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Nanoparticle-Based Remediation and Environmental Cleanup

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Environmental Nanotoxicology

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Abstract

The chapter entitled “Nanoparticle-Based Remediation and Environmental Cleanup” provides a thorough examination of the utilization of designed nanoparticles as effective instruments in mitigating environmental pollution and resolving contamination issues in diverse ecosystems. The chapter commences by providing a definition of nanoparticle-based remediation and emphasizing its importance in augmenting the efficacy of environmental remediation while mitigating the use of resource-intensive techniques. The importance of promptly implementing novel remedial strategies is emphasized, taking into account the constraints associated with conventional methodologies. The chapter also explores different categories of nanoparticles, namely, metallic nanoparticles, metal oxide nanoparticles, carbon-based nanoparticles, and polymer nanoparticles. Each of these categories possesses unique characteristics and finds specific utility in various applications. This section delves into various mechanisms through which nanoparticles can effectively target and eliminate contaminants, with a particular focus on adsorption, absorption, and catalytic destruction. The aim is to highlight the wide array of approaches that nanoparticles employ in order to achieve successful contaminant removal. The chapter presents many practical implementations, such as the remediation of groundwater and soil, the management of air pollution, the purification of water, and the restoration of marine ecosystems. These examples effectively illustrate the wide range of uses and potential of nanoparticles in tackling pollution-related issues. The significance of responsible implementation and mitigation measures is underscored, with a particular emphasis on environmental safety and risk assessment. The chapter examines prospective developments in the field, including developing technology, regulatory factors, and ethical considerations. It underscores the significance of public knowledge and community engagement in influencing the responsible application of nanoparticle-based remediation methods. In summary, the chapter presents a vision for a planet that is cleaner, healthier, and more sustainable. This vision is achieved through the responsible utilization of nanoparticle technologies in environmental cleanup, driven by a dedication to environmental stewardship and adherence to ethical principles.

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