We asked our partners what they had gained from participating in the NanoFATE project and what skills, facilities and expertise they could offer to future nanoparticle research. Here are some of their responses…

NERC

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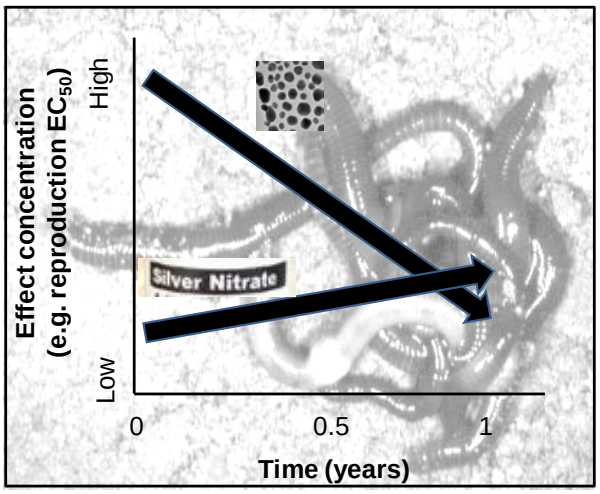
Claus Svendsen

What have you gained from participating in the NanoFATE project?

In taking the lead role in NanoFATE, NERC has been given the oportunity to coordinate the development of a world leading infrastucture for the environmental fate and hazard assessment of nanoparticles in natural ecosystems. We have refined existing chemical fate models previously used to assess the fate of "down the drain" chemicals and for airborn releases to include relevant nanospecific process that have allowed the most comprehensive fate and transport assessment for nanoenabled products conducted to date. Our work to understand the hazards of nanoparticles have focussed on realistic exposure scenrios providing essential data on effects and insights into appropriate test designs for future nanoecotoxicology studies. These studies have shown the importance of understanding the dynamic processes that influence exposure and toxicity over time. Key transformations such as agglomeration, dissolution, chemical speciation and interaction with solid phase components all combine together in an integrated manner to determine effects.



Patterns of change in toxicity of Ag ions and AgNPs over extended time

What expertise, skills and facilities can you offer to future nanoparticles research?

The NERC Centre for Ecology and Hydrology has developed as a centre of expertise for research on the environmental fate and effects of nanomaterials. Expertise developed in the characterisation of nanoparticles in soil, waters and importantly in biological tissues include use of SP-ICP-MS, synchrotron based micro-X-ray fluorescence and gene, protein and metabolomics. These approaches can underpin future research to establish key toxicokinetic and toxicodynamic properties for nanoparticles. Understanding of the relationship between material properties and toxicity are likely to be central to developing methods for read across in support of risk assessment. Our models developed to understand bioavailability, fate and transport are also applicable at relevant local, catchment, national and trans-national scales

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Andrzej Mościcki

What have you gained from participating in the NanoFATE project?

Participation of Amepox Enterprise lab staff in the NanoFate project, gave the possibility to increase their qualification through the new studies of R&D works. We developed a new colloid on the base of water with the nAg fillers with size 3-8 nm (Fig.1). Extremely polar water environment was the principal problem for their polarization effect with such a small particle size of silver. The fact of the protective shell with paraffin family material, was the additional difficulty for preparing fully homogenous and stable colloid. At present the smallest size of silver particles - to size 3 - 8 nm (you should remember that the diameter of the Ag atom is 0.29 nm) is the reason of the growth the active surface of silver. This is cause, that it should be the big influence on the environment. The use of the paraffin protective shell (in the quantity 18% bw) gave the considerable weakness of this influence.

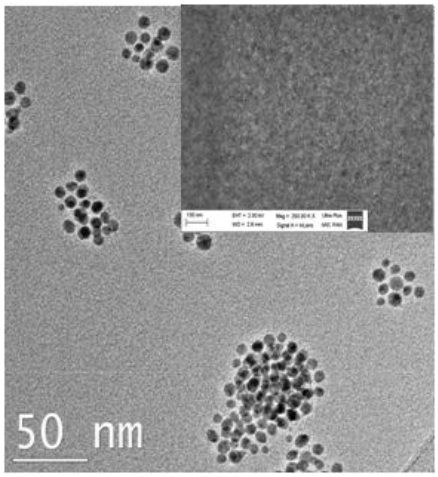

Figure 1, TEM image of 3-8nm nanosilver particles

The new product with water base and the smallest nano silver filler we call NanoSilver R 1000.This is a product with the best technical parameters and with the highest purity of ingredients. All production process is fully controlled.

What expertise, skills and facilities can you offer to future nanoparticles research?

Current and future research for colloid containing nanosilver in the Amepox laboratory will be focused on biological activity. The biological activity of nanoparticles depends on many features, such as their size, surface coatings and release of silver ions. Their size and the release of silver ions are regulated by the silver particles stability. A reduction in their stability can result in aggregation of the silver nanoparticles which consequently leads to the total or partial lose of their nanoscale properties. The aggregation of silver nanoparticles also alters their cellular uptake and the response of cells to the nanoparticle, and modifies their bioavailability and toxicity. These studies will allow creating environmentally friendly products with very good physico-chemical parameters.

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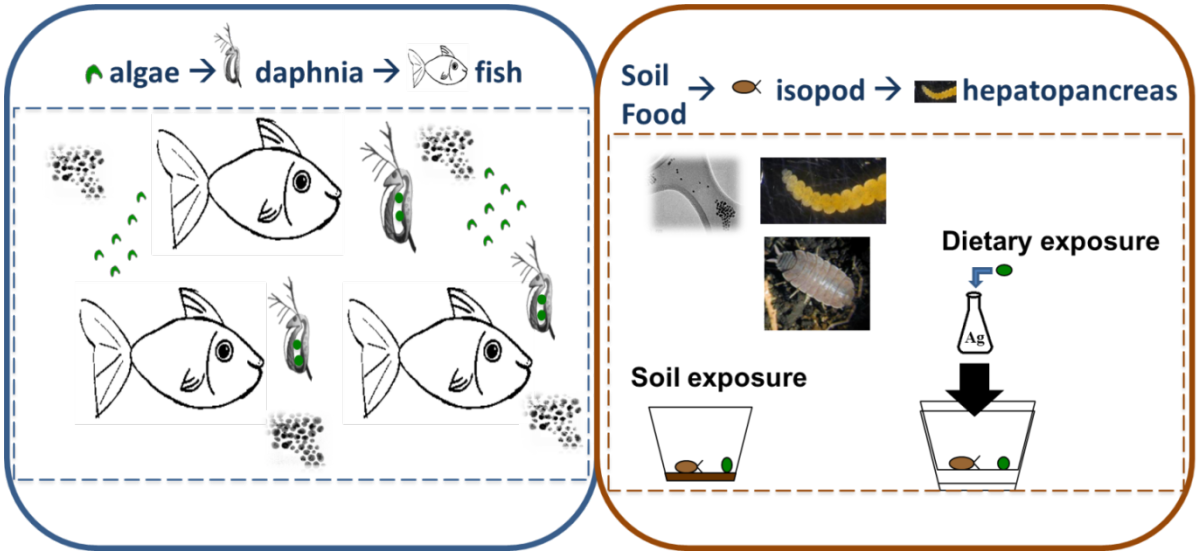
Susana Loureiro

What have you gained from participating in the NanoFATE project?

The research team from UAVR has gained several skills and expertise regarding the evaluation and understanding of toxicity effects of NPs to non-target organisms. This resulted from the interdisciplinarity of the partners that jointly investigated several crucial issues that have been and still are in discussion within NPs hazard and risk. In addition, young researchers had the excellent opportunity to visit labs from other research areas and learn new techniques and methodologies (e.g. within Qnano applications).

What expertise, skills and facilities can you offer to future nanoparticles research?

The UAVR research team involved in NanoFATE has a new building where facilities for ecotoxicity assessing of emerging chemicals are available. Therefore, in the new labs we can evaluate from genomics to populations responses, using high throughput techniques, molecular and enzymatic methodologies, micro and mesocosms facilities, both for aquatic (freshwater/marine/estuarine) and soil organisms. We have several in-house cultures of standard and non-standard organisms that can be tested in CT rooms. In addition, we have facilities available to test natural stressors like different temperatures, dissolved oxygen or ultraviolet radiation singly or jointly with other stressors (e.g. NPs). Therefore, standard and non-standard toxicity tests, bioaccumulation and biomagnification assays can be carried out in our research group.



Schematic representation of the food-chain transfer studies carried out by the University of Aveiro as part of the NanoFATE project

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Cornelis 'Kees' van Gestel

What have you gained from participating in the NanoFATE project?

Working within NanoFATE brought us into the new field of nano-ecotoxicology. From our work in NanoFATE we learned a lot about the fate and effects of nanoparticles in soil, but also in water. The work in NanoFATE was especially performed by a PhD student (Pauline Waalewijn-Kool) who successfully finished her PhD in October 2013. In addition to her PhD thesis, the work of our group in NanoFATE yielded seven publications in peer-reviewed journals, while one paper still is under review. In addition, I had the pleasure to act as co-supervisor of a PhD student of the University of Aveiro, who plans to finalize her PhD in 2015. This collaboration and the cooperation with other partners within NanoFATE did already lead to two publications, while several more are currently in preparation, under review or already in press. NanoFATE also enabled us to join the network of nano-ecotoxicologists, and it increased our visibility in the field. This already resulted in two PhD students coming to our lab to work with us on nanoparticles.

What expertise, skills and facilities can you offer to future nanoparticles research?

Besides the basic skills and expertise in soil ecotoxicological research, we can offer expertise in the handling of nanoparticles, more in particular in how to dose them to soils and expose soil invertebrates. Our research group has great facilities for culturing and toxicity testing different species of soil invertebrates, characterizing soil and porewater and for measuring metal concentrations in abiotic and biotic substrates, to very low concentrations, using Atomic Absorptions Spectrometry. With the latter we may help defining exposure and uptake of metal-based nanoparticles in organisms. In addition, we have an excellent molecular-biology lab having facilities of measuring gene expression responses to nanoparticles.

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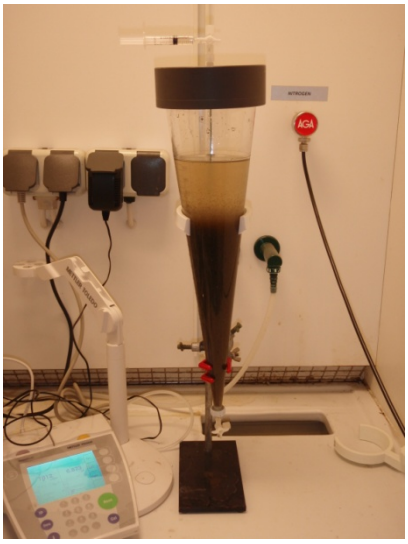
Martin Hassellöv

What have you gained from participating in the NanoFATE project?

We have gained a strong position internationally within the environmental fate and environmental detection part of Nanosafety research. We have developed a novel concept of how to address the complexity of natural waters and simplify and standardize water types relevant to span the European aquatic chemistries into a fate testing platform. Further we have developed single particle ICP-MS so that it now can be applied to routine environmental nanosafety research applications, e.g. within natural waters or waste water fate processes.

What expertise, skills and facilities can you offer to future nanoparticles research?

We can offer knowledge, expertise and methods based on cutting edge analytical detection and characterization, e.g. single particle ICP-MS. We have a good understanding on fate processes that can now be offered to generate data that is urgently needed for fate model development.



Bench-top system, which when coupled with single particle ICP-MS anaylsis can help determine the fate and speciation of nanoparticles in sewage treatment works

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What have you gained from participating in the NanoFATE project?
Nanofate allowed us to study the microbial ecotoxicology of metal nanoparticles. In particular silver nanoparticles proved to be highly toxic, with the ionic silver being the toxicity driver. We could show that ecotoxicological effects already occur at nanogram/L concentrations, which is a silver concentration regularly monitored in the aquatic environment. This work would not have been possible without close collaboration especially with material scientists.

What expertise, skills and facilities can you offer to future nanoparticles research?
The ecotoxicology group at the University of Gothenburg studies the impact of emerging pollutants on natural microbial communities, in freshwater as well as marine systems. This includes, but is not limited to, the ecotoxicology of nanomaterials. One of our focus areas is the analyses of the joint action of different pollutants (mixture ecotoxicology), as the simultaneous presence of pollutants is typical for current exposure scenarios.

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Michael Faust

What have you gained from participating in the NanoFATE project?
NanoFATE provided us with the opportunity to work closely with a broad range of experimental (aquatic and terrestrial) ecotoxicologists and material scientists. This provided valuable insights into the actual challenges when characterizing the hazard of nanoparticles for various organisms under environmentally realistic conditions. Additionally, the broad range of experimental data from different organism groups provide a solid basis for describing the distribution of species sensitivities, allowing for advanced environmental risk assessments.

What expertise, skills and facilities can you offer to future nanoparticles research?
We are working on the interface between science and regulation. In that respect we aim to develop regulatory approaches for nanoparticles and chemical risks in general that adequately consider the scientific state of the art. Our expertise covers a broad range of environmental risks and regulatory regimes, providing options that facilitate the sustainable and environmentally benign use of nanotechnology.

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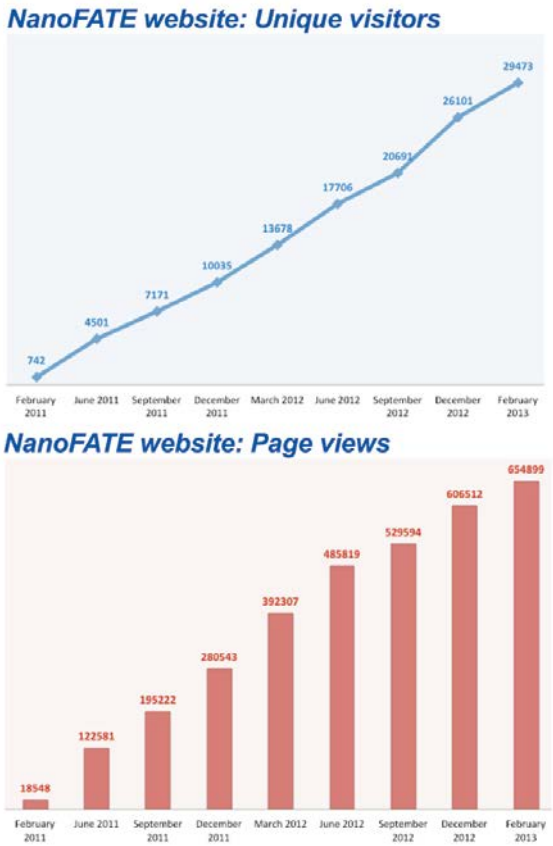
Claire Mays

What have you gained from participating in the NanoFATE project?

A wonderful collaboration with open, modern, smart scientists who met the challenge of multidisciplinarity. At Symlog we were constantly learning about the scientific issues and the experimental approaches to develop understanding of ENM toxicity and fate. We were able to lend our own social science methods to surveying nanotech specialists across Europe, and have submitted a paper that contains the literature's first quali-quanti demonstration of a common-sense assumption: specialists structure their perception of nanotechnology using the two concepts of risk and opportunity. Our survey also demonstrated that the relative weight differs with scientific background.

What expertise, skills and facilities can you offer to future nanoparticles research?

Symlog has worked for ten years in scientific project dissemination, backing up our 30-year experience in engaging stakeholders for complex socio-technical risk management. With NanoFATE, our team with CEH showed that high integration between an attractive newsletter and a rich website leads to outstanding visibility. We are ready to assist other projects to achieve the same performance.



▲ NanoFATE WP7. Steady growth in frequentation of our website across the project lifetime

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Witold Lojkowski

What have you gained from participating in the NanoFATE project?

Through our participation in NanoFATE the Laboratory of Nanostrucutres of the Institute of High Pressure Physics has gained an understanding of:

- the importance of the studies on the impact of nanotechnology on environment. We learned also about the methodology of such studies. Why is this knowledge important for us? Since we aim to commercialise nanoparticles based technology, we become now sensitive to the environment impact of nanoparticles. We can also advise our industrial partners on the peculiarities of nano-particles toxicity and environment impact.

- the complexity of nanoparticles environment impact. Besides the chemical composition, it depends also on their size, size distribution, surface coating and details of the environment (water, soil).

- how to scale up the ZnO nanoparticles production. We are now able to produce 100 gr very fine nanoparticles per day. This is a high amount, taking into account their activity.

What expertise, skills and facilities can you offer to future nanoparticles research?

The experience gathered during nanoparticles characterization permitted us to apply for the ISO 17025 certificate for characterization of them using several methods. Now we offer this service to laboratories and to industry. Further, we offer our excellent nano-ZnO nanoparticles and others, to be tested in antibacterial applications in research and industry.

Participation in NanoFATE has given us an understanding of the issues relating to the environmental fate and toxicity of nanomaterials that informs our discussions when meeting potential clients.

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