk, P. W., ... & Metcalfe, C. D. (2008). Runoff of pharmaceuticals and personal care products following application of biosolids to an agricultural field. *Science of the Total Environment*, 396(1), 52-59.
84. Clarke, B. O., & Smith, S. R. (2011). Review of 'emerging' organic contaminants in biosolids and assessment of international research priorities for the agricultural use of biosolids. *Environment international*, 37(1), 226-247.
85. Campanale, C., Galafassi, S., Savino, I., Massarelli, C., Ancona, V., Volta, P., & Uricchio, V. F. (2022). Microplastics pollution in the terrestrial environments: Poorly known diffuse sources and implications for plants. *Science of the Total Environment*, 805, 150431.