Imaging of Engineered Nanoparticles in Water by WetSEM™/EDS

The production of engineered nanoparticles (NPs) is increasing and many new applications of NPs are being identified. NPs may be released to the environment intentionally (e.g. remediation) or unintentionally (e.g. wastewater). However there is a lack of knowledge of the environmental impact of these ultrafine particles.

This study aims to develop quantitative and qualitative methods to investigate the persistence, fate and bioavailability of NPs in the environment. The poster describes imaging and analysis of engineered NPs in liquids using WetSEM™/EDS capsules (www.QuantomiX.com). These comprise an electron transparent membrane enabling the imaging and analysis of liquid samples.

Method

Sample preparation. Samples were applied to QuantomiX™ capsules (Fig. 1) for imaging wet samples. Samples consisted of TiO_2 (5-10nm) NPs, dispersed in distilled water and lake water spiked with ZnO (50-70nm) and Fe_2O_3 (20-25nm) NPs.

Imaging and qualitative analysis. Imaging took place on a FEI Sirion™ FEGSEM in back-scattered mode. Qualitative analysis was obtained by an Oxford Instruments INCA™ EDS x-ray analysis system.

Figure 1. QuantomiX™ capsule

Results

We were able to detect a range of nanoparticles in either distilled or natural lake water using WetSEM™/EDS (Fig. 2 & 3). TiO_2 NPs were found to agglomerate in distilled water (Fig. 2). Fe_2O_3 & ZnO NPs agglomerated in natural lake water with an agglomerated size of $\sim 2\mu m$. Using EDS it was possible to chemically characterise the particles (Fig.3).

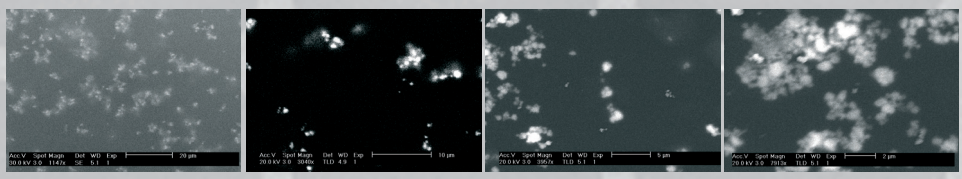

Figure 2. Agglomerated TiO_2 NPs imaged in distilled water

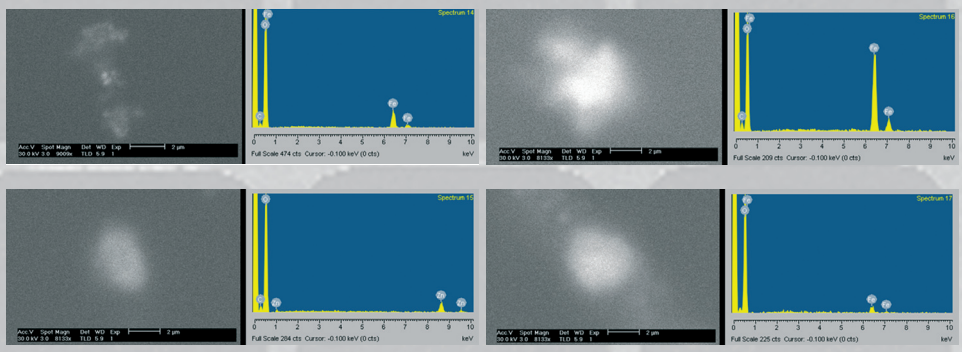

Figure 3. Images of Fe_2O_3 and ZnO particles respectively imaged in lake water and analysed using EDS

Conclusion

WetSEM™ with EDS is a powerful tool for imaging and analysis of NPs under wet conditions, although the usage of QuantomiX capsules significantly affects the resolution.

Future work will compare other analysis methods including Atomic Force Microscopy, Inductive Coupled Plasma Mass Spectrometer (ICP-MS) and Size-Exclusion Chromatography (SEC). This approach will help to interpret intended experimental studies regarding the fate and bioavailability of NPs in the best way possible.

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