



## Systems Biology in Nanosafety Research Conference

**W**ith the continued rise in the use of engineered nanomaterials (ENM) it can be difficult to not only keep track of the safety of these ENMs but also to predict how complex biological systems might react when exposed to them.

Systems biology — the mathematical and computational modelling of complex biological systems — is now being used to

deal with this issue, and is at the crux of the NANOSOLUTIONS project.

In this newsletter we will be looking at the events of the “Systems Biology in Nanosafety Research – 3rd Mini-Conference on Nanotoxicology”, as well as the new NANOSOLUTIONS film, the current status and activities of the NANOSOLUTIONS work packages, and upcoming nanotechnology events.

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## System Biology in Nanosafety Research



**On the 9-10th November 2015, the Systems Biology in Nanosafety Research conference took place at the Nobel Forum in Stockholm, Sweden. It marked the third in a series of mini-conferences on nanotoxicology, and was chaired by Professor Bengt Fadeel and Professor Juha Kere of the EU funded NANOSOLUTIONS project.**

Systems biology, defined as the computational and mathematical modelling of complex biological systems, is increasingly being applied in the field of nanosafety research for observing and predicting the biological perturbations inflicted by exposure to engineered

nanomaterials. The aim of this two-day meeting was to provide an overview of the state-of-the-art of systems biology approaches in nanosafety research.

The conference was organised by Professor Bengt Fadeel with Professor Juha Kere within the EU funded project FP7-NANOSOLUTIONS and in collaboration with the Working Group on Systems Biology in the EU NanoSafety Cluster, and took place at the Nobel Forum, which is part of the world renowned Karolinska Institutet.

The meeting was the third event in a series of mini-conferences on nanotoxicology at the Nobel Forum organised by Professor Bengt Fadeel, the first of which was organised in 2006 and the second in 2010 in the context of the FP7-NANOMMUNE project. The 2015 meeting was the first meeting to focus specifically on systems biology, a topic that is of central importance for the FP7-NANOSOLUTIONS project. The project coordinator, Professor Kai Savolainen, provided the introductory remarks at the event.

Dr Olli Ikkala presented the opening keynote lecture oriented towards material sciences and emerging nanomaterial applications, he discussed the “amazing” qualities of biological materials using the examples of silk, “as strong as turbine steel” and calcium carbonate, “so tough” and the colours of a butterfly to declare that: “Nature is brilliant at materials!”.

Penny Nymark from the Karolinska Institute spoke on fibre-induced effects in human lungs and the possible carcinogenic effects; Mark Viant talked about the impact zinc oxide nano particles have on Daphnia, making them unnoticeable to algae. In the closing keynote lecture Dr Martin Philbert focused on the increasing number and diversity of engineered nanomaterials, which necessitates more sophisticated approaches in toxicological testing. The invited lectures, with speakers from several European countries, the US, Canada and China, were organised into sessions covering nanosafety, transcriptomics, proteomics, epigenomics and metabolomics, and bioinformatics. Highlights included Lucia Migliore’s talk on the epigenetic effects of nano-sized materials, as well as Brian Thrall’s lecture on the prediction of the biological effects of engineered nanoparticles on innate immune susceptibility mechanisms using integrated ‘omics.

This international meeting was targeted at academic scientists with an interest in systems biology and nanosafety research, as well as representatives from nanotechnology related industries and regulatory agencies.

Read more on the individual sessions [here](#)



### WP3: Criteria for Selection of ENM

During the NANOSOLUTIONS Project a total of 31 engineered nanomaterials (ENM) were acquired for performing toxicity studies in end-user labs and thereby generating a complete set of data to feed into and help develop the prototype of the NanoSafety Classifier. The selection of ENM types to be included in the project was based on a pre-established set of selection criteria, which were:

- the selected ENM should exhibit a wide range of toxicities;
- the ENM should be used by European industry with likelihood of human exposure (intentional and non-intentional), or be relevant in the future;
- the selection should support European legislation initiatives.

The complete matrix of ENM in NANOSOLUTIONS is summarised in the table below. It covers both 3D (nanoparticles) and 1D (nanotubes or nanorods), which were acquired directly from industry or synthesised by partners for the project.

Core ENM	Expected toxicity	Diam./nm or aspect ratio (constituent particles)	Particle type	Industrial Relevance / Exposure/ Applications	Functionalisations	Dimension	Producer
TiO <sub>2</sub> particles (Rutile)	low	10-20	Metal oxide	Mass production; High likelihood of exposure; Used as white pigment in paint industry, cosmetics, colorant in food.	Core; -COOH; -NH <sub>2</sub> ; PEGylat.	3D	Plasmachem
TiO <sub>2</sub> rods		1:5				1D	
CuO particles	high	10-20	Metal oxide	Mass production; High likelihood of exposure; Used in microelectronics, antifouling paints, biocide in textiles.	Core; -COOH; -NH <sub>2</sub> ; PEGylat.	3D	PlasmaChem
Au particles (smaller)	low-med	3-5	Metal	Not yet used broadly in industry but relevant in the scope of future biomedical applications; Potential use in nanomedicine	-COOH; -NH <sub>2</sub> ; PEGylation	3D	UB
Au particles (larger)		10-20					
Ag particles	low-med	10-20	Metal	Mass production; Used in food supplements, in food packaging, storage boxes, in refrigerators as an antimicrobial, and in biocide sprays.	-COOH; NH <sub>2</sub> ; PEGylat.	3D	UB



CdTe particles	high	3-5	Ceramic incl. heavy metal	Currently in mass production; Potential exposure in the future; Used in LED/solar cells/lasers and inkjet printing applications.	-COOH; -NH <sub>2</sub> ; PEGylation	3D	PlasmaChem
Nanodiamonds	low-med	3-5	Carbon	Available in large amounts; High likelihood of exposure; Used in the IT field, as an additive in engine oils, lubricant, and in plastic reinforcements.	-COOH; NH <sub>2</sub> ; PEGylat.	3D	PlasmaChem
MWCNTs	high	1:100	Carbon	Available in large amounts; Exposure is likely; Used in composite materials (electrically conductive polymers), antifouling paints, and sporting goods.	Core; -COOH; - NH <sub>2</sub> ; PEGylat.	1D	NANOCYL and UNIMAN

The ENMs were provided by NANOCYL or synthesised in-house for the project by other project partners - namely PlasmaChem, University of Bordeaux (UB), University of Manchester (UNIMAN) and CiC BiomaGUNE.

The nine types of ENM selected for the project cover a wide range of relevant industrial applications of ENM and meet the pre-established selection criteria, thereby supporting the primary goal of NANOSOLUTIONS - the development of a prototype safety classifier for ENM.

The presence of ENM with the same core material in different sizes (3-5 and 10-20 nm Au particles) and shapes (TiO<sub>2</sub> particles and rods) allow investigation of the role of size and shape of ENM on their toxicity. In addition to the core pristine particles, each ENM type is also available in 3 specific functionalised variants, in order to study the influence of the surface properties of ENM on their toxicity. The ENM were functionalized with -COOH, -NR<sub>1</sub>R<sub>2</sub> or polyethylene glycol, thus yielding ENM with pH-dependent negative and positive charges, respectively, or improved hydrophilicity.

## WP6: Collection of in vitro samples

WP6 has been working towards their late November (week 32) deadline for D6.6 collection of in vitro samples for delivery to WP10. The WP6 partners at the Karolinska Institutet have now delivered the full set of samples, using THP.1 cells, to the relevant partners in WP10 for OMICS analysis. FIOH are soon to be finishing the sample preparation and will send all of their samples to WP10, using the BEAS-2B cell model.



## ESOF2016

Nanosolutions are pleased to announce that the EuroScience Open Forum (ESOF) Steering Committee has accepted the project's proposal for a session on nanosafety, which will be organised by FIOH/Nanosolutions Project and the Academy of Finland as part of the Science programme of ESOF2016. Competition was extremely tough this year as over 80 session proposals competed for programme slots.

The exact date and time of the session is to be announced on the NANOSOLUTIONS website as soon as the programme committee have come to a decision but attendees are advised to save the ESOF2016 dates of 23-27 July 2016

The session will include speaker Kai Savolainen (session chair) from FIOH, Andrea Hartwig from the Karlsruhe Institute of Technology (KIT), Dario Greco from the Academy of Finland, Socorro Vázquez-Campos from LEITAT Technological Centre and Emma Martín Rodríguez from the University of Madrid.

The safety of nanomaterials has been identified as one of the key issues having a major impact on the success of the whole nanoindustry and European competitiveness. Solutions that promote the safe and sustainable use of nanotechnology are essential as the commercialisation of nanotechnology expands.

The session will consist of a short general introduction and four introductory presentations from various perspectives to nanomaterial safety, followed by an interactive panel discussion. The session will address the following questions: 1) How are consumers and workers exposed to nanomaterials and what are the health and other risks? 2) How can we promote the safe and sustainable use of nanomaterials?

## About ESOF

The EuroScience Open Forum (ESOF) is a biennial, pan-European, general science conference dedicated to scientific research and innovation. Each conference aims to deliver stimulating content and lively debate around the latest advancements and discoveries in the sciences, humanities and social sciences.

ESOF brings together over 4,500 leading thinkers, innovators, policy makers, journalists and educators from more than 90 countries, to discuss current and future breakthroughs in contemporary science.

Now in its seventh iteration, ESOF attracts thousands of delegates to the host city during the week of the conference, which, in 2016, will be held between 23 and 27 July in Manchester. ESOF is one of the best opportunities for everyone from leading scientists, early careers researchers, business people, policy makers, science and technology communicators to the general public to come together to find out more about how science is helping us advance today.

*More information about ESOF:*

<http://www.esof.eu/about/introduction-to-esof.html>



## NANOSOLUTIONS – Safer by Design film release



A new NANOSOLUTIONS film “NANOSOLUTIONS –Safer by design” has been released explaining how NANOSOLUTIONS will help make the use of nano materials safer for all. The film looks at how the project will ensure that the use of engineered nanomaterials (ENM) is safer for all by identifying the characteristics that determine their biological hazard potential. Through interviews with the project coordinator Kai Savolainen and several more key partners, the film shows how NANOSOLUTIONS

is developing a safety classification tool for ENM based on an understanding of their interactions with living organisms. A complex algorithm will assess this data, collected through detailed experimentation and systems biology analysis, and be able to predict whether any type of ENM developed in the future will be safe to use, thus speeding up innovation and keeping the costs down of bringing new and exciting materials to the market.

## Diary Events

### EuroScience Open Forum Manchester 2016 (ESOF2016)

**Manchester Central, Manchester, UK | July 23-27, 2016**

ESOF – EuroScience Open Forum –was founded in 2004 by EuroScience, the non-profit grassroots organisation of researchers in Europe, is the biennial pan-European meeting dedicated to research and innovation.

At ESOF meetings leading scientists, researchers, young researchers, business people, entrepreneurs and innovators, policy makers, science and technology communicators and the general public from all over Europe discuss new discoveries and debate the direction that research is taking in the sciences, humanities and social sciences.



ESOF2016 will feature a session on Nanosafety by NANOSOLUTIONS, organised by FIOH/Nanosolutions Project and Academy of Finland

Click [here](#) to register for ESOF 2016



## Diary Events

### 2nd Sustainable Nanotechnology School

Venice, Italy | 24-29 January 2016



The achievement of safe nanoproducts requires an understanding of the properties, biological interactions, fate, risks and environmental impacts of manufactured nanomaterials (MN). The school will also highlight the best available experimental and modelling approaches and practices for physicochemical characterisation, (eco)toxicity testing, exposure, risk, lifecycle a decision support for sustainability of nanotechnologies and risk governance. The course is structured to balance breadth and depth in these diverse topics while providing an interactive learning environment and direct access to key experts from Europe. The Sustainable Nanotechnology School is organised in the frame of the major EU FP7 projects SUN, the MODENA Cost Action and ECONANOSORB.

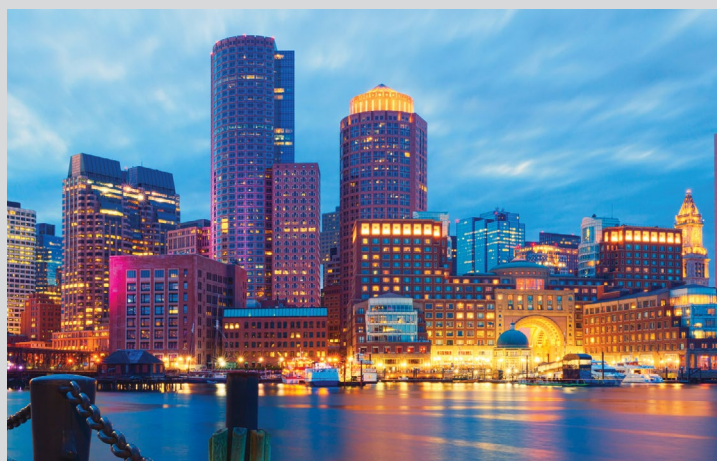
[www.unive.it/nqcontent.cfm?a\\_id=66712](http://www.unive.it/nqcontent.cfm?a_id=66712)

### 8th International Nanotoxicology Conference

Boston, USA | June 2016

The 2016 International Nanotoxicology Congress is the 8th in a continuing series of international meetings that are broadly focused on nanotoxicology, one that began in Boston in 2006.

The objective of this conference is to bring together scientists from academia, industry, government agencies, and non-governmental organisations to present current research findings, focus their respective talents and expertise, and initiate new collaborations in an effort to ensure the safe implementation of nanotechnology. The Advisory Board is working now to develop the scientific program for this conference, which will include plenary lectures, symposia, workshops, poster sessions, and dedicated time for presentations by young scientists.



<http://nanotoxcongress.net/index.html>

## **NANO2016 11th ICEENN**

**Golden, Colorado, USA | August 14-18th**

Now in its second decade, this highly successful conference series which started in 2006 (London), organised by Richard Handy (NANOSOLUTIONS WP7). As one of the leading international conferences on environmental nanoscience, the 11th ICEENN will bring together researchers, regulators and industry to discuss recent advances in our understanding of both the nature of nanomaterials and the key issues relating to maintaining the economic and social benefits of nanotechnology.

<http://igwmc.mines.edu/ICEENN2016.html>



## **EuroTOX2016**

**Lutfi Kırdar International Convention & Exhibition Center. Istanbul | 4-7 September 2016**

EUROTOX 2016 will be home to talks on Toxicology, Biology, Pharmacology, Health, Public Health, Environment and Toxicity And Risk Assessment.

[www.eurotox.com](http://www.eurotox.com)

## **NANOSAFE 2016 Conference**

**Grenoble, France | 7-10 November 2016**

The NANOSAFETY PLATFORM PNS organises the Fifth International Conference NANOSAFE 2016

[www.materials.cea.fr/en/index.php](http://www.materials.cea.fr/en/index.php)





**NANOSOLUTION partners**

*Please find a list below of the NANOSOLUTION partners.*

Finnish Institute of Occupational Health

<http://nanosolutionsfp7.com/partners/FIOH/>

Karolinska Institutet

<http://nanosolutionsfp7.com/partners/karolinska-institutet/>

Centre for BioNano Interactions (NUID UCD)

<http://nanosolutionsfp7.com/partners/nuid-ucd/>

Netherlands Organisation for Applied Scientific Research (TNO)

<http://nanosolutionsfp7.com/partners/tno-netherlands/>

Universite Bordeaux-1

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University of Manchester

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LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN

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<http://nanosolutionsfp7.com/partners/iom/>

Turku Centre for Biotechnology

<http://nanosolutionsfp7.com/partners/turku-centre-for-biotechnology/>

National Institute for Occupational Safety and Health

<http://nanosolutionsfp7.com/partners/niosh/>

LEITAT

<http://nanosolutionsfp7.com/partners/leitaf/>

The Technical University of Denmark, National Food Institute

<http://nanosolutionsfp7.com/partners/dtu-food/>

Telethon Institute of Genetics and Medicine

<http://nanosolutionsfp7.com/partners/tigem/>

The University of Leipzig

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Empa - Swiss Federal Laboratories for Materials Science and Technology  
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National Health Laboratory Service / National Institute for Occupational Health  
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