Application and future perspective of automated electron microscopy to quantify engineered nanoparticles in complex matrices.

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Increasing amounts of engineered nanoparticles (ENP) already found their way into a range of consumer products, such as sunscreen, food products and textiles. Although the use and incorporation of ENPs into consumer products leads to beneficial properties of the respective products, the risks associated with the exposure and ingestion of these novel materials are still only poorly understood.

Research on the effects and interaction of ENP with biological systems is hampered by the lack of analytical technique to detect and quantify ENP in complex matrices. Most frequently applied bulk technique, such as dynamic light scattering or disc centrifugation are inappropriate for complex matrices (e.g. presence of other particulate materials) and lack chemical information, which makes respective results very challenging to interpret.

Recent developments rely on the 'counting' of individual particles and thus the signals are not biased towards any size fraction. Most promising methods include single particle ICP-MS analysis and highly resolved imaging techniques (e.g. electron microscopy) combined with image analysis tools, the latter being the focus of this presentation.

Although the electron microscopy is a rather old technique and sub-nanometer resolutions have been achieved decades ago, the lack of automated analysis routines (including both recording and analysis) makes the technique very labor and thus cost intensive. However, recent improvements in electronics and detector design resulted is faster image acquisitions and more robust long term (several hours) operations, which substantially reduces the required manpower. In combination with tailored image analysis routines (e.g. developed within the FP7 project 'NanoDefine) the cost per analysis can be substantially be reduced.

In this presentation we will demonstrate the possibilities of automated electron microscopy operations based on standard samples. Furthermore, selected examples from food science will be presented to illustrate the applications this sector.