Multi-feature round silicon membrane filters enable fractionation and spectroscopic analysis of small micro- and nanoplastics with Raman spectroscopy and nano-FTIR

Michaela Meyns , Frank Dietz , Carin-Sonja Weinhold , Heiko Züge , Saskia Finkh , and Gunnar Gerdts*†[1]

[1]Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI) – Biologische Anstalt Helgoland Kurpromenade 201 27498 Helgoland, Germany

Abstract

Visualization of small micro-(20-1 μm) and nanoplastics ($<$ 1 μm) combined with chemical identification is still a challenge. To address this, we designed and manufactured easy-to-handle silicon membrane filters with a standard round filter geometry of 25 mm in diameter and a 10 mm diameter filtration area, holding hexagonal sections with periodically arranged pores of either 250 nm or 1 μm. Due to their flat and reflective surface, the filters serve as a versatile substrate for spectroscopic identification of particles. Optical markers at different levels of magnification, including the bare eye, allow for an easy transfer and repositioning of samples between instruments and methods as well as for a re-measurement of nanoscale particles. We demonstrate how nanoscale particles of weakly absorbing polymers such as polyethylene and polystyrene are analyzed on these filters by nano-FTIR, a combination of atomic force microscopy and Fourier transform infrared spectroscopy. By sequential filtration we separated the fractions of small micro and nanoplastics from a degraded polylactic acid coffee cup lid and achieved subsequent identification by Raman and nano-FTIR spectroscopy. The applications presented in this study will enable future research regarding the identification of small polymer particles difficult to access by other methods.

Keywords: analytical approaches, FTIR, Raman, nanoFTIR

*Speaker

†Corresponding author: gunnar.gerdts@awi.de