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Towards the Analysis of Nanoplastics Using Sub-Micron Optical-Photothermal Infrared (O-PTIR) and Simultaneous Raman Microspectroscopy

The widespread use of plastic materials has led to the global presence of microplastics (1 µm to 1 mm) and nanoplastics (<1 µm) in the environment and consumer products. The risks posed by these particles depend on their type, morphology, and size, with nanoplastics being particularly hazardous due to their ability to penetrate biological barriers and transport absorbed toxic compounds, facilitated by their small size and large surface-to-volume ratio [1]. This highlights the need for advanced detection methods for nanoplastics.

Traditional Fourier-transform infrared (FTIR) spectroscopy can only detect particles larger than ~10 µm, while Raman spectroscopy can identify particles down to 1 µm, and sometimes even 300-500 nm, but often suffers from fluorescence interference [2].

Optical-Photothermal Infrared Spectroscopy (O-PTIR) is a novel technique that addresses these limitations. By combining the high spatial resolution of Raman spectroscopy with the chemical specificity of infrared (IR) spectroscopy, O-PTIR achieves IR spectra at submicron spatial resolution, which is particularly beneficial for analyzing nanoplastics affected by fluorescence interference.
Additionally, O-PTIR allows for the simultaneous collection of IR and Raman spectra, providing complementary information and cross-validation between these techniques. This dual-spectroscopy approach enhances the accuracy and reliability of nanoplastic detection and characterization.

References

[1] Magrì D, Sánchez MP, Caputo G, Gatto F, Veronesi M, Bardi G, Catelani T, Guarnieri D, Athanassiou A, Pompa PP, Fragouli D, Laser Ablation as a Versatile Tool To Mimic Polyethylene Terephthalate Nanoplastic Pollutants: Characterization and Toxicology Assessment, ACS nano (2018); 12 (8), 7690–7700

[2] Ivleva NP, Chemical Analysis of Microplastics and Nanoplastics: Challenges, Advanced Methods, and Perspectives, Chemical reviews (2021); 121 (19), 11886–11936