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Raman microspectroscopy as a tool for microplastic particle analysis

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Plastic is essential to modern life, especially in the packaging industry. However, if plastic is carelessly discharged into the environment, it is exposed to UV-light and mechanical stress. This can lead to leaching of additives and/or fragmentation into smaller particles called microplastic (MP, <5 mm). MP particles can be found in many compartments of the environment and food products including, but not limited to, bottled beverages [1,2]. MP compositions from the latest Raman microspectroscopy (RM) studies were compared to give an overview on which polymers are most commonly found in typical environmental and food samples [3]. This led to the discovery that MP particles extracted from solid samples (salt/sediment) show a higher variety in polymer types, as well as a better correlation with polymer market shares. In contrast, light polymer types dominate in samples extracted from liquids which points to a natural density separation in these systems.

Using RM for the single particle detection of MP offers the advantage that chemical as well as morphological information becomes accessible. This combination enables the correlation of chemical properties with particle size distributions. In the context of MP research this is especially helpful, as a multitude of polymers, sizes and shapes are encountered, as well as naturally occurring particles. Based on theoretical considerations for RM the smallest analyzable particle size and limitations by acquisition time were evaluated and compared with results from literature to provide guidelines.

Apart from instrumentation, settings and methodological limitations another challenge in single particle analysis is to determine how many particles need to be analyzed to produce a statistically meaningful result. Therefore, we fitted a simple random sampling approach to the analysis of MP with RM to give an estimated minimal number of required particles for an idealized system (excluding sampling and systematic errors). It is noteworthy that the required number of particles can be tailored to be measured in a feasible time at the expense of the margin of error e. Another advantage of the statistical approach is that the margin of error e can be determined without the need for replicate measurements [3]. In conclusion this approach provides robust criteria for the comparison of future quantitative MP studies of environmental and food samples.

References:
[1] B. E. Ossmann, G. Sarau, H. Holtmannspotter, M. Pischetsrieder, S. H. Christiansen, W. Dicke, Water Res 2018, 141, 307-316.
[2] D. Schymanski, C. Goldbeck, H. U. Humpf, P. Furst, Water Res 2018, 129, 154-162.
[3] P. M. Anger, E. von der Esch, T. Baumann, M. Elsner, R. Niessner, N. P. Ivleva, TrAC Trends in Analytical Chemistry 2018, 109, 214-226.