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In the Aftermath of Throwaway Living: Bridging the gap between analytical limitations and the need to assess growing concerns regarding micro-, submicron-, and nanoplastics

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The environmental presence of small plastic particles within the micro- (5 mm – 1 µm), submicron- (1 µm – 100 nm), and nano- (< 100 nm) size ranges has been of increasing interest within the past decade; with many researchers aiming to assess potential hazards associated with their exposure to plants, animals, and humans that live within a contaminated environment. Despite this increasing interest and need to gain insight into potential hazardous effects, much remains unknown about the fate of these plastic particles and the potential impacts of their interactions with organisms.

This knowledge gap is the result of difficulties that arise due to parameters such as i) a lack of reference materials that leads to over- and underrepresentation of different types of plastics in studies, ii) a lack of standardization making it difficult to compare across results from different studies, iii) a lack of analytics for plastic particles with small sizes (typically < 1 µm) and low concentrations that makes it challenging to obtain meaningful results, and iv) a multitude of additional challenges related to interactions between plastic particles and other sample matrix materials, altering their behavior and influencing detection.

To address such challenges, this thesis has focused on the development of various analytical pathways that allow for the detection of multiple types of particles in the microplastic, submicronplastic, and nanoplastic size ranges. The final reported studies herein span everything from the creation of various types of reference plastic particles (*e.g.,* polyethylene, polystyrene, polypropylene, and poly(ethylene terephthalate) at different sizes), to the detection of microplastic particles in jellyfish tissue using correlative light and electron microscopy with Raman spectroscopy, to the initial optimization of gold nanoparticle-based surface-enhanced Raman scattering (SERS) spectroscopy substrates that facilitate submicron- and nanoplastic detection down to low microgram or nanogram concentrations, to the final application of Raman spectroscopy and scanning electron microscopy for the detection of submicron- and nanoplastics spiked into environmental waters.

When taken all together, the presented findings help to gain insight into the factors that are most important for detection of micro-, submicron-, and nanoplastics within a complex sample matrix using techniques such as Raman spectroscopy.

Jury:

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- Prof. Dr. Barbara Rothen-Rutishauser (thesis co-supervisor)
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