SUCCESS STORY

microONE
Microplastic Particles: A Hazard for Human Health

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Module

Project:
Preparation – Detection - Analysis
01/2022-12/2025; multi-firm

BREAKTHROUGH IN THE DETECTION OF MICRO- AND NANOPLASTICS IN TISSUE SAMPLES

THE INTRODUCTION OF OPTICAL PHOTOTHERMAL INFRARED SPECTROSCOPY (OPTIR) – A NOVEL ANALYTICAL TECHNIQUE – ENABLES THE ACCURATE DETECTION OF MICRO- AND NANOPLASTICS IN BIOLOGICAL SAMPLES. THIS PAVES THE WAY FOR A BETTER UNDERSTANDING OF POTENTIAL HEALTH IMPACTS.

Researchers within the COMET Module **microONE** are developing innovative analytical methods for detecting micro- and nanoplastics (MNP) within complex matrices, such as biological samples. This research shall pave the way for studying the impact of MNP on human health. The analytical method of choice provides label-free biochemical information, it is contactless and non-destructive – requirements that are met by just a few methods, among them infrared (IR) spectroscopy. A key challenge specific to MNP is the required lateral resolution and the need to surpass traditional limits in optical technology.

Breaking the Diffraction Limit

The diffraction limit is an important concept in optics that sets a restriction for how detailed an image a microscope can produce. It basically means that a microscope's ability to distinguish fine details (its lateral resolution) is limited by the wavelength of the light it uses. In IR spectroscopy this limits the lateral resolution to approximately ten micrometers, which is insufficient for detecting micro- and nanoplastics reliably. Researchers of **microONE** are pioneering Optical Photothermal Infrared (OPTIR) spectroscopy, a cutting-edge technology that detects and characterizes the smallest plastic particles. This innovative approach surpasses traditional resolution limits by utilizing a visible laser beam. It identifies

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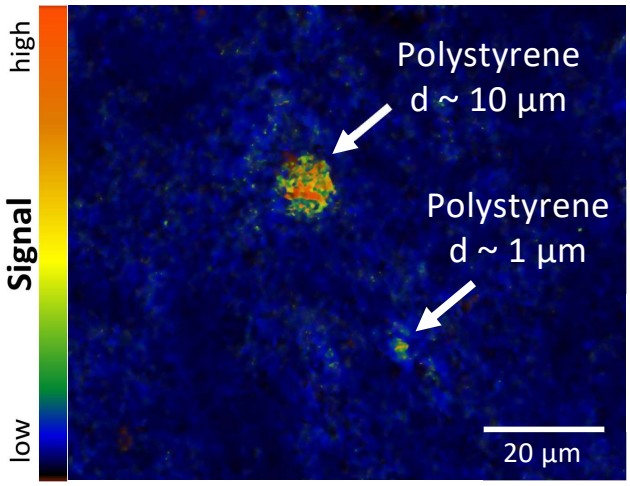
particles as small as a few hundred nanometers in a label-free, contactless, and non-destructive way.

Efficient Detection of Micro- and Nanoplastics (MNP)

In a practical demonstration of OPTIR, biological samples with artificially added MNP were prepared, effectively simulating real-world contamination scenarios. The obtained data showed impressive results. The OPTIR technology enabled the detection of MNP directly within the complex matrix of a biological sample, greatly simplifying the usual extensive preparation process. It also allowed for identifying these tiny particles and provided insights into their shapes and types. This breakthrough in the precise and effortless detection of MNP marks a significant step forward in assessing and addressing environmental pollution challenges and their effects on human health.



High-resolution OPTIR image of kidney tissue perfused with polystyrene (PS) beads. The image highlights two single beads, with a diameter of 10 µm and 1 µm respectively. The color gradient on the left reflects the signal intensity captured by the OPTIR system, transitioning from low (blue) to high (red), corresponding to the presence of polystyrene beads within the tissue. Figure: © RECENDT GmbH

Expanding Applications and Future Directions

The ongoing refinement of OPTIR within **microONE** is poised to better understand biochemical effects and the potential health risks associated with true-to-life MNP. Offering a more detailed understanding of the nature and impact of MNP pollution contributes to efforts addressing environmental challenges that directly affect human health. The effective use of OPTIR in detecting MNP highlights the importance of innovative research in understanding and solving complex problems and supporting informed public health and sustainability strategies.

Project coordination (Story)

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