Techniques to Detect and Identify Microplastics and Nanoplastics in Complex Environmental Systems

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The degradation of bulk plastics in the environment leads to the release of microplastics that can contaminate water supplies, agricultural fields, and foods we consume. Weathering of a single microplastic particle can yield up to billions of nanoplastics and nanoplastic pollution is expected to be ubiquitous in the environment. Nanoplastics are potentially more hazardous than microplastics because they can cross biological membranes; yet, there is little data on the occurrence, fate and impacts of nanoplastics. A key challenge in understanding the environmental burden of nanoplastics is the detection of such small, carbon-based particles in complex natural matrices such as soils and whole organisms. We have been working on the development of new plastic labeling and imaging techniques for detection of nanoplastics and microplastics in environmental samples. The first approach relies on stimulated emission depletion microscopy (STED) to detect labeled nanoplastics in whole organisms or other complex samples. More recent developments circumvent the need to label the plastic particles by implementing a tissue clearing technique or histology technique to image the particles while preserving the structure of the whole organism. This presentation will describe the new methodologies and provide examples of microplastic and nanoplastic detection and localization in representative aquatic and terrestrial organisms.