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Correlative techniques to probe micro- and nanoparticles and their human health implications

The presence of micro- and nanoparticles in the world has notably increased in recent years, especially those related to cosmetics products and plastic materials. Several scientific publications study the impact of such particle size range on human health [1,2]. A single technique cannot provide a full characterization of the particle, nor a complete understanding of its impact on humans. Multiple correlative techniques are required for a comprehensive analysis of the particles, which can vary in size, shape, and composition. This study outlines an investigation into the detection, characterization, and spatial mapping of these particles, emphasizing their presence in water sources and cosmetic products. Microplastics coming from water sources are considered a primary human exposure pathway, becoming crucial to be analyzed, characterized, and identified as an important vector of human contamination. Cosmetics are composed of a complex mixture of components, including micro- and nanoparticles that, in contact with the skin surface, can easily penetrate and play a key role in the body, either by protecting the skin or affecting essential mechanisms. Both cases deal with complex matrices and deserve the combination of several techniques. Correlating Atomic Force Microscopy (AFM), which facilitates high resolution imaging, enabling the visualization of surface morphology, mechanical properties, and spatial distribution of nanoparticles, and Raman spectroscopy, which discerns molecular composition, structural integrity, and chemical interactions, providing insights into the identity and behavior of nanoparticles, we were able to fully characterize these particles down to the nanoscale, gaining insights into their morphology, chemical composition, and distribution. A key aspect of our study involves the application of nanoGPS technology, facilitating data correlation across diverse microscopy techniques. This method enables precise spatial localization of particles, allowing comprehensive integration of information from various analytical methods. Our findings underscore the necessity for advanced analytical techniques in assessing health risks associated with micro and nanoparticle exposure.

References

[1] Li, Penghui, and Jingfu Liu, Micro (nano) plastics in the Human Body: Sources, Occurrences, Fates, and Health Risks, Environmental Science & Technology (2024)
[2] Galloway, Tamara S, Micro-and nano-plastics and human health, Marine anthropogenic litter (2015); 343-366

Figure

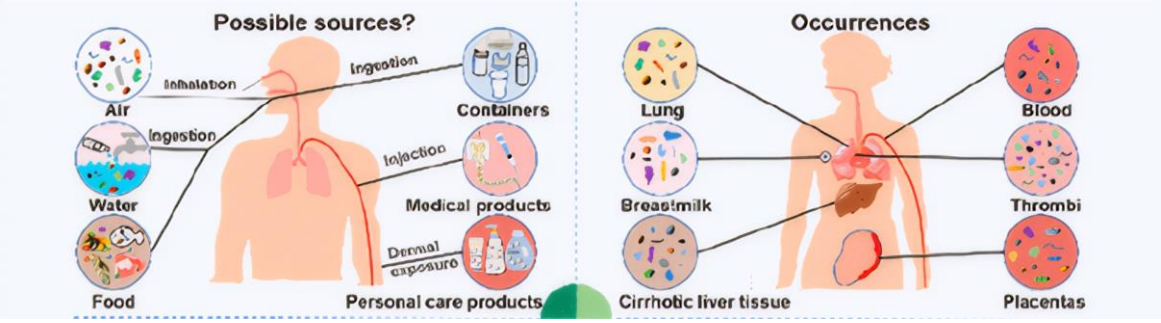

Figure 1: Possible sources and occurrences of micro and nano plastics in the human body. [1]