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EDITORIAL PAPER

Nanotechnology: A Robust Green Strategy for Sustainable Water and Environmental Remediation

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Recently, developments in the application of nanotechnology in water purification and environmental remediation have had an impactful role in changing the manner in which professionals deal with issues including water shortages, pollution caused by industrial and agricultural activities, and resource depletion. According to the scope, According to the scope, the Journal of Water and Environmental Nanotechnology (JWENT) focuses on introducing promising strategies for environmental sustainability including water and wastewater treatment, removal of environmental pollutants, and mitigation of the hazardous environmental effects of agrochemical and industrial residues [1-5]. The current issue includes contributions that go beyond proof of concept to more sustainable and potentially scalable achievements. Of particular interest are environmentally benign methodologies, the utilization of circular economy principles, and the transformation of nanotechnology into operational technology.

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Using dual treatment combining electrochemical coagulation (ECC) and membranes on the wastewater resulting from real silk textiles has demonstrated the potential of the developed hybrid nanosystems to efficiently reduce COD and pollutants, recover clean water, and enhance overall water quality [6]. Eco-friendly synthesis of copper encapsulated graphene nanocomposites via a hydrometallurgical method using low-cost materials with various potentials as a nanocatalyst [7]. The biogenic $CuCr_2O_4$/G-C_3N_4 nanophotocatalyst emphasized the significance of heterojunction construction under visible light for the degradation of organic pollutants such as methylene blue [8]. Notably, there are good examples of research that embeds sustainability within materials and process design. Herein, researchers have presented their results on the utilization of agricultural or industrial residues for the synthesis of magnetic NPs and cellulose nanocrystals from iron-rust waste and embroidery backing paper as natural and low-cost catalytic precursors or feedstocks, respectively [9, 10]. Green synthesis routes for the preparation of biogenic ZnO nanophotocatalysts further exemplify how facilitating synthesis and decreasing environmental burden can coexist with improved removal capacities for heavy metals and organic contaminants [11]. From a materials engineering point of view, some studies have focused on the surface modification of nanomaterials to improve their selectivity and efficiency. L-cysteine functionalized Fe_3O_4 NPs were found to be potential for selective picking up Au(III) from aqueous mixtures. High efficiency, selectivity, and recyclability of these NPs offered a practical and green approach for gold recovery from water [12]. The WO3 NPs immobilized on a graphitic carbon nitride, as a reusable nanocatalyst, effectively degraded bromophenol blue dye within wastewater released by textile manufacturing companies. It also exhibited remarkable antibacterial activity against multidrug-resistant S. aureus and E. coli [13]. The contents presented in this issue are not limited to aqueous systems but also address the environmental concerns, including soil and natural platforms. There is a review focused on design and studying nanomaterials, e.g., CNTs and Fe3O4 NPs for phytoremediation. Nano-enabled materials could improve the adsorption and degradation of pollutants for having environmental sustainability. Then, the utilization of diatoms, photosynthetic microalgae with siliceous walls, as a brilliant approach to address heavy metal contamination via bioaccumulation was comprehensively discussed. Diatoms are nature's nano-signatures, recognized as useful and biocompatible agents for sustainable management practices [14, 15].

This highlights that the sustainable remediation technologies will prospectively emerge at the interfaces of nanotechnology, biological processes, and environmental monitoring. It is hoped that this issue will help to develop efficient solutions that are translatable to field practice. This issue aims to provide valuable references for researchers involved in the fields of nanotechnology, water and wastewater treatment, sustainable agriculture, and environmental sustainability. I would like to appreciate the authors, reviewers, editorial team, and publishing staff for their valuable contributions.

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