SUCCESS STORY

microONE
Microplastic Particles: A Hazard for Human Health?

Programm: COMET – Competence Centers for Excellent Technologies

Förderlinie: COMET-Modul

Projekttyp: Interaction – Human Health Effects - Treatment, 01/2022-12/2025, strategic

NOVEL WORKFLOW FACILITATES THE DETECTION OF MICROPLASTICS IN CLINICAL HUMAN TISSUE SAMPLES

TISSUE SAMPLES OBTAINED FROM PATIENTS DURING MEDICAL PROCEDURES ARE PRESERVED AND STORED LONG-TERM IN HOSPITALS. UTILIZING CHEMICAL IMAGE DATA MEASUREABLE THROUGH OPTICAL PHOTOTHERMAL INFRARED SPECTROSCOPY (OPTIR), THESE SAMPLES CAN NOW BE ANALYZED FOR THE PRESENCE OF MICROPLASTIC PARTICLES.

Building on their previous breakthrough in using an innovative analytical method to detect micro- and nanoplastics (MNPs), scientists from the COMET-module microONE and the Medical University of Vienna have been able to detect MNPs in patient samples. These tissue samples, which are collected during a wide range of medical procedures, undergo a process designed to prepare the samples for diagnostic purposes and to preserve them for long-term storage.

This invaluable resource for the clinic – and the patients themselves – could now be made accessible to the field of microplastics research through the newly developed workflow. The novel method has been created by combining the processes used to preserve tissue samples in hospitals with a spectroscopic method for obtaining high-resolution chemical image data, thus allowing them to be screened for microplastic particles without interfering with clinical routines.

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Novel workflow enables integration of clinical routine and innovative research

In the pursuit of new knowledge, hypotheses and methods can be redefined and adapted to address previously unanswered research questions. In contrast, clinical procedures rely on well-established methods and workflows to maximize data security and reproducibility. The high degree of standardization required to ensure optimal patient care leaves no room for adaptation for scientific purposes.

The microONE team has now succeeded in establishing a novel workflow that enables the detection of MNPs in tissue samples processed by standard methods routinely used in the clinic. Patient material obtained during medical procedures is preserved and stored as “formalin-fixed paraffin-embedded” (FFPE) tissue. These samples can then be analyzed using optical photothermal infrared spectroscopy (OPTIR), which provides chemical image data that allows the identification of microplastic particles within the sample.

Detection of microplastic particles in human colon tissue

Using their novel workflow the research team successfully detected microplastic particles in human colon samples. Three different types of polymers commonly used in food packaging were identified: polyethylene (PE), polystyrene (PS) and polyethylene terephthalate (PET) (Figure 1).

This proof-of-concept experiment is an important milestone towards the detection of microplastics in patient samples.

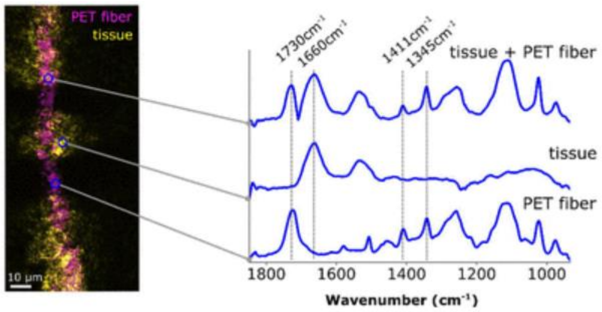

Figure 1: This high-resolution spectroscopic image, recorded at wavelengths indicative of tissue and polymer, shows a PET fibre in human colon tissue (left). Due to unique spectral signals, the recording of a full infrared spectrum at selected points allows a clear distinction between tissue and the plastic particle (right).

Figure taken from manuscript draft: Gruber et al., Unveiling Hidden Threats: Introduction of a Routine Workflow for Label-Free and Non-destructive Detection of Microplastics in Human FFPE Tissue Sections. medRxiv 2025.01.09.24319030 (2025) doi:10.1101/2025.01.09.24319030.

A stepping stone for microplastics research in the clinical context

The data generated during this project demonstrates the feasibility of analyzing patient samples for the presence of microplastic particles without interfering with established clinical procedures. Building on this achievement, the researchers are now working to improve and validate the workflow to elucidate the strengths and weaknesses of the procedure, to test the compatibility of the method with different types of polymers, and to extend the application to quantitative and high-throughput analysis.

As part of the ongoing microONE project, the team aims to put the finishing touches to this workflow to ultimately enable the assessment of potential health risks of MNPs using “real world” data.

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Project partners

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