

Summary of the NANOSH project

1st reporting period 1.11.2006-31.10.2007

Project summary

Nanotechnology, i.e. the production based on different nano-sized particles, is a rapidly increasing area of industry providing new and innovative solutions being introduced into many industrial sectors. In near future, it will have a major impact on the everyday life of people in the industrialized countries and therefore, there are increasing demands by society for reliable and understandable information on the possible health effects of engineered nanoparticles. It is essential that reliable information should be gathered before entering with widespread use of nanoparticles to avoid potential health problems. This research project will focus on occupational exposure to nanoparticles and their health effects.

One goal of the research is to characterize the levels of exposure to specific engineered nanoparticles. Exposure levels will be evaluated both under laboratory conditions and during the manufacture of the particles. The particles will be characterized with respect to their morphology and particle-size distribution, surface activity, and potential for agglomerate formation. Health effects to be studied include genotoxicity and pulmonary inflammatory responses as well as the effects of nanoparticles on the vasculature.

Expected end results

The overall goal of the project is to delineate exposure and health effects of selected nano-sized particles relevant to the occupational environment. The information gathered on the health effects of the particle exposure together with the state-of-the-art technology utilized in these studies will create a reliable basis for the evaluation of the health effects of the nanoparticles.

This project will bring together expertise from different research areas highly relevant for assessing the safety of nanoparticles and will thereby significantly promote the formation of new centers of excellence in this rapidly evolving area. Finally, the project will promote the formation of a competitive European Research Area.

Intentions for use and impact

The project will have a significant socio-economic impact on the European capability for conducting research and innovation in the area of nanotechnology. Assuring the safety of new nanomaterials will be a crucial prerequisite for successful promotion of nanotechnological innovations and their applications in the future. This research aims at creating a reliable and sound foundation for the assessment of safety of nano-size particles and products containing nanoparticles and is this way to encourage nanotechnological advances to support the European national economies, as well as the prosperity and wellbeing of citizens in the EU Member States.

The project will provide essential information which can be used on a wider basis for assessing occupational and other safety risks associated with the production and use of nanoparticles. Essential products that will serve these scientific and technological goals are means and methods to characterize particle properties, ways to carry out reliable exposure assessments to support safety evaluation of nanoparticles, and models for assessing key-health effects as components of the safety evaluation of nanoparticles.

Scientific and technological objectives of the project

Particle and exposure characterization:

- to define exposure levels of selected nanoparticles under laboratory conditions and in workplaces
- to delineate particle size distribution, dissolution, agglomeration properties, surface area and surface activity of various nanoparticles

Genotoxicity of nanoparticles:

- to delineate nanoparticle-induced oxidative DNA damage in lung cells
- to explore nanoparticle-induced DNA strand breakage in pulmonary cells
- to study nanoparticle induced chromosomal damage in pulmonary cells

Pulmonary inflammation induced by nanoparticles:

- to investigate direct effects of nanomaterial exposure on pulmonary inflammation
- to investigate modulatory effects of nanomaterial exposure on the development of allergic asthma

Effects of nanoparticles on microcirculation:

- to investigate the effects of nanoparticles on microvascular thrombus formation
- to investigate potential prothrombotic and proinflammatory effects of nanoparticles in the microvasculature of healthy mice
- to investigate the role of nanoparticles in consequences of post-ischemic injury

Partic. no.	Participant name	Short name	Country
1	Finnish Institute of Occupational Health	FIOH	Finland
2	Institute for Surgical Research, University of Munich	LMU	Germany
3	Central Institute for Labour Protection - National Research Institute	CIOP	Poland
4		TNO	Netherlands
5	Health and Safety Laboratory	HSL	UK
6	Berufsgenossenschaftliches Institut für Arbeitsschutz	BGIA	Germany
7	Cancer Biomarkers and Prevention Group	ULEIC	UK

Name of the Co-ordinating person: Professor Kai Savolainen
Co-ordinator email: kai.savolainen@ttl.fi
Co-ordinator fax: +358 30 474 2200

Results achieved so far:

WP1-Characterization of nanoparticles

- Eighteen relevant nanomaterials used in commercial applications have been selected for characterization. Suitable characterization protocols are being developed and good progress has been made in the electron microscopy analysis.
- The standard dustiness test has been modified to enable particle size as well as mass concentration from the aerosol to be measured.
- Test materials for toxicological studies have been selected and characterized and special attention has been paid to the dispersion properties of these nanoparticles in media used in cell cultures.
- A sampling strategy for characterisation by Scanning Electron microscopy (SEM) or Transmission Electron microscopy (TEM) has been written as an advice guide for WP2. Samples collected during workplace surveys (WP2) are also being analysed by electron microscopy.

WP2-Assessment of exposure to nanoparticles and associated control issues

- Pilot studies in four workplaces:
All four partners involved successfully carried out pilot studies. The results from these studies are presented in the report "Report of outcome of pilot studies in workplaces and proposed sampling plan for main study".
- Outcome of pilot studies and revised sampling strategy for main study

WP3-Genotoxic effects

- Preliminary experiments have concentrated on the determination of oxidative DNA damage in cells treated with positive control substances. These cells will act as positive controls for comparison in future experiments involving the treatment of cells with engineered nanoparticles.

WP4-Pulmonary inflammation induced by nanoparticles

- Short-time inhalation exposure to TiO₂ nanoparticles seems to lead on significant infiltration of inflammatory cells, particularly neutrophils, into the lungs of healthy mice.
- The expression of neutrophil attracting chemokine (CXCL5) at messenger RNA level is increased after aerosol exposure of nanosized TiO₂ particles.
- Moreover, proinflammatory protein (TNF- α) is induced after repetitive exposure.

WP5-Microvascular effects

- Novel mouse models (thrombosis) and modified existing mouse models (cremaster preparation, liver, isolated-perfused mouse liver) suitable for the analysis of microvascular effects of nanoparticles has been established.
- Analysis of the effects of nanoparticles in both the thrombosis and liver model has been started.