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Detecting Nanoplastics – Challenges for Environmental Analysis

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Abstract Body

Plastics, due to their high versatility and adaptability, have become ubiquitous in daily life. Since large-scale production began in the 1950s, over 8 billion metric tons of virgin plastic have been produced, with an estimated 20 million metric tons of plastic waste accumulating annually [1-3]. Plastic waste eventually fragments into so-called macro-, micro- (MPs), and potentially even nanoplastic particles (NPs) and reports about the omnipresence of these particles have raised environmental and health concerns. The United Nations has termed plastic pollution as "the defining challenge of our times," underscoring the urgency of addressing its environmental and health impacts [4].

Recent EU guidelines define NPs as particles smaller than 1 micrometer [5], and while MPs have been detected across ecosystems, NPs remain understudied due to challenges in NP detection and characterization [6,7]. However, due to their size and surface reactivity NPs are considered to pose greater environmental and health risks. While Pyrolysis–gas chromatography–mass spectrometry (PyGCMS) has emerged as a powerful technique for detecting the presence of nanoplastics (NPs) [8], in-depth characterization of individual particles—particularly in environmental samples—remains in its early stages. As we recently pointed such in-depth characterization requires a combination of methods enabling concentration, speciation, and visualization of NPs [9].

In this presentation I will review our efforts in detecting and characterizing NPs in simple and complex matrices using a combination of microscopic and micro-spectroscopic analytical techniques highlighting the analytical challenges we face. Specifically, I will focus on a novel approach combining grazing-incidence X-ray Fluorescence analysis (GI-XRF) with tailor-made sample preparation procedures and microscopic techniques such as photo-induced force microscopy (PiFM) and confocal fluorescence microscopy (CFM).

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