

**House of Lords Science and Technology Select Committee
Nanotechnologies and food inquiry**

**Response to request for additional information by the Department for
Innovation, Universities and Skills**

This response provides the further information that the Committee asked DIUS to provide at the evidence session on 31 March 2009.

Nanotechnologies cut across traditional scientific disciplines and could lead to a very diverse range of potential applications and potential risks, therefore research usually involves inter-disciplinary working and responsibility for risk management is shared across a number of Government departments and agencies.

In February 2008, the Government published a detailed statement that described the range of activities carried out by Government departments and agencies and the Research Councils, and the reasons for those activities. It also described the mechanisms that are in place to coordinate those activities. We have provided copies of the statement to the Committee. While it does not specifically address nanotechnologies in specific sectors such as food, we hope that it will give the Committee an overview of how the various activities and responsibilities are linked.

The direction of the Government agenda for nanotechnologies was set out in 2005 in response to the report by the Royal Society and Royal Academy of Engineering "Nanoscience and nanotechnologies: opportunities and uncertainties". The Council for Science and Technology review in 2007 found that good progress was being made in certain areas, although there was scope for improvement in others. Subsequently, the Ministerial group on nanotechnologies was established to give a greater profile to the Government's work in this area. The statement was the result of the first meeting of the group. At its most recent meeting the group agreed on the need for an informed debate about the future direction of the development of nanotechnologies, and agreed that a strategy should be developed in dialogue with stakeholders.

On the specific information that DIUS offered to provide to the Committee—

Work taking place to encourage research and development and translation in relation to nanotechnologies in the food sector. (This would include projects such as knowledge transfer networks which are not aimed specifically at the food sector but would impact upon it.)

The Government funds a number of activities to translate the knowledge and ideas generated by fundamental research into new products and services in areas where there are market opportunities through the Technology Strategy Board. It does this in a number of ways, for example Innovation Platforms, Knowledge Transfer Networks, Knowledge Transfer Partnerships and initiatives such as the Small Business Research Initiative.

The joint evidence submitted to the Committee by the Nanotechnology Knowledge Transfer Network and Leatherhead Food International noted that they have formed a Food Focus Group to promote awareness of the potential for nanotechnologies for the food industry.

One of the 24 Micro and Nanotechnology open access centres funded by the Technology Strategy Board, Eminate, focuses its work on state of the art solutions to the food and pharmaceutical industries with the aim of applying in-house process technologies to develop customer products in the areas of advanced coatings, materials and powders, food technology, drug delivery, measurement and scale up through to pilot productions. This is a five year project and the total grant is £3.5 million of which £3 million has been drawn down to date.

Although not specifically addressing food, the Technology Strategy Board is currently preparing strategies for nanoscale technologies and biosciences. For nanoscale technologies there is a focus on linking the pervasive nature of nanoscale technologies to societal challenges of living with environmental change, living with a growing/ageing population, and living in an intelligent connected world. For Biosciences, the focus will be on food technology and food safety.

The Research Councils are not specifically encouraging research in relation to nanotechnologies in the food sector although, as described in their evidence to the Committee, they are funding a large amount of fundamental research in areas that may be of relevance to the development of new technologies and products and to the improved understanding of potential risks.

Details of projects being funded by the Government into the toxicology of nanoparticles in the gut.

The Medical Research Council issued a 'highlight notice' in March 2007 to encourage applications in nanotoxicology with the aim to inform policy development. The notice has proved successful in stimulating a significant increase of applications to the Research Boards. Since launch five awards were made at a total level of approximately £3 million. This research aims to better understand the uptake of nanoparticles into cells and the functional consequences including oxidative stress, inflammatory response, cell death and genotoxicity. By linking this information to the physical and chemical characteristics of nanoparticles, predictive models for nanoparticle toxicity can be developed that will help risk assessment. There is currently no agreement on which characteristics should be studied to evaluate the toxicity of nanoparticles and many of the funded studies aim to address this issue. A lot of this work is currently focused on the lung, although some of the principles may be transferable to other organs systems. Building on the current funding and the recommendations in the recent report from the Royal Commission on Environmental Pollution, the Medical Research Council has further refined the highlight notice to encourage in particular studies which investigate the effects of engineered nanoparticles *in vivo*.

More detail on the awarded studies is below:

1) Mechanisms of bioreactivity of engineered nanoparticles with pulmonary gas exchange barrier (Imperial College) - £600k/3yrs

Investigates the toxicity of common nano-particles, such as carbon nanotubes, silver and titanium oxide, when taken up by lung cells. The toxic effects will be related to the physical and chemical properties of the nanoparticles to establish patterns that will allow to predict the health effects engineered nanoparticles.

2) Understanding the genotoxic potential of ultra-fine superparamagnetic iron oxide nanoparticles (University of Wales, Swansea) - £450/3yrs

Studies the genotoxic properties of iron oxide nanoparticles with the aim to develop high-through-put screening tests for genotoxic effects; Aims to understand dose-response relationships, to inform future in vivo studies and predictive approaches.

3) Defining the biologically effective dose for pro-inflammatory effects of nanoparticles in lung target cells (University of Edinburgh) £500k/3yrs

Investigates the inflammatory response in lungs following the exposure to commonly used industrial nanoparticles. The potential of these nanoparticles to cause oxidative stress and inflammation will be examined at the cellular level and in animal models to establish and validate better models for predictive testing.

4) Biological consequences of exposure to prosthetic nanoparticles (University of Leeds) - £500k/3yrs

Hip replacements generate nano-sized metal wear particles that are released into the body. The project studies the genotoxic and immunotoxic consequences in animal models over a period of 10 months.

5) Pathway analysis in characterising toxicological properties of nanoparticles (Imperial College) - £550k/3yrs

Uses novel technologies (proteomics, functional genomics) to identify key pathways that are responsible for toxic effects. The aim is to apply these for routine screening purposes in the future.

In addition to these projects the Medical Research Council supports research exploring the potential of dietary nanoparticles for therapeutic use at the MRC Collaborative Centre for Human Nutrition Research in Cambridge. This programme investigates the uptake of dietary nanoparticles in the gut, the toxicity of these particles and their effect on diseases of the digestive tract. Dr Jonathan Powell, the Principal Investigator, has given evidence to the Committee.

The toxicity of wear particles released from hip replacements and the dietary nanoparticles for therapeutic use are studied in the medium to longer term.

Although the focus of research at the National Nanotoxicology Inhalation Research Centre (funded by the Health Protection Agency) is on inhalation, research into the absorption of nanoparticles across the skin is planned and the possibility of studies into gut absorption is being considered. In addition,

the Food Standards Agency has recently published a research requirement in the area of the toxicokinetics of nanoparticles, which includes their behaviour in the gut.

Details of how the Government is trying to close the gaps in scientific knowledge required for risk assessment: what programmes are being supported, what money is being spent, and how the Government is measuring progress.

Through the Nanotechnologies Research Coordination Group (NRCG), Defra coordinates the activities of Government departments, their agencies and the Research Councils. The NRCG has published two research reports that provide much of this information and copies of the reports can be found at <http://www.defra.gov.uk/environment/nanotech/research/index.htm>. A Defra-commissioned report “Emergnano” was published on 15 April 2009 and details how much progress has been made between 2004 and 2008 on NRCG’s health, safety and environmental research objectives (<http://www.defra.gov.uk/environment/nanotech/research/reports/index.htm#emergano>). On the basis of the report, the NRCG will update its research requirements and publish the new requirements.

The Emergnano report looks at global research in this area and identifies gaps that still remain. Globally there is insufficient evidence to be able to say that any of the health, safety and environmental research objectives have been completed. Thus full risk assessments for any nanomaterial are not possible at present.

The OECD and EU are also very active in the area of risk assessment. Defra leads an OECD steering group that is dedicated to identifying best risk assessment methods in the absence of complete data.

DIUS does not retain funds centrally (these are managed by delivery partners) and hence does not directly fund work on risk assessment. However, DIUS does provide support in the following areas –

- Progress in the ability to measure and characterise nanoscale materials is essential for both the development and the risk assessment of nanotechnologies. DIUS supports the National Measurement Programmes across a number of different areas, with a significant sum being spent on nanometrology.
- DIUS provides funding for the fundamental research supported by the Research Councils, who have provided a separate submission to the Committee.
- DIUS funds the Technology Strategy Board. In addition to its support for innovation, the Board part-funds SAFENANO, a free information service run by the Institute of Occupational Medicine to provide companies with a multi-disciplinary range of solutions to ensure that

they can offer employees a safe and healthy working environment and products that are safe for consumers.