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Carbon-Based Nanobiosensors for Heavy Metal Identification in Soil †

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Abstract: Heavy metal contamination in soil significantly threatens environmental and human health, necessitating rapid and sensitive detection methods. Carbon-based nano biosensors have emerged as promising tools for the identification of heavy metals in soil due to their unique properties, such as high surface area, electrical conductivity, and biocompatibility. Here, it provides an overview of various methods employed in heavy metal detection in soil using nano biosensors, focusing on carbon-based platforms. Firstly, it discusses the principles of nano biosensors and their advantages over conventional techniques. Carbon nanomaterials, including carbon nanotubes, graphene, and carbon dots, exhibit exceptional sensitivity and selectivity towards heavy metals, making them ideal candidates for biosensing applications. The integration of biological recognition elements such as enzymes, antibodies, or DNA aptamers enhances the specificity of these biosensors. Next, it highlights different approaches for heavy metal detection in soil utilizing carbon-based nano biosensors. Techniques such as electrochemical sensing, fluorescence detection, and surface-enhanced Raman scattering (SERS) are discussed. These methods offer rapid detection, high sensitivity, and low detection limits, making them suitable for on-site monitoring of heavy metal contamination in soil. Furthermore, recent technological advancements in metal detection using nano biosensors are addressed. These include the development of miniaturized and portable biosensor devices, integrating with smartphone platforms for real-time data analysis, and using machine learning algorithms for improved accuracy and reliability. In conclusion, carbon-based nano biosensors represent a promising approach for the identification of heavy metals in soil, offering high sensitivity, selectivity, and portability. Continued research and development in this field are crucial for addressing environmental concerns and ensuring food safety.

Keywords: carbon-based nano biosensors; heavy metal detection; soil contamination; technological advancements.

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Conflicts of Interest

The authors declare no conflicts of interest.