Frequency domain fluorescence lifetime imaging microscopy: A new method to directly identify microplastics in water.

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Abstract

Oceans and freshwater are ubiquitously polluted with microplastics, posing a threat to the environment, ecosystem and human health. Yet, there is no analysis method for the direct quantification and identification of microplastics (MP) in aqueous systems and thus a fast risk assessment is not possible. A direct identification of microplastic in water using micro-Fourier transform infrared (micro-FTIR) spectroscopy or attenuated total reflectance (ATR) spectroscopy is difficult because of the superimposition of the IR spectrum and the absorption band of water. Furthermore, an identification is possible using Raman microspectroscopy but complicated if highly fluorescent additives or fillers and organic matter are present on the plastic surface, as the fluorescence signal overlays the Raman spectra used for the identification. The fluorescence lifetime of plastics is gaining attention as it is a fast, sensitive and easy appliable identification method for plastic types. Plastic can be unambiguously identified by the measurement of the fluorescence lifetime using the frequency domain fluorescence lifetime imaging microscopy (FD-FLIM) method. Hence, this study is conducted to evaluate whether the FD-FLIM method can be used to identify pure granulate of ABS, PC, PET, PS and PVC in a 1 cm thick water layer. Our results show that an identification of all five plastic types is possible in water and thus FD-FLIM seems promising to identify MP directly in aqueous samples. Consequently, further studies need to be conducted on plastics covered in organic matter to determine the limitations of the FD-FLIM method .

Keywords: plastic identification in water, frequency domain fluorescence lifetime imaging microscopy FD, FLIM, fluorescence lifetime

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