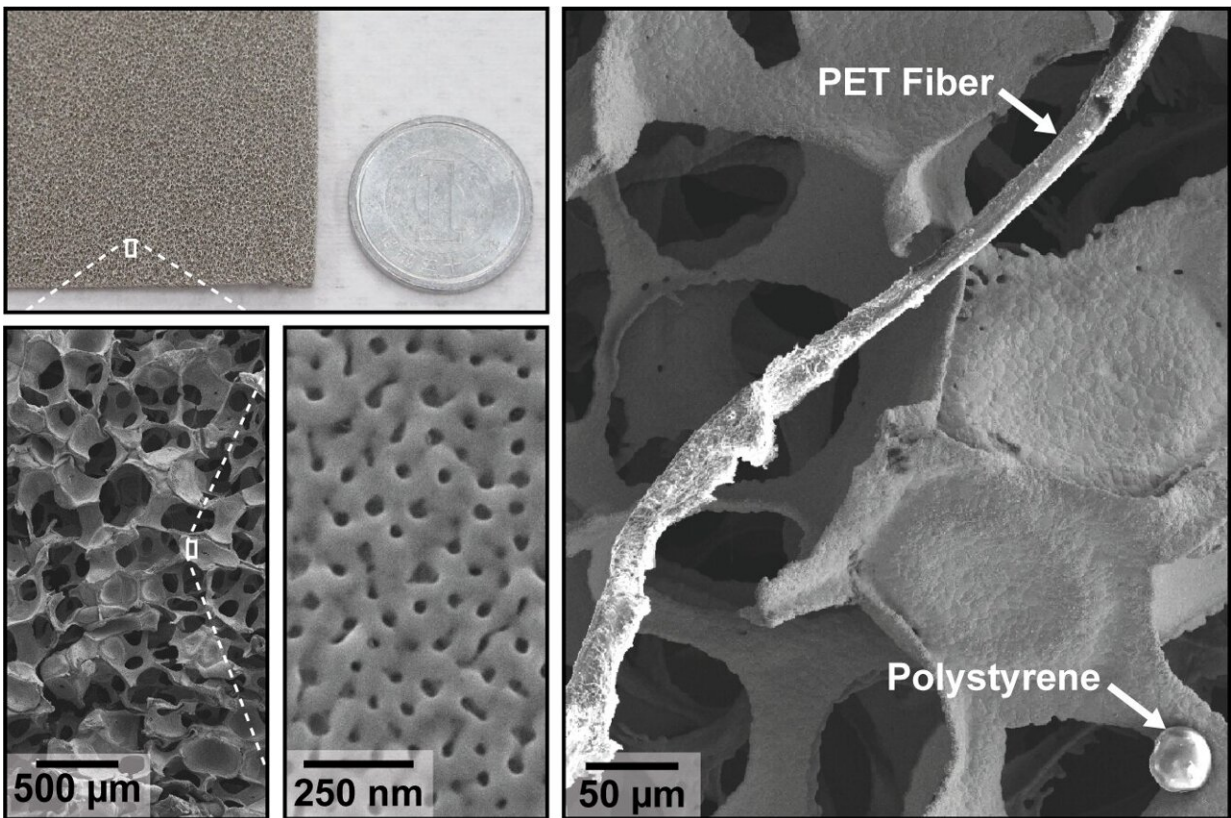


# Porous materials and machine learning provide inexpensive microplastic monitoring method

May 28 2024



Metal foam and a 1-yen coin for scale. Bottom left: SEM image of a silver foam showing macropores used to capture microplastics from solution. Bottom middle: SEM image of the nanoscale pores used to capture light and enhance the chemical signal of the microplastics. Right: SEM image of the metal foam exposed to polystyrene beads, PET fibers, algae and soil. Credit: Olga Guselnikova and Joel Henzie

Optical analysis and machine learning techniques can now readily detect microplastics in marine and freshwater environments using inexpensive porous metal substrates. Details of the method, developed by researchers at Nagoya University with collaborators at the National Institute for Materials Sciences in Japan and others, are published in the journal *Nature Communications*.

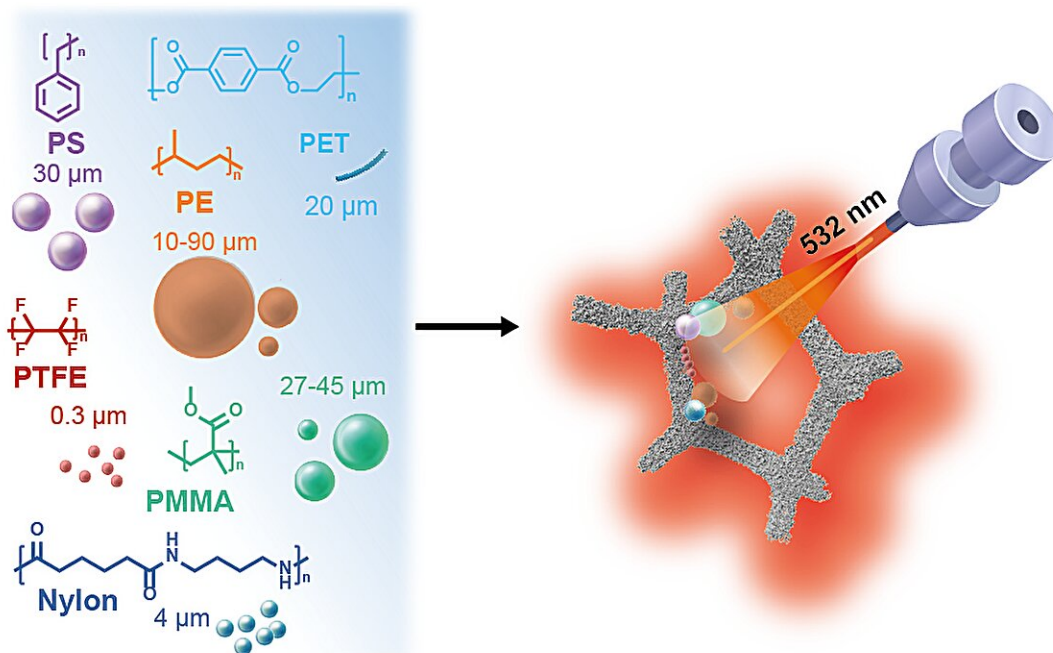
Detecting and identifying microplastics in [water samples](#) is essential for [environmental monitoring](#) but is challenging due in part to the structural similarity of microplastics with natural organic compounds derived from biofilms, algae, and decaying organic matter. Existing detection methods generally require complex separation techniques that are time-consuming and costly.

"Our new method can simultaneously separate and measure the abundance of six key types of microplastics—polystyrene, polyethylene, polymethylmethacrylate, polytetrafluoroethylene, nylon and polyethylene terephthalate," says Dr. Olga Guselnikova of the National Institute for Materials Science (NIMS).

The system uses a porous metal foam to capture microplastics from solution and detect them optically using a process called surface-enhanced Raman spectroscopy (SERS). "The SERS data obtained is highly complex," explains Dr. Joel Henzie of NIMS, "but it contains discernible patterns that can be interpreted using modern machine learning techniques."



Inexpensive microplastic monitoring through porous materials and machine learning. Credit: Reiko Matsushita



An unknown liquid sample containing various microplastics (left) is passed over the porous metal surface. Raman spectroscopy is then performed on the metal foam surface (right), and the scattered light is analyzed with a machine learning algorithm trained to accurately identify microplastics in complex mixtures. Credit: Olga Guselnikova

To analyze the data, the team created a [neural network](#) computer algorithm called SpecATNet. This algorithm learns how to interpret the patterns in the optical measurements to identify the target microplastics more quickly and with higher accuracy than traditional methods.

"Our procedure holds immense potential for monitoring microplastics in samples obtained directly from the environment, with no pretreatment required, while being unaffected by possible contaminants that could interfere with other methods," says Professor Yusuke Yamauchi of

Nagoya University.

The researchers hope their innovation will greatly assist society in evaluating the significance of [microplastic](#) pollution on public health and the health of all organisms in marine and freshwater environments. By creating inexpensive microplastic sensors and open-source algorithms to interpret data, they hope to enable the rapid detection of microplastics, even in resource-limited labs.

Currently, materials required for the new system bring cost savings of 90% to 95% compared to commercially available alternatives. The group plans to drive the cost of these sensors down even further and make the methods simple to replicate without the need for expensive facilities. In addition, the researchers hope to expand the capability of the SpecATNet neural network to detect a broader range of microplastics and even accept different kinds of spectroscopic data in addition to SERS data.

**More information:** *Nature Communications* (2024). [DOI: 10.1038/s41467-024-48148-w](#)

Provided by Nagoya University

Citation: Porous materials and machine learning provide inexpensive microplastic monitoring method (2024, May 28) retrieved 26 June 2024 from <https://phys.org/news/2024-05-porous-materials-machine-inexpensive-microplastic.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--