In search of microplastic by microscopy

In the meantime, microplastic is omnipresent. The millimeter to even nanometer small particles, which consist of various plastic and rubber compounds, are nowadays not only found in the sea, lakes and rivers but also in the soil and in the ambient air. The origin of microplastics can be attributed to various sources. On the one hand, products based on polymers have been produced for decades. These are products that are used in many areas of daily consumption (e.g. cosmetics, packaging, textiles, etc.). Those products and their fragments end up in the environment (e.g. in vital waters and on agricultural land) after being used (https://www.youtube.com/watch?v=ZHCgA-n5wRw). On the other hand, road traffic also produces a considerable proportion of microplastics in the form of tire abrasion.

In recent years, Particle Vision has specialized in tracking down the sources and transport of dust. One of the focus today is on the identification and characterization of tire wear, as these particles are ubiquitous in the air of urban and traffic environments (Figure 1). They can be >100 microns if they are derived from a truck tire or <2.5 microns when the tires are under heavy use, such as braking or parking.

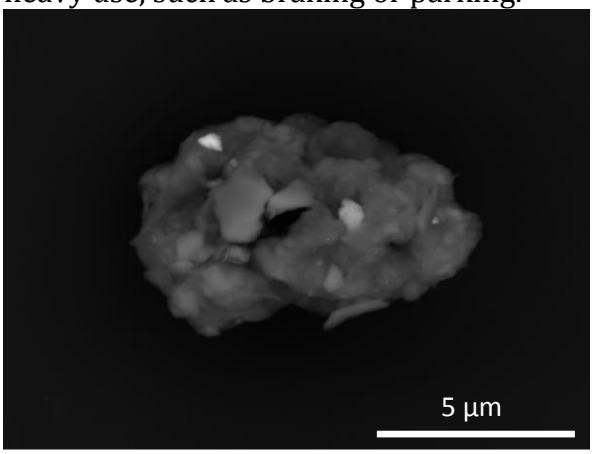

Fig. 1: Tire wear from an air sample

Because of the further development of the method by Particle Vision into a routine method, individual tire wear particles can be detected and quantified in air, soil or water samples, automatically. The method is based on the single-particle analysis by means of SEM/EDX[1] and allows to determine the concentration or relative frequency of these particles. In contrast to conventional methods (e.g. bulk analysis), SEM/EDX allows the detection of individual particles of several hundred to about 0.1 micrometer in size and to determine their morpho-chemical fingerprint.
In addition to tire wear, other microplastic particles can also be identified. Figure 2 shows examples of tire wear and blue microplastic particles that were detected and characterized by light microscopy (Figure 2A) and SEM/EDX (Figure 2B) in a filtered water sample.

[1] SEM/EDX (Scanning Electron Microscopy coupled to Energy Dispersive X-ray Spectroscopy)

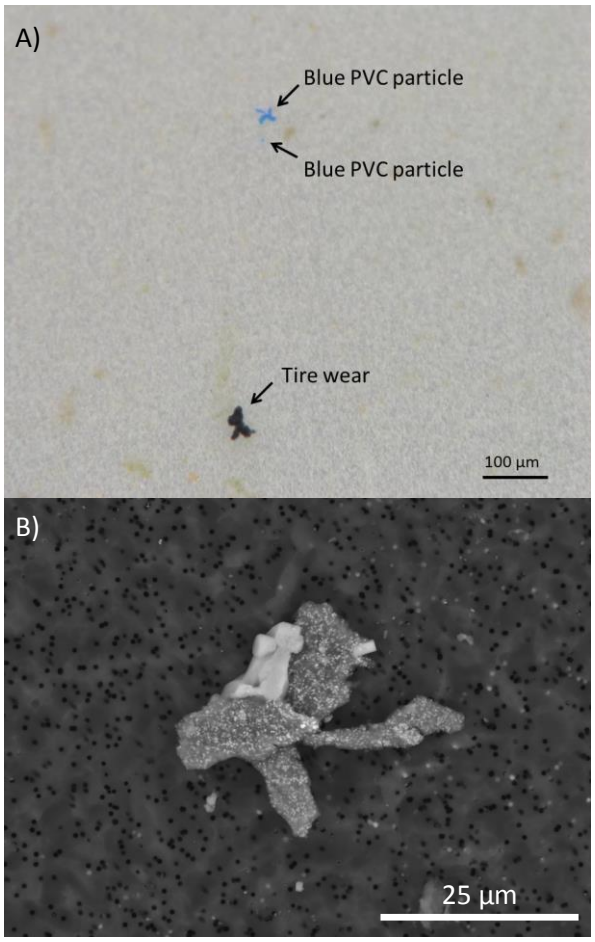

Figure 2: A) Light microscopy image of two blue PVC particles and a tire wear from a filtered seawater sample. B) SEM image of a C, O, Ti, Ca, Si, Al, Cu-bearing microplastic (blue PVC particle of the upper image) corresponding to an industrially manufactured product.

The sample was collected in the frame of the scientific sailing trip "Round Britain 2017" of the eXXpedition Foundation near Plymouth in the English Channel (www.eXXpedition.com).

Conclusion

The SEM/EDX single-particle analysis represents a powerful method for the quantitative analysis of microplastic in water, soil and air samples. The morpho-chemical characterization allows conclusions to be drawn on the product origin (e.g. contribution of the tire wear particles - which can entirely be apportioned to road traffic - on the total amount of microplastic in a specific environment). These new possibilities make it possible to take targeted and therefore more effective measures for the reduction of microplastics in the various environmental areas.

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