Editorial

Wastewater Treatment: Functional Materials and Advanced Technology

Jingtao Bi [1,*] **and Guohui Dong** [2,*]

1   Engineering Research Center of Seawater Utilization of Ministry of Education, School of Chemical Engineering and Technology, Hebei University of Technology, Tianjin 300401, China
2   School of Environmental Science and Engineering, Shaanxi University of Science and Technology, Xi'an 710021, China
*   Correspondence: jingtaob@gmail.com (J.B.); dongguohui@sust.edu.cn (G.D.)

With accelerated advancements in various industries, water pollution has emerged as a significant issue characterized by two features: (1) the rapid increase in population and corresponding demands, leading to a sharp rise in wastewater discharge, and (2) the development of new technologies, contributing to a significant increase in the variety of emerging contaminants, resulting in a more complex wastewater composition [1–4]. Against this background, we proposed and launched a Special Issue, "Wastewater Treatment: Functional Materials and Advanced Technology", to provide feasible methods and insights for addressing these two features.

According to the publication status of the Special Issue, 34 publications have been released, including 4 reviews, 2 communications, and 28 full-length research articles. Focused on the theme of the Special Issue, the publications have reported a series of functional adsorption materials, ion sieves, and oxidation/reduction materials for typical contaminants such as salts, heavy metals, radioactive nuclides, soluble organic pollutants, and oils. Additionally, they have reported on related technologies such as adsorption, ion exchange, oxidation, reduction, oil–water separation, reverse osmosis, and electrodialysis. To deepen readers' understanding of this Special Issue, we have also created a word cloud based on the keywords of the 34 papers in the Special Issue, as shown in Figure 1.

Overall, "Wastewater Treatment: Functional Materials and Advanced Technology" has achieved certain results. However, considering the current trends in wastewater treatment research and the status of publications in this Special Issue, we consider that future research could focus on the following aspects, which will be welcomed in the second edition of this Special Issue:

(1) Wastewater treatment is application-oriented [5] and should focus on existing wastewater with specific treatment challenges. Therefore, while emphasizing theoretical innovation, exploring the application of relevant materials and technologies in real wastewater and specific application scenarios is particularly important.

(2) Emerging pollutants present new challenges for wastewater treatment [6,7]. Efficient treatment materials and technologies for emerging pollutants, such as microplastics, radionuclides, new drugs and their metabolites, and per/polyfluoroalkyl substances (PFASs), are particularly crucial.

(3) Process intensification has wide applications in wastewater treatment [8–10]. Some articles in this Special Issue have discussed ultrasonic intensification in materials fabrication and treatment technology [11,12]. To further enhance research in this area, emerging techniques such as nanoscale confinement intensification and external field (electric field, magnetic field, gravity field, etc.) intensification technologies are frontier topics worthy of attention.

(4) Although many efficient functional materials and advanced processes have been reported for wastewater treatment, their economic balance has received less investigation.

Wastewater treatment is often considered a "rescue" step in various processes, with cost remaining at its core. Therefore, the focus should also be on the economy while considering treatment efficiency.

Figure 1. Keyword cloud of the 34 papers in the Special Issue.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Dulsat-Masvidal, M.; Ciudad, C.; Infante, O.; Mateo, R.; Lacorte, S. Water Pollution Threats in Important Bird and Biodiversity Areas from Spain. *J. Hazard. Mater.* **2023**, *448*, 130938. [CrossRef] [PubMed]
2. Wang, M.; Bodirsky, B.L.; Rijneveld, R.; Beier, F.; Bak, M.P.; Batool, M.; Droppers, B.; Popp, A.; van Vliet, M.T.H.; Strokal, M. A Triple Increase in Global River Basins with Water Scarcity Due to Future Pollution. *Nat. Commun.* **2024**, *15*, 880. [CrossRef]
3. Junaid, M.; Siddiqui, J.A.; Liu, S.; Lan, R.; Abbas, Z.; Chen, G.; Wang, J. Adverse Multigeneration Combined Impacts of Micro(Nano)Plastics and Emerging Pollutants in the Aquatic Environment. *Sci. Total Environ.* **2023**, *882*, 163679. [CrossRef] [PubMed]
4. Puri, M.; Gandhi, K.; Kumar, M.S. Emerging Environmental Contaminants: A Global Perspective on Policies and Regulations. *J. Environ. Manag.* **2023**, *332*, 117344. [CrossRef]
5. Fundamentals and Applications in Water Treatment. *Nat. Water* **2024**, *2*, 101. [CrossRef]
6. Kumar, M.; Sridharan, S.; Sawarkar, A.D.; Shakeel, A.; Anerao, P.; Mannina, G.; Sharma, P.; Pandey, A. Current Research Trends on Emerging Contaminants Pharmaceutical and Personal Care Products (PPCPs): A Comprehensive Review. *Sci. Total Environ.* **2023**, *859*, 160031. [CrossRef]
7. Zhao, D.L.; Zhou, W.; Shen, L.; Li, B.; Sun, H.; Zeng, Q.; Tang, C.Y.; Lin, H.; Chung, T.-S. New Directions on Membranes for Removal and Degradation of Emerging Pollutants in Aqueous Systems. *Water Res.* **2024**, *251*, 121111. [CrossRef] [PubMed]
8. Wang, Y.; Gu, X.; Quan, J.; Xing, G.; Yang, L.; Zhao, C.; Wu, P.; Zhao, F.; Hu, B.; Hu, Y. Application of Magnetic Fields to Wastewater Treatment and Its Mechanisms: A Review. *Sci. Total Environ.* **2021**, *773*, 145476. [CrossRef] [PubMed]
9. Wu, C.; Gao, J.; Liu, Y.; Jiao, W.; Su, G.; Zheng, R.; Zhong, H. High-Gravity Intensified Electrodeposition for Efficient Removal of Cd^{2+} from Heavy Metal Wastewater. *Sep. Purif. Technol.* **2022**, *289*, 120809. [CrossRef]
10. Bi, J.; Xing, S.; Shan, G.; Zhao, Y.; Ji, Z.; Zhu, D.; Hao, H. Electro-Intensified Simultaneous Decontamination of Coexisting Pollutants in Wastewater. *Sci. Total Environ.* **2023**, *904*, 166949. [CrossRef] [PubMed]

11. Han, Z.; Sun, L.; Chu, Y.; Wang, J.; Wei, C.; Liu, Y.; Jiang, Q.; Han, C.; Yan, H.; Song, X. Ultrasonication-Tailored Graphene Oxide of Varying Sizes in Multiple-Equilibrium-Route-Enhanced Adsorption for Aqueous Removal of Acridine Orange. *Molecules* **2023**, *28*, 4179. [CrossRef] [PubMed]
12. Chen, W.S.; Hsu, M.C. Ultrasound-Assisted Mineralization of 2,4-Dinitrotoluene in Industrial Wastewater Using Persulfate Coupled with Semiconductors. *Molecules* **2023**, *28*, 4351. [CrossRef] [PubMed]