New approaches to detect microplastics and nanoplastics in complex environmental systems

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Abstract

The breakdown of plastics in the environment results in the release of microplastics that can contaminate water supplies, agricultural fields, and even our food. The fragmentation of one microplastic particle can yield up to billions of nanoplastics and nanoplastic pollution is expected to be pervasive in the environment. Nanoplastics could be more dangerous than microplastics because they are small enough to cross biological membranes; however, there is little information on the environmental occurrence, fate and impacts of these small plastic particles. A key challenge in understanding the environmental impacts of nanoplastics is the detection of such small, carbon-based particles in complex systems such as natural soil and whole organisms. Our group has been working on the development of advanced imaging techniques for detection of nanoplastics and microplastics in complex environmental systems, such as whole organisms. Recently, we used a histology technique combined with optical photothermal IR microspectroscopy (O-PTIR) to localize and identify plastic particles in whole organisms at sub-micron resolution. We will describe the new method and show examples of the identification of different plastic particles (polystyrene, polyethylene, polypropylene and polymethyl methacrylate) in representative aquatic and terrestrial organisms (*Daphnia magna*, *Drosophila melanogaster*, and *Eisenia andrei*).

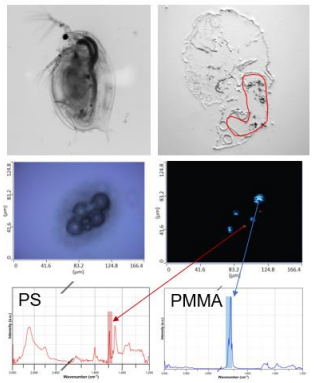

Figure 1. Histological sections of *Daphnia* exposed to microplastics, analyzed using Optical Photothermal Infrared (O-PTIR) spectroscopy. The imaging (middle row) and spectral identification (bottom row) confirm the presence of polystyrene (PS) and poly (methyl methacrylate) (PMMA) within the organism.

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Biography

Nathalie Tufenkji is a Professor in the Department of Chemical Engineering at McGill University where she holds the Tier I Canada Research Chair in Biocolloids and Surfaces. She earned MSc and PhD degrees in Chemical and Environmental Engineering from Yale University. Her research is in the area of particle-surface interactions with applications in protection of water resources, plastic pollution as well as the discovery of natural antimicrobials. She is a fellow of the Royal Society of Canada and the Canadian Academy of Engineering. Professor Tufenkji has served on the editorial advisory boards of the journals Environmental Science and Technology, npj Clean Water, Advances in Colloid and Interface Science, Water Research, and Environmental Science: Nano.