Development and application of new techniques to monitor engineered nanoparticles in complex matrices

Profs Éva Valsami-Jones and Jamie Lead (GEES)
Dr Mark Rehkamper, Imperial College London

Abstract

Nanotechology has the potential to revolutionise modern living by creating novel materials and processes and helping rationalise the use of global resources. However, there have been concerns about the potential links between the unique properties of nanomaterials and toxicity. As a result, "nanotoxicity" has become a major reseach objective in the EU and internationally. Many aspects in the study of nanotoxicity remain novel and challenging due to the difficulties in identifying, characterising and monitoring nanomaterials particularly in complex media. A number of research projects on nanotoxity are currently under way at the University of Birmingham. The proposed PhD studentship will be linked with one of these projects, the EU infrastructure QNano (www.qnano-ri.eu) thus offering a potential for the successful candidate to become established in the european nanosafety community. The research will involve two key aspects: a) making metal and metal oxide nanoparticles, introducing them to complex matrices and monitoring their transformations as a function of time and b) developing methods for labelling nanoparticles in unique ways to make them traceable. The project will initially focus on Ag nanoparticles as the main study system, but may also include silica, titania and zinc/copper oxides.

Project description

Nanotechology has the potential to revolutionise modern living by creating novel materials and processes and helping rationalise the use of global resources. Many new nanomaterials are already industrially produced and used in a variety of products including cosmetics, sunscreens, textiles, food packaging and electronics. Many more are due to be developed and marketed in the near future, some of which will eventually involve second generation "smart" nanomaterials. However, concerns have been expressed that all these technological developments proceed without safety considerations and that there may be links between the novel properties displayed by nanomaterials and potential toxic behaviour.

In response to these concerns there has been substantial recent national, european and international funding to allow a better understanding of nanomaterial properties along with their hazard potential. However, working with nanosized objects is challeging and many fundamental scientific questions remain particularly regarding the behaviour and fate of nanoparticles in the enviroment.

The proposed PhD project will fit in this area of research and will focus specifically in investigating the transformations which may occur to nanoparticles when found in complex media (seawater, food, cosmetics). It will complement research within current EU project QNano (www.qnano-ri.eu), which will allow the student to work wihin the framework of an international research project, be trained in nanoparticle characterisation by international experts and operate in the context of and liaise with other labs carrying out similar work. The project offers a challenging research programme and a great potential for novel discoveries. The project's generic research and training objectives are:

- Synthesis and characerisation of a range of relatively simple nanoparticles; nanoAg will be the main study system, but other nanoparticles may be synthesised, such as silica, titania and zinc/copper oxides.

- Identification of the in situ nature of the synthesised nanoparticles in a range of relevant media (plasma, synthetic waters) and in complex matrices such as cosmetics and food;

- Assessment of the evolution of the selected nanoparticle characteristics (including the dispersion quality) in a range of relevant media and complex matrices;

- Development of protocols and validation of techniques for time-resolved assessment of nanoparticles in situ via round robin studies;

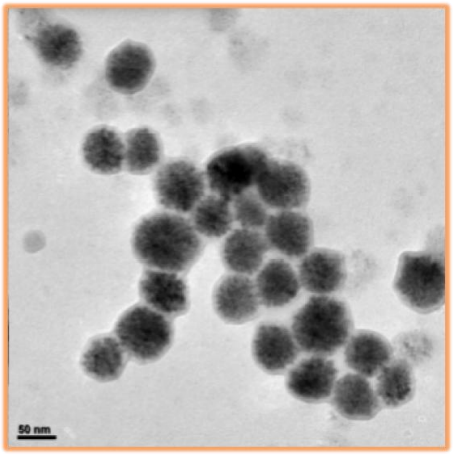
- Recommendations on the appropriate level of time-resolved nanomaterials characterisation to ensure appropriate knowledge regarding the status of the nanomaterials in aged matrices.

The PhD project's unique and distinct from QNano objectives are:

- Detailed investigation of the qualitative and quantitative changes in nanoparticle size, structure and composition when exposed to complex matrices as a function of the properties of the initial nanoparticle composition and time;

- Study of the kinetics of nanoparticle transformations in complex matrices;

- Development of unique tracers, e.g. isotopically or chemically labelled nanoparticles and studies of their traceability.



The picture above shows isotopically labelled ZnO nanoparticles imaged by Transmission Electron Microscopy. The label is "invisible" by TEM, but can be traced using analytical techniques such as ICP-MS.

Contact details: Professor Éva Valsami-Jones, GEES, e.valsamijones@bham.ac.uk