

Andrii Kutsyk

Danylo Komisar, Yaroslav Aulin, Konstantinos Stergiou, Yurii Pilhun,
Oleksii Ilchenko

Lightnovo ApS, Blokken 11, 1., Birkerød 3460, Denmark

ak@lightnovo.com

Machine Learning-Guided Portable Raman Microscopy for Microplastics Analysis

Microplastic pollution has become a significant environmental challenge, requiring rapid and reliable analytical methods for particle detection and identification. Conventional techniques based on Raman microscopy provide high chemical specificity [1]. They are often limited to laboratory settings due to their size, cost, and analysis time. This work presents a portable Raman microscopy platform [2] that integrates visible-light imaging, machine learning (ML), and automated spectroscopic analysis for efficient microplastic characterization. High-resolution optical images are first acquired and processed using ML-based image segmentation to detect individual particles and separate them from the background. Regions of interest (ROIs) corresponding to suspected microplastics are automatically extracted based on their morphological features, including size, shape, and color. The selected ROIs are subsequently investigated by Raman spectroscopy to acquire vibrational spectra for chemical identification. We tested our approach to detect polystyrene particles (Fig. 1a). We use several techniques to identify chemical composition: spectral similarity library search and multivariate curve resolution (Fig. 1b). The proposed workflow reduces analysis time while maintaining chemical specificity. It provides a practical solution for environmental monitoring, field investigations, and rapid assessment of contaminated samples.

References

- [1] C.F. Arayjo et al., *Water Research*, 142 (2018) 426.
- [2] O. Ilchenko et al., *Nature Communications*, 15 (2024) 3049.

Figures

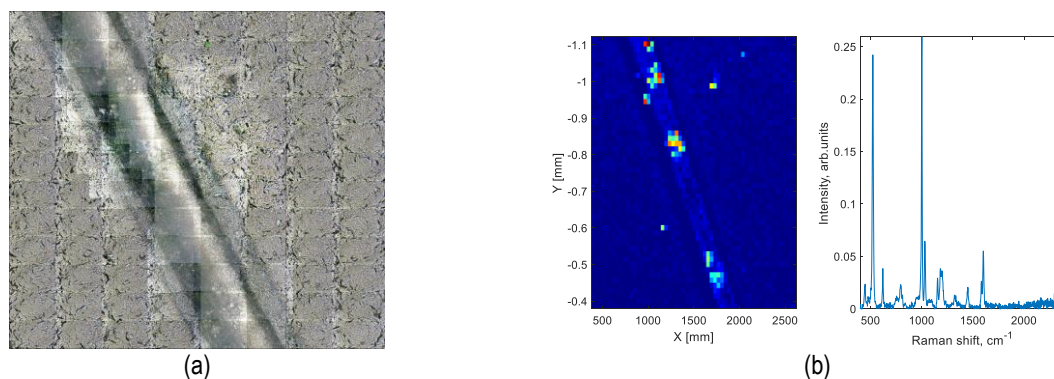


Figure 1: Visible image of a sample with polystyrene particles (a); the corresponding chemical map and spectrum (b).