Carolin Borbeck
Francisco van Riel Neto, Peter Gilch
Institut für Physikalische Chemie, HHU Düsseldorf, Universitätsstr. 1, 40215 Düsseldorf, Germany
carolin.borbeck@hhu.de

A Fast Broadband Approach to the Analysis of Microplastics: Femtosecond Stimulated Raman Microscopy

Microplastics, mostly defined as plastic particles sized 1 µm to 5 mm, are emitted into the environment in large amounts [1]. They originate from the degradation of synthetic materials (secondary microplastics) or are produced intentionally (primary microplastics). The latter is often used in household products like cleaners or cosmetics. Raman microscopy is a commonly used method of analysis for microplastic contaminations [1]. It offers the possibility of accessing both quantitative information on the number, shape and size as well as chemical compositions of the contaminating particles. However, conventional Raman microscopy suffers from the usually low Raman scattering cross section of samples, resulting in a long acquisition time, and also from interfering fluorescent background. Therefore, the potential of non-linear Raman techniques such as CARS [2] and SRS [3] for the analysis of microplastics is currently investigated. Both techniques show some drawbacks for example in terms of a non-resonant background or incompleteness of spectra, respectively. Here, Raman imaging of microplastics by Femtosecond Stimulated Raman Microscopy (FSRM) will be reported for the first time. FSRM [4,5] yields complete Raman spectra with minimal acquisition times as short as 0.1 ms without distortions by fluorescence or a non-resonant background. In our proof-of-concept experiment, a microplastic particle in a commercial facial scrub is imaged (Figure 1). The image reveals the irregular shape of the particle which presumably enhances its exfoliating properties.

References

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Figures

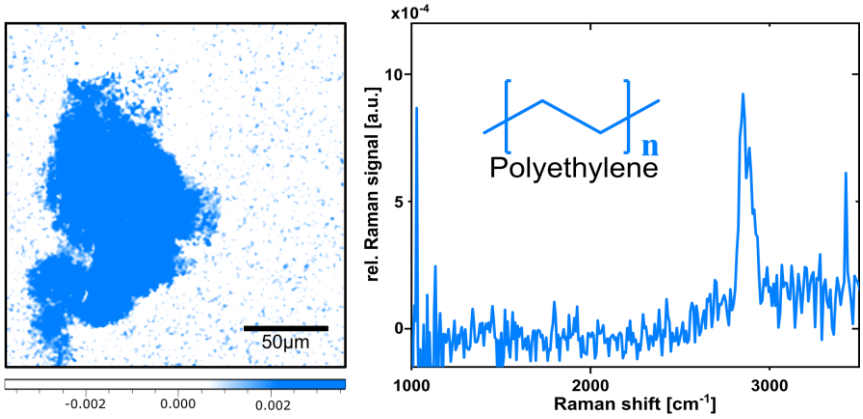

Figure 1: A chemical image of a polyethylene particle in a commercial facial scrub. In the Raman image at the left the FSRM signal at 2849 cm^{-1} is color-coded. Acquisition of the 200x200 µm image with a spatial resolution of 0.5 µm takes approximately 49 minutes. On the right, a single Raman spectrum from the chemical map is shown.