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Commentary

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## **Chemical Monitoring and Analysis of Microplastics in the Environment**

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## DESCRIPTION

Designing Microplastics, tiny plastic particles measuring less than 5 millimeters in size, have emerged as a significant environmental concern globally. These particles are pervasive in various ecosystems, posing potential threats to marine life, wildlife, and human health. The accurate detection and quantification of microplastics require sophisticated chemical monitoring and analysis techniques. This article explores the importance of chemical monitoring in understanding the distribution, fate, and impacts of microplastics in the environment.

Microplastics can be categorized into two main types: primary and secondary. Primary microplastics are intentionally manufactured at a small size for specific applications, such as microbeads in personal care products or pellets used in industrial processes. Secondary microplastics are generated through the degradation of larger plastic items, including fibers from textiles, fragments from packaging materials, and tire wear particles. These sources release microplastics into the environment, leading to their wide distribution in water bodies, soils, and even the atmosphere.

Microplastics are composed of various types of polymers, including polyethylene, polypropylene, polystyrene, and Poly Ethylene Terephthalate (PET). Determining the chemical composition of microplastics is crucial for understanding their environmental behavior and potential impacts. Chemical techniques such as Fourier-Transform Infrared Spectroscopy (FTIR) and Raman spectroscopy allow researchers to identify the polymer type present in microplastics. These methods rely on the unique molecular vibrations and spectral fingerprints of different polymers, enabling accurate identification and differentiation.

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The Sampling methods for microplastic analysis depend on the environmental medium being studied. In aquatic environments, techniques such as surface trawls, sediment cores, and water filtration are employed. In terrestrial environments, soil cores, sediment grabs, and litter collection are common methods. Sample preparation involves several steps to isolate and concentrate microplastics from complex environmental matrices. This typically includes density separation using salt solutions or surfactants, followed by filtration and drying of the collected microplastics.

Chemical analysis techniques play a pivotal role in the quantification and characterization of microplastics. The most widely used technique is microscopy, which includes optical microscopy and electron microscopy. Optical microscopy provides information on particle size, shape, and color, while electron microscopy, such as Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM), offers higher resolution and enables surface morphology analysis. Additionally, spectroscopic techniques like FTIR and Raman spectroscopy are used to identify the polymer composition of microplastics. These methods rely on the interaction of light with the chemical bonds present in the plastics, allowing for reliable identification. However, these techniques are generally time-consuming and require specialized equipment.

To enhance the efficiency of microplastic analysis, emerging techniques like Fourier-Transform Infrared Microspectroscopy (FTIR microspectroscopy) and micro-Raman spectroscopy are being developed. These techniques provide chemical information at the micro-scale, allowing for the mapping of microplastics on surfaces or within tissues. Furthermore, the application of spectroscopic techniques can be complemented by thermal analysis methods such as Thermo Gravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC). These techniques provide information on the thermal stability and behavior of microplastics, which aids in understanding their degradation pathways and potential environmental effect.

Chemical monitoring and analysis techniques are vital for the accurate detection, identification, and quantification of microplastics in the environment. These techniques enable scientists to understand the sources, distribution, and potential impacts of microplastics on ecosystems and human health. Continued advancements in chemical analysis methods, including spectroscopy and microscopy, will further enhance our understanding of the complex behavior and effect of microplastics, enabling the development of effective strategies to mitigate their environmental impacts.