ICCES, 2024, vol.30, no.4
DOI: 10.32604/icces.2024.012655

PROCEEDINGS

Three-Dimensionally Printed Transition Metal Catalysts with Hierarchically Porous Structures for Wastewater Purification

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ABSTRACT

3D printing technology has demonstrated considerable potential in wastewater remediation. Zero-valent metal (ZVM) has been recognized as an efficient catalyst facilitating the organic pollutant degradation in water. However, owing to its inclination toward oxidation and aggregation, the practical utilization of ZVM remains a challenge. Herein, we have employed 3D printing techniques to fabricate hierarchically porous ZVM, such as zero-valent copper and zero-valent iron, which exhibit a high level of printing precision and commendable resistance to compression. These 3D-ZVM catalysts can effectively activate peroxymonosulfate (PMS), thereby degrading various organic pollutants, including tetracycline, ciprofloxacin, rhodamine B, and metronidazole. Additionally, the 3D-ZVM/PMS system exhibits a broad pH resistance range, exceptional adaptability, and superior reusability. The impact of several parameters, such as PMS concentration, solution pH and temperature, and coexisting inorganic anions, on the performance of the ZVM/PMS system is also explored. Notably, a toxicity estimation analysis suggests the toxicity of degradation products significantly reduced, which is further confirmed by growth control experiments on bean sprouts. This work offers valuable insights into the practical applications of the ZVM/PMS system, and also serves as a guide for the rational design of efficient and stable catalysts that can be readily recovered from aqueous environments.

KEYWORDS

3D printing; triply periodic minimal surface; zero-valent metal; advanced oxidation process; wastewater treatment

Funding Statement: This study received financial support from National Natural Science Foundation of China (No. 51905192) and Nanyang Environment and Water Research Institute (Core Fund), Nanyang Technological University, Singapore.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.