Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

28-Apr-2006

Bil.

ENV/JM/MONO(2006)19
Non classifié/Unclassified

DIRECTION DE L'ENVIRONNEMENT
ENVIRONMENT DIRECTORATE
REUNION CONJOINTE DU COMITE SUR LES PRODUITS CHIMIQUES ET DU GROUPE DE TRAVAIL SUR LES PRODUITS CHIMIQUES, LES PESTICIDES ET LA BIOTECHNOLOGIE
JOINT MEETING OF THE CHEMICALS COMMITTEE AND THE WORKING PARTY ON CHEMICALS, PESTICIDES AND BIOTECHNOLOGY

Rapport sur l'Atelier de l'OCDE sur la Sûreté des Nanomatériaux Manufacturés : Renforcer la Coopération, Coordination et Communication (Annexes en anglais uniquement)

Report of the OECD Workshop on the Safety of Manufactured Nanomaterials: Building Co-operation, Co-ordination and Communication

Washington D.C., Etats-Unis, du 7 au 9 décembre 2005
Washington D.C., United States, 7th-9th December 2005

JT03208175

Bil.

OECD Environment, Health and Safety Publications
Series on the Safety of Manufactured Nanomaterials

Publications sur l'Environnement, la Santé et la Sécurité
Série sur la Sécurité des Nanomatériaux Manufacturés

No. 1

Report of the OECD Workshop on the Safety of Manufactured Nanomaterials

Building Co-operation, Co-ordination and Communication

Washington D.C., United States, 7th-9th December 2005

Rapport sur l'Atelier de l'OCDE sur la Sûreté des Nanomatériaux Manufacturés

Renforcer la Coopération, Coordination et Communication

(Annexes en anglais uniquement)

Washington D.C., États-Unis, du 7 au 9 décembre 2005

Environment Directorate / Direction de l'Environnement

ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

ORGANISATION DE COOPÉRATION ET DE DÉVELOPPEMENT ÉCONOMIQUES

Paris, 2006

About the OECD

The Organisation for Economic Co-operation and Development (OECD) is an intergovernmental organisation in which representatives of 30 industrialised countries in North America, Europe and the Asia and Pacific region, as well as the European Commission, meet to co-ordinate and harmonise policies, discuss issues of mutual concern, and work together to respond to international problems. Most of the OECD's work is carried out by more than 200 specialised committees and working groups composed of member country delegates. Observers from several countries with special status at the OECD, and from interested international organisations, attend many of the OECD's workshops and other meetings. Committees and working groups are served by the OECD Secretariat, located in Paris, France, which is organised into directorates and divisions.

The Environment, Health and Safety Division publishes free-of-charge documents in ten different series: **Testing and Assessment**; **Good Laboratory Practice and Compliance Monitoring**; **Pesticides and Biocides**; **Risk Management**; **Harmonisation of Regulatory Oversight in Biotechnology**; **Safety of Novel Foods and Feeds; Chemical Accidents; Pollutant Release and Transfer Registers; Emission Scenario Documents; and the Safety of Manufactured Nanomaterials.** More information about the Environment, Health and Safety Programme and EHS publications is available on the OECD's World Wide Web site (http://www.oecd.org/ehs/).

This publication was produced within the framework of the Inter-Organisation Programme for the Sound Management of Chemicals (IOMC).

The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. The participating organisations are FAO, ILO, OECD, UNEP, UNIDO, UNITAR and WHO. The World Bank and UNDP are observers. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organisations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

FOREWORD

The OECD's Joint Meeting of the Chemicals Committee and Working Party on Chemicals, Pesticides and Biotechnology (hereafter referred to as the Joint Meeting), held a Special Session on the Potential Implications of Manufactured Nanomaterials for Human Health and Environmental Safety (7 June 2005), which was intended to identify human health and environment safety issues associated with manufactured nanomaterials.

Based on the discussion of the Special Session, the 38th Joint Meeting (held 8-10 June 2005) recognized that nanotechnology offers a wide range of potential benefits which will impact on a large number of sectors. At the same time, it was agreed that countries should begin to work together in a proactive way, to ensure human health and environmental safety while economic advantages may be taken of the opportunities that these technologies can provide. Accordingly, the Joint Meeting decided to organize this ***OECD Workshop for the Safety of Manufactured Nanomaterials*** to identify potential safety issues in more detail.

This document is the report of the OECD Workshop held 7-9 December 2005. This report includes: i) an introduction; ii) the background and objectives of the workshop; iii) a summary of the plenary presentations and discussion; iv) an introduction to the breakout sessions; v) reports of breakout sessions; and vi) the ***general conclusions and recommendations*** of the workshop. It also includes a French version of these sections.

In addition, it also includes five annexes (only available in English) listed as followed: Annex I) the outcomes/ questions considered by the breakout sessions; Annex II) the reports of the breakout sessions including detailed technical recommendations; Annex III) the references and background documents; Annex IV) the Results of the Questionnaire/ Survey on the Safety of Manufactured Nanomaterials which was completed by delegations before the Workshop; and Annex V) the list of participants.

AVANT-PROPOS

La Réunion Conjointe du Comité des produits chimiques et du Groupe de travail sur les produits chimiques, les pesticides et la biotechnologie de l'OCDE (désormais nommée Réunion Conjointe), a tenue une session spéciale (7 juin 2005), sur les impacts sanitaires et environnementaux potentiels des nanomatériaux manufacturés. Cette réunion a cherché à identifier les questions de sécurité pour la santé humaine et l'environnement qui sont associées aux nanomatériaux manufacturés.

Suite a la discussion basé sur la session spéciale, la 38eme Réunion Conjointe (tenue le 8-10 juin 2005) a reconnue les potentiels avantages offerts par les nanotechnologie et l'impact que celles-ci auront sur plusieurs secteurs. Au même temps, il a été convenu de travailler de manière proactif afin d'assurer la santé humaine et la sécurité de l'environnement, en tenant compte des avantages économiques que ces technologies peuvent fournir et les enjeux potentiels au plan réglementaire. La Réunion Conjointe a donc décidés d'organiser l'***Atelier de l'OCDE sur la Sécurité de Nanomatériaux Manufacturé*** pour identifier les issues potentielles concernant leur sûreté en plus de détail.

Ce document est le rapport de l'Atelier de l'OCDE tenu le 7-9 Décembre 2005. Ce rapport comprend : i) Introduction ; ii) Rappel de l'historique et des objectifs de l'Atelier ; iii) Présentations et débats en séance plénière; iv) Introduction des sessions en sous-groupes ; v) Rapports des sessions en sous-groupes ; vi) Conclusions et recommandations générales de l'Atelier. Ces sections sont disponibles en français et anglais.

Également, il comprend aussi cinq annexes (uniquement en anglais) listés de la suivante façon: Annexe I) questions/ résultats pris en compte par les groupes de travail; Annexe II) les conclusions détaillées des groupes de travail; Annexe III) les références et documents utilisé ; Annexe IV) les réponses au « *Questionnaire sur les conséquences potentielles sur la santé humaine et l'environnement de l'utilisation des nanomatériaux manufacturés »* ; et Annexe V) la liste des participants.

Ce document est publié sous la responsabilité du Secrétaire Générale de l'OCDE. Les avis exprimés ce document sont ceux des participants à l'Atelier et ne reflètent pas nécessairement les vues officielles de l'organisation ou des gouvernements de ses pays membres.

TABLE OF CONTENTS

REPORT OF THE WORKSHOP ON THE SAFETY OF MANUFACTURED NANOMATERIALS

Introduction

The OECD Workshop on the Safety of Nanomaterials was hosted by the United States and held 7th-9th December 2005. As far as is known, this was one of the first opportunities for governments to discuss this topic at the international level, together with other stakeholders.

The workshop programme was prepared by a steering group involving delegates from Australia, Canada, Germany, Italy, Japan, Switzerland, United Kingdom, United States, EC, WHO, BIAC and Environmental NGOs.

The workshop was chaired by Jim Willis, US EPA. There were 120 delegates from 23 delegations from: OECD member countries; the non-member economies Argentina, China and India; BIAC; Environmental NGOs; and invited experts. In addition to the opening remarks of the Chair and the secretariat, Susie Hazen (Chair of the Joint Meeting) set the scene by giving a summary of OECD's Chemicals Programme.

Background and Objectives

The agreement to hold the workshop was made at the 38th meeting of the Joint Meeting. One of the main objectives (as envisaged by the Joint Meeting) was to begin to identify those human health and environmental safety issues, associated with manufactured nanomaterials, which should be addressed – within the context of OECD's Chemicals Programme – in the short, medium and long term. At the same time, it was foreseen as an opportunity for delegations to exchange information on national activities related to the safety of nanomaterials and to identify opportunities for other forms of co-operation or other fora where activities could be undertaken.

The workshop was able to examine in more detail, some of those issues identified at the Joint Meeting Special Session on the Potential Implications of Manufactured Nanomaterials[1], which was held at OECD Headquarters in June 2005. In particular, to investigate what is underway or has already been accomplished and what future research and policy work needs to be done within the themes: i) definitions, nomenclature and characterisation; ii) environmental effects; iii) human health effects; and iv) regulatory frameworks.

Presentations and plenary discussions

The workshop began with a plenary session where a number of delegations made presentations[2]. The objective was to have an update on those national experiences and/or events since the 38th meeting of the Joint Meeting. These delegations were Germany, Italy, Japan, UK, US, EC and the Environmental NGOs. The interventions covered a wide range of topics, for example, specific research programmes (either planned or underway) and national regulatory developments. China and India also gave presentations on the developments that have been or are being undertaking concerning the safety of

1. Available on OECD's web site at: http://www.oecd.org/ehs

2. The speakers and delegations gave power point presentations. These materials will be made available on the OECD web site.

nanomaterials. This was followed by a discussion in which all delegations had the opportunity to comment on what they had heard and to begin to identify those issues which were relevant to all participants.

As previously expressed during the Special Session held in June 2005, there was a strong convergence of views and preoccupations, especially on the need for international coordination, information sharing and exchange for harmonising the baseline information when addressing regulatory frameworks, assessment methodologies and testing schemes.

The plenary also focused on a number of documents, notably, the *Results of the Questionnaire/ Survey on the Safety of Manufactured Nanomaterials* [see Annex IV] which had been prepared as background for the workshop. It was noted that this document contains important information which was instrumental in facilitating the discussions.

Introduction to the breakout sessions

The plenary also discussed the organisation of four parallel breakout sessions focused around the four themes:

- Definitions, nomenclature and characterisation (physicochemical properties, uses);
- Environmental effects (hazard identification; hazard and exposure assessment methods);
- Human health effects (hazard identification; hazard and exposure assessment methods);
- Regulatory frameworks (limited mainly to the industrial chemicals sector).

Specifically, the plenary agreed to a series of outcomes/questions [see Annex I] intended to guide the discussions in the breakout sessions.

The facilitators for the four breakout sessions made presentations to the plenary on how they intended to conduct their work, and identified potential outputs, taking into account the agreed questions/ outcomes.

Reports of the breakout sessions

The breakout sessions were held during the second day. To stimulate the discussion, each session was launched with an introductory presentation[3]. These presentations focussed on the specific topics that were previously identified in the background documents.

Each breakout session produced a report [see Annex II], in which they identified the specific points raised during their discussions. These reports included a number of general recommendations that were common to more than one breakout session, as well as those of a more detailed or technical nature.

The reports were discussed in the plenary session on the third (and final) day to give an opportunity to all participants to make their input. There was a particular emphasis on the recommendations identified within the reports of the breakout sessions. Consequently, the reports of the breakout sessions and the outcome of the plenary discussion are the basis for the following general conclusions and recommendations of the workshop. The recommendations of a more detailed or technical nature are identified in the report of the breakout sessions [see Annex II].

3. These will be made available on the OECD web site.

General conclusions and recommendations of the workshop

The Workshop focused on those human health and environmental safety issues, associated with manufactured nanomaterials.

The Workshop concluded that there is a broad diversity of activities underway, and a range of issues which need to be considered concerning those human health and environmental safety issues, associated with manufactured nanomaterials. However, there was clear evidence of a willingness – and commitment – to move forward together as countries and stakeholders to address these within the context of OECD's Chemicals Programme.

As a main recommendation, the Joint Meeting should consider as a first step establishing a Working Group. This Working Group would consider how best to organise and prioritise future activities to manage and assess nanomaterials for environment, health and safety, taking into account available resources. The Workshop agreed (provisionally) that Working Group would be named the *Working Group on the Risk Assessment and Management of Nanomaterials*, subject to further discussions.

A Working Group could also advise on the best approach to carrying forward the work, for example, by a lead country approach, or through small task groups and/or workshops. If established, the Working Group would take into account the general recommendations and conclusions below as well as the detailed technical recommendations from the breakout sessions [see Annex II].

During the workshop, a number of references were made to the Woodrow Wilson database, which includes details of both ongoing investigations (as described in research proposals and preliminary datasets) and accepted peer-reviewed papers related to nanomaterials and environment, health and safety. It is recommended that this eventually be taken over and managed by OECD's Chemical Programme. It should be further developed in co-operation with a similar database being developed by ICON (International Council on Nanotechnology). This is a process which needs to be managed over time. If established, the proposed Working Group could consider how best this could be organised, but this should be a crucial starting point for the Chemicals Programme, which could realise the full potential of the database by ensuring a global resource on studies on environment, health and safety.

The Joint Meeting is encouraged to consider implementation, in collaboration with BIAC, of a programme to create a foundation dataset by testing representative nanomaterials for health and environmental effects and environmental fate. Such a dataset would be openly available to all stakeholders. BIAC is invited to consider this point and to offer a practical and tangible response at the February Joint Meeting.

Environmental NGOs appreciate the potential for an OECD wide effort to broaden and expand the scope of proposed national voluntary efforts to develop and make available more and better information relevant to potential risks of nanomaterials, but urge that such an effort be implemented so as not to constrain, or delay the initiation or completion, of the national efforts.

A number of standardisation efforts are already underway, most notably in ISO, especially in the area of definitions, characterisation and nomenclature. Linkages should be explored with ISO to ensure that the results of these efforts can be used by governments in their regulatory frameworks. It is recommended in this regard that the OECD Working Group should elaborate the policy needs, e.g., determining what issues need to be explored, with ISO fulfilling a more technical role in elaborating how to resolve the respective issues. It was noted that, should ISO not be in a position to address a particular issue, the Working Group may need to consider alternative approaches.

There was a convergence in the discussion on the need for a change in the "mindset" when considering the safety assessment of nanomaterials – as compared with "traditional" chemicals. However, there are a number of linkages with other elements of OECD's Chemicals Programme. There is likely to be a need, for example, for considering the amendment of existing OECD Test Guidelines or the development of new OECD Test Guidelines (which would be an integral part of the OECD Council Acts on the Mutual Acceptance of Data) in order to make them applicable to nanomaterials.

Reference was made to other possible nanotechnology activities within OECD, such as those proposed within the Committee for Science and Technology Policy (CSTP) and the OECD's Future's Programme. There will be a need to ensure co-ordination with such activities. Similarly, there will be a need to ensure co-ordination with any future related initiatives within other Inter-Governmental Organisations.

The United States indicated that it will be organising a public scientific peer consultation on characterisation and basic risk management practices and is open to considering inviting OECD member countries to attend.

The Workshop benefited from the participation of key non-member economies (Argentina, China and India) and such linkages should be maintained and strengthened in any future activities with these and other key players.

The Joint Meeting should consider the declassification of this Workshop Report with the accompanying Room Document [see Annexes] as an integral part. This includes the Results of the Questionnaire/ Survey on the Safety of Manufactured Nanomaterials. This will ensure openness and transparency by giving those who were not able to attend the workshop an opportunity to understand the outcomes.

In order to prepare for the 39th Joint Meeting the existing steering group will continue its work by assisting in the preparation of a draft terms of reference for a Working Group, building upon the recommendations of the breakout sessions [see Annex II]. The steering group will also begin to sift through those recommendations and organise priorities for work that can provide a timely start to the Working Group, for example, by considering tiered-approaches to testing as well as cross-cutting issues.

RAPPORT SUR L'ATELIER DE L'OCDE SUR LA SÛRETÉ DES NANOMATÉRIAUX MANUFACTURÉS

Introduction

L'Atelier de l'OCDE sur la sûreté des nanomatériaux, qui était accueilli par les Etats-Unis, s'est déroulé du 7 au 9 décembre 2005. C'était semble-t-il la première fois que des gouvernements avaient la possibilité de débattre de ce thème au niveau international, avec d'autres parties prenantes.

L'ordre du jour de l'Atelier avait été préparé par un Groupe de pilotage, comprenant des délégués d'Allemagne, d'Australie, du Canada, des Etats-Unis, d'Italie, du Japon, du Royaume-Uni, de la Suisse, de la CE, de l'OMS, du BIAC et d'ONG environnementales.

L'Atelier était présidé par Jim Willis, de l'US EPA. Y ont assisté 120 délégués de 23 délégations de pays Membres de l'OCDE, d'économies non membres (Argentine, Chine et Inde); du BIAC; et d'ONG environnementales, ainsi que des experts invités. Après les remarques liminaires du Président et du secrétariat, Susie Hazen (Présidente de la Réunion conjointe) a fixé le contexte en présentant succinctement le Programme sur les produits chimiques de l'OCDE.

Historique et Objectifs

La décision d'organiser l'Atelier a été prise à la 38ème session de la Réunion conjointe. L'un des principaux objectifs (tels qu'envisagés par la Réunion conjointe) était de commencer à identifier les problèmes de santé humaine et de sûreté environnementale associés aux nanomatériaux manufacturés qu'il conviendrait de prendre en compte – dans le contexte du Programme de l'OCDE sur les produits chimiques – à court, moyen et long terme. Dans le même temps, on y voyait une opportunité pour les délégations d'échanger des informations sur les activités nationales en relation avec la sûreté des nanomatériaux et de rechercher d'autres formes de coopération ou d'autres enceintes dans lesquelles des activités pourraient être entreprises.

Les participants à l'Atelier ont pu examiner plus en détail certaines des questions identifiées lors de la session spéciale de la Réunion conjointe sur les implications potentielles des nanomatériaux manufacturés[4] qui s'est tenue au Siège de l'OCDE en juin 2005. Ils ont notamment pu étudier ce qui est en cours ou a déjà été accompli, et les recherches futures et travaux de fond qui doivent être menés à l'intérieur des thèmes : i) définitions, nomenclature et caractérisation ; ii) effets environnementaux ; iii) effets sur la santé humaine ; et iv) cadres réglementaires.

Présentation et débats en séances plénières

L'Atelier s'est ouvert par une session plénière durant laquelle un certain nombre de délégations ont effectué des présentations[5]. L'objectif était de faire le point des expériences nationales et/ou des événements intervenus depuis la 38ème session de la Réunion conjointe. Les délégations qui sont intervenues sont celles de l'Allemagne, des Etats-Unis, de l'Italie, du Japon, du Royaume-Uni, de la CE et des ONG environnementales. Les interventions ont couvert un large éventail de sujets, par exemple des

4. Disponible sur le site Web de l'OCDE: http://www.oecd.org/ehs.

5. Les orateurs et les délégations ont effectué des présentations powerpoint, qui seront disponibles sur le site Web de l'OCDE.

programmes spécifiques de recherche (soit prévus soit en cours) et des évolutions réglementaires nationales. La Chine et l'Inde ont également effectué des présentations sur les évolutions qui ont été ou vont être engagées concernant la sûreté des nanomatériaux. Ces présentations ont été suivies d'un débat au cours duquel toutes les délégations ont eu la possibilité de commenter ce qu'elles avaient entendu et de commencer à identifier les questions intéressant l'ensemble des participants.

Comme cela avait déjà été dit lors de la Session spéciale tenue en juin 2005, il existait une forte convergence de vues et de préoccupations, notamment sur le besoin de coordination, de mise en commun de l'information et d'échange au plan international afin d'harmoniser l'information de base pour l'examen des cadres réglementaires, des méthodologies d'évaluation et des dispositifs d'essais.

La session plénière a également mis l'accent sur un certain nombre de documents, en particulier les *Résultats du Questionnaire sur la sûreté des nanomatériaux manufacturés* [voir Annexe IV] qui avait été préparé pour servir de référence pour l'Atelier. Les participants ont noté que ce document contenait des informations importantes, qui ont puissamment contribué à faciliter les débats.

Introduction des sessions en sous-groupes

Les participants en séance plénière ont également débattu de l'organisation de quatre sessions en sous-groupes parallèles, centrées sur quatre thèmes :

- Définitions, nomenclature et caractérisation (propriétés physicochimiques, usages) ;
- Effets environnementaux (identification des dangers ; méthodes d'évaluation des dangers et de l'exposition) ;
- Effets sur la santé humaine (identification des dangers ; méthodes d'évaluation des dangers et de l'exposition) ;
- Cadres réglementaires (limités essentiellement au secteur des produits chimiques industriels).

Les participants à la session plénière sont convenus en particulier d'une série de questions/réalisations [voir Annexe I] destinées à guider les discussions dans les sessions en sous-groupes.

Les facilitateurs des quatre sessions en sous-groupes ont fait des présentations à la séance plénière sur la façon dont ils se proposaient de conduire leurs travaux, et ils ont identifié les résultats potentiels, compte tenu des questions/réalisations retenues.

Rapports des sessions en sous-groupes

Les sessions en sous-groupes se sont déroulées le deuxième jour. Afin de stimuler les débats, chaque session a été ouverte par une présentation d'introduction[6]. Ces présentations ont mis l'accent sur des thèmes spécifiques qui avaient été auparavant identifiés dans les documents de référence.

Chaque session en sous-groupe a débouché sur un rapport [voir Annexe II], dans lequel étaient identifiés les points particuliers soulevés pendant les débats. Ces rapports comportaient un certain nombre de recommandations générales communes à plusieurs de ces sessions en sous-groupes, ainsi que d'autres à caractère plus détaillé ou technique.

6. Ces présentations seront disponibles sur le site Web de l'OCDE.

Les rapports ont été examinés en session plénière le troisième (et dernier) jour pour donner la possibilité à l'ensemble des participants d'apporter leur contribution. Une importance particulière a été donnée aux recommandations mises en lumière dans les rapports des sessions en sous-groupes. C'est la raison pour laquelle les rapports des sessions en sous-groupes et la substance des débats en session plénière forment la base des conclusions et recommandations générales suivantes issues de l'Atelier. Les recommandations plus détaillées ou techniques sont reproduites dans le rapport des sessions en sous-groupes [voir Annexe II].

Conclusion et recommandations générales de l'atelier

L'Atelier était centré sur les questions de santé humaine et de sûreté environnementale associées aux nanomatériaux manufacturés.

L'Atelier a conclu que l'éventail des activités en cours est très large, et qu'un certain nombre de questions doivent être examinées concernant ces questions de santé humaine et de sûreté environnementale associées aux nanomatériaux manufacturés. Il était clair toutefois qu'il existait une volonté – et un engagement – des pays et des parties prenantes à agir ensemble dans le cadre du Programme de l'OCDE sur les produits chimiques.

L'une des principales recommandations est que la Réunion conjointe devrait envisager à titre de première mesure la création d'un Groupe de travail. Ce Groupe de travail étudierait le meilleur moyen d'organiser les activités futures pour la gestion et l'évaluation des nanomatériaux du point de vue de l'environnement, de la santé et de la sûreté, compte tenu des ressources disponibles. L'Atelier est convenu (à titre provisoire) que le Groupe de travail serait dénommé *Groupe de travail sur l'évaluation et la gestion des risques des nanomatériaux*, sous réserve de nouvelles discussions.

Un Groupe de travail pourrait également formuler des conseils sur la meilleure approche pour faire avancer les travaux, par exemple avec une organisation articulée autour de pays pilotes, de petits groupes de réflexion ou d'ateliers. Si sa création était décidée, le Groupe de travail tiendrait compte des recommandations et conclusions générales ci-après ainsi que des recommandations techniques détaillées issues des sessions en sous-groupes [voir Annexe II].

Durant l'atelier, il a été fait référence à plusieurs reprises à la base de données Woodrow Wilson, qui contient des détails à la fois sur les recherches en cours (telles que décrites dans les propositions de recherches et les ensembles de données préliminaires) et sur les communications validées par des comités de lecture en relation avec les nanomatériaux et l'environnement, la santé et la sûreté. Il est recommandé que cette activité soit à terme reprise et gérée par le Programme de l'OCDE sur les produits chimiques. Il conviendrait également d'en poursuivre le développement en coopération avec une base de données similaire que développe l'ICON (International Council on Nanotechnology). C'est un processus qu'il va falloir à terme organiser. S'il est créé, le Groupe de travail pourrait étudier qu'elle est la meilleure façon d'organiser cette activité, mais ce devrait être un point de départ crucial pour le Programme sur les produits chimiques, qui pourrait permettre de concrétiser tout le potentiel de la base de données en assurant la disponibilité d'une ressource mondiale sur les études consacrées à l'environnement, la santé et la sûreté.

La Réunion conjointe est encouragée à envisager la mise en oeuvre, en collaboration avec le BIAC, d'un programme destiné à la création d'un ensemble de données de base en procédant à l'essai de nanomatériaux représentatifs pour en déterminer les effets sur l'environnement et la santé et le devenir dans l'environnement. Cet ensemble de données serait librement à la disposition de toutes les parties prenantes. Le BIAC est invité à examiner ce point et à y répondre de façon pratique et concrète à la réunion de février de la Réunion conjointe.

Les ONG environnementales reconnaissent le potentiel d'une action à l'échelle de l'OCDE pour élargir et accentuer la portée des efforts volontaires nationaux proposés visant à développer et rendre disponibles des informations plus complètes et de meilleure qualité en relation avec les risques potentiels des nanomatériaux, mais elles insistent pour que cette action soit mise en oeuvre de manière à ne pas entraver, ou retarder, le lancement ou l'achèvement des efforts nationaux.

Un certain nombre d'efforts de standardisation sont déjà en cours, en particulier à l'ISO, notamment dans le domaine des définitions, de la caractérisation et de la nomenclature. Il conviendrait d'explorer les synergies avec l'ISO pour faire en sorte que les résultats de ces efforts puissent être exploités par les gouvernements dans leurs cadres réglementaires. Il est recommandé à cet égard que le Groupe de travail de l'OCDE se consacre plus particulièrement aux questions de fond, par exemple la détermination des questions qu'il conviendrait d'explorer, l'ISO remplissant un rôle plus technique dans la recherche des solutions à ces différentes questions. On note que si l'ISO n'était pas en mesure d'aborder une question spécifique, le Groupe de travail devrait peut-être rechercher d'autres approches.

Une convergence de vues s'est dessinée lors de la discussion sur la nécessité d'un changement d'"état d'esprit" pour l'évaluation de la sûreté des nanomatériaux – par opposition aux produits chimiques "traditionnels". Toutefois, il existe un certain nombre de liens avec d'autres éléments du Programme de l'OCDE sur les produits chimiques. Il faudra sans doute, par exemple, envisager d'amender les Lignes directrices pour les essais de l'OCDE ou en élaborer de nouvelles (qui feraient partie intégrante des actes du Conseil de l'OCDE sur l'acceptation mutuelle des données) pour les rendre applicables aux nanomatériaux.

Il a été fait référence à d'autres activités envisageables concernant les nanomatériaux au sein de l'OCDE, comme ceux proposés dans le cadre du Comité de la politique scientifique et technologique (CPST) et du Programme de l'OCDE sur l'avenir. Il importera d'assurer la coordination avec ces activités. De même, il faudra assurer la coordination avec toute initiative apparentée future dans d'autres organisations intergouvernementales.

Les Etats-Unis ont indiqué qu'ils organiseront une consultation scientifique publique entre pairs sur la caractérisation et les pratiques de gestion des risques de base, et qu'ils sont disposés à inviter les pays Membres de l'OCDE à y assister.

L'Atelier a bénéficié de la participation d'économies non membres clés (Argentine, Chine et Inde) et ces liens doivent être maintenus et renforcés dans les activités futures éventuelles avec ces économies et d'autres acteurs clés.

La Réunion conjointe devrait envisager la déclassification du présent rapport sur l'Atelier et du document de séance qui l'accompagne [voir les Annexes] et qui en fait partie intégrante. Celui-ci comprend les résultats du Questionnaire/Enquête sur la sûreté des nanomatériaux manufacturés. Cela permettra d'assurer l'ouverture et la transparence en donnant à ceux qui n'ont pu assister à l'Atelier une possibilité de comprendre les avancées réalisées.

Pour préparer la 39ème Réunion conjointe, le groupe de pilotage actuel continuera ses travaux en aidant à la préparation d'un projet de mandat pour le Groupe de travail, inspiré des recommandations des sessions en sous-groupes reproduites dans le Document de séance [voir Annexe II]. Le Groupe de pilotage commencera également à analyser ces recommandations et à organiser les priorités de travail de manière à permettre au Groupe de travail de débuter rapidement ses activités, par exemple, en examinant des approches par paliers pour les essais, de même que certaines questions à caractère transversal.

ANNEXES

These Annexes are an integral part of the Report of the *OECD Workshop on the Safety of Manufactured Nanomaterials – Building Co-operation, Co-ordination and Communication*.

There are five annexes of the report, which list as follow: Annex I) the outcomes/questions for breakout sessions; Annex II) the reports of the breakout sessions, including detailed technical recommendations; Annex III) the references and background documents; Annex IV) the Results of the Questionnaire/ Survey on the Safety of Manufactured Nanomaterials, which was completed by delegations before the Workshop; and Annex V) the list of participants.

ANNEX I. Outcomes / Questions for Breakout Sessions

These outcomes/questions were prepared as a background or a format to be used during the breakout sessions. The aim was to have a set of questions, to help facilitators and rapporteurs to guide the discussion through their respective sessions and facilitate their work - especially when summarising the discussions and recommendations.

Session A: Definitions, nomenclature and characterisation (physicochemical properties, uses)

Nomenclature

- Is there a need for a naming convention for nanomaterials?
- If yes, how best can nanomaterials be described to differentiate them from their bulk chemical counterparts?

Definitions

- Are there existing definitions useful for regulatory risk assessment, or alternatively, what efforts are underway to draft such definitions?
- What process should be undertaken to develop a harmonised working definition of a nanomaterial?

Categorisation:

- Once we've identified the universe of nanomaterials, should they be sub-categorised?
- If so, what categories would be appropriate, or what process should be put in place to categorise them, including what parameters should be used to define categories.

Uses

- What are the major applications of nanomaterials?
- What use categorises would be appropriate for the purposes of addressing risk assessments?

Properties

- What physicochemical properties of nanomaterials are relevant to predicting and understanding their risks?
- Are there additional characteristics in addition to chemical composition, including impurities, aggregation/agglomeration state, physical form, concentration, size distribution, surface area, and solubility that should be considered?
- Can we extrapolate nanomaterial properties and behaviour from data based on bulk chemical substances?

Characterisation

- Are conventional methods, protocols and tools useful to adequately characterise nanomaterials? If not, what changes or additions need to be made to characterisation requirements to:
    - definitively identify specific nanomaterials;
    - account for their novel or enhanced properties; and
    - facilitate comparison of hazards and risks among different types of nanomaterials and between nanomaterials and bulk chemical substances.
- What process should be put in place to harmonise characterisation methods?

Outcomes

- Agree on an approach or process for
    - naming nanomaterials.
    - developing a harmonised definition of nanomaterials.

  - identifying appropriate sub-categories
  - developing an inventory of uses/use patterns
- What data would be necessary to develop an adequate understanding of the behaviour of nanomaterials?
- What data gaps are apparent and what additional research might be necessary?
- Path forward to address these gaps including:
  - What non-OECD efforts are underway with respect to nomenclature, properties, and characterisation?
  - How can the OECD establish linkages to these existing activities?
  - What role should the OECD play in bringing resolution to these issues?

Session B: Environmental Effects (hazard identification; hazard and exposure assessment methods).

Entry to the environment

- What are the major routes of entry into the environment (*e.g.* emissions, waste streams)?

Behaviour in the environment (fate and transport)

- How will various types of nanomaterials behave in the environment, including their:
  - compartmentalisation;
  - persistence;
  - bioaccumulation.
- Do the classic definitions of persistence and bioaccumulation apply to nanomaterials? If not, how should they be modified?
- How can the environmental fate and transport be measured (*e.g.* distribution and partitioning)?
- Are conventional test methods and tools adequate to characterise the behaviour of nanomaterials in the environment? If not, what modifications need to be made to conventional test methods and tools to assess environmental fate/behaviour of nanomaterials?

Monitoring

- How can nanomaterials be monitored in the environment?
- What changes or additions need to be made to conventional methods, protocols, and tools to detect and measure the presence of nanomaterials in the environment?

Effects

- What are the potential environmental effects/impacts of various types of nanomaterials?
- Are conventional test methods and tools adequate to characterise environmental effects of nanomaterials? If not, what changes or additions need to be made to determine the environmental effects?

Outcomes:

- Summarise current state of knowledge concerning:

  - Exposure/sources
  - Environmental behaviour
  - Monitoring methods
  - Effects characterisation
- What data would be necessary to conduct an adequate environmental risk assessment?
- What data gaps are apparent and what additional research might be necessary?
- Path forward to address these gaps including.
  - What non-OECD efforts are underway with respect to developing approaches to assessing environmental exposure, fate, and risk assessment?
  - How can the OECD establish linkages to these existing activities?
  - What should be OECD's role in developing these approaches?

Session C: Human Health Effects (hazard identification; hazard and exposure assessment methods)

Exposure

- What are the major sources of exposure to humans from nanomaterials (*e.g.* products, environmental, workplace, etc.)?
- Can the potential routes be characterised adequately?
- Are conventional test methods and tools adequate to characterise human exposure to nanomaterials? If not, what changes or additions need to be made to determine human exposure?

Monitoring

- How can human exposure to nanomaterials be measured?
- What type of monitoring should be done (e.g. indoor air, biomonitoring, etc.)
- Are conventional test methods and tools adequate to monitor nanomaterials? If not, what changes or additions need to be made to detect and measure the presence of nanomaterials to which humans may be exposed?

Health effects

- What are the potential human health effects?
- Are conventional test methods and tools adequate to characterise human health effects of nanomaterials? If not, what changes or additions need to be made to determine the human health effects?
- How can the biological fate and transport be measured and assessed (*e.g.* adsorption, metabolism, elimination, distribution and translocation, etc.)?
- Are conventional test methods and tools adequate to characterise biological fate and transport of nanomaterials? If not, what changes or additions need to be made to assess biological fate and transport of nanomaterials?

Outcomes:

- Summarise current state of knowledge concerning:
  - Exposure/sources

    - Monitoring methods
    - Effects characterisation
- What data would be necessary conduct an adequate human health risk assessment?
- What data gaps are apparent and what additional research might be necessary?
- Path forward to address these gaps, including:
    - What non-OECD efforts are underway with respect to developing approaches to assessing human health exposure, monitoring, and risk assessment?
    - How can the OECD establish linkages to these existing activities?
    - What should be OECD's role in developing these approaches?

Session D: Regulatory frameworks (limited mainly to the industrial chemicals sector)

- Do novel properties of existing substances used for nanomaterials create new risks which warrant notification as new substances?
- Do current regulatory exemptions, weight-based standards and notification and reporting thresholds developed for conventional chemicals apply or need to be revisited for application to nanomaterials?
- How do (or how should) regulatory assessments and policies address:
    - the high potential diversity of nanomaterials;
    - their wide and expanding array of potential and actual uses;
    - the potential for releases or exposures from activities occurring over their full lifecycle; and
    - the rapidly evolving nature of nanotechnology?
- How and under what preconditions should a precautionary approach be applied to nanomaterials?
- What basic risk management practices are being used or should be encouraged or required?
- Should on-going environmental and human exposure monitoring requirements be applied to production, use, and release of nanomaterials?
- How can or should the effectiveness of risk management measures and controls be assessed?

Outcomes

- Should nanomaterials be addressed through existing "new" and "existing" chemical assessment processes, or should they be addressed under a separate assessment regime or some alternate process?
- What would be an adequate regulatory structure for addressing assessment of nanomaterials?
- Is it necessary for jurisdictions to have a harmonised approach? If so, what process is necessary to harmonise such an approach?

ANNEX II. Reports of Breakout Sessions

Breakout Session A
on Definitions, Nomenclature, & Characterisation – (physicochemical properties, uses)

Outcomes

What are the major & prioritised recommendations from this Breakout Session A?

General Statement

- This breakout group recommends to the OECD Joint Meeting to establish a Working Group on nanotechnology.
- This breakout group invites the OECD Joint Meeting to establish direct links between members from this OECD Joint Meeting and ISO members. This breakout group invites national members to collaborate actively with the respective groups that would work with ISO.
- This breakout group recommends to the OECD Joint Meeting that it should identify different document and knowledge sources. These should, where appropriate, be fully taken into account and made active use of.

Definition, Nomenclature, Terminology

- This group recommends to the OECD Joint Meeting that nomenclature and terminology be developed & normalised by ISO.

Characterisation, Physicochemical Properties

- This group recommends to the OECD Joint Meeting that toxicity test systems be developed & harmonised by OECD.
- This group recommends to the OECD Joint Meeting that sampling and measurement methodologies for exposure & characterisation be developed and normalised by ISO.

Working Definition for Nanoscale-materials

- This group recommends to the OECD Joint Meeting that it should establish a Working Group to develop and propose a definition of the size range that defines nanoscale-materials in the context of human and eco-toxicity and suitable for potential environmental and safety regulations.

Physical and chemical properties of nanoscale-materials

- This group recommends to the OECD Joint Meeting that it should establish a Working Group to develop and propose a matrix of prioritised physical and chemical properties necessary to characterise nanoscale-materials in the context of human and eco-toxicity and suitable for potential environmental and safety regulations along the lines depicted in the attached sheet.

Propose a *matrix of prioritised physical and chemical properties* necessary to characterise nanoscale-materials in the context of human and eco-toxicity, suitable for potential environmental and safety regulations:

	Basic Set	Extensive Basic Set	Kown to effect Bioactivity	Suspect of effect	Other
Chemical Compound	X (NPPTAC)				
Dp Particle size diameter	X				
Dp Distribution	X (NPPTAC)				
Solubility in H2O	X (NPPTAC)				
Surface Roughness/Morphology	X (NPPTAC)				
Bioaccumulation					
Persistence					
Tendency to agglomerate	X (NPPTAC)				
Strength of agglomery					
Surface coating					
Toxicity of parent compound					
Specific Surface Area	X (NPPTAC)				
Impurity Profile	X (NPPTAC)				
Shape	X (NPPTAC)				
Crytal Structure					
Surface chemistry					
Surface charge					
Porosity					
Catalytic activity					
Red-Ox Potential					

- This group recommends to the OECD Joint Meeting that testing methodologies for the physical and chemical properties identified above be developed & normalised by ISO.

Breakout Session B
Environmental Effects
(Hazard identification, hazard and exposure assessment methods)

Notes of Discussion

1. Introductions

- Participants – 21 attendees - US (EPA, FDA, Department of Energy, Academia, ILSI), Canada (Academia, Environment Ministry), Switzerland (EPA), Japan (Academia, Government), China (Academy of Sciences), Argentina (Atomic Energy Commission), UK (Environment Ministry), BIAC (BASF, American Chemistry Council), European Commission (Institute for Health and Public Protection).
- Agenda – assumptions, related non-OECD activities.

2. Presentation – Rebecca Klaper (University of Wisconsin-Milwaukee, Great Lakes WATER Institute)

Introduction

- Introduced the concept of nano, and what are their various properties and applications (*e.g.* environmental clean up tools).
- Highlighted the presence of natural nanoparticles (NPs) and incidental particles (not to be covered here).
- Medical research
  - Information from this research could provide insight on potential environmental impacts of NPs. Medical applications could also be a source of contamination (already see medical waste and pharmaceuticals in the environment).
- In attempting to detect the potential impact of NPs on environment:
  - Examine toxicity.
  - Mechanism of action.
  - Consider Interaction of organisms.
  - Ecosystem impacts.

Daphnia and NPs

- Used Daphnia for studies.
  - Issue of which are most appropriate organisms for studies was raised, and the potential significance of filter feeders as vulnerable species.
- Examined TiO2 and fullerenes.
- Behaviour of Daphnia changed (even below observable toxicity levels) – why important?
  - Affects energy use.
  - Problems with predation, mating and feeding.
  - Indicator of early response.
- Measured the uptake of NPs using luminescence.

Herbivores and Silica

- Looked at impact of natural substances in nano-form (now being engineered) – using silica on herbivores (caterpillar), and examined the effects of macro vs nano-particles.
- Another way to examine impact is by using genomics to examine biochemical pathways impacted by exposure.
- Looked at biochemical/genomic impacts of NPs:
  - Impact on physiology.
  - Whether NPs are reaching certain tissues.
  - How different tissues respond to NP exposure.

Fish and fullerenes

- Looked at effect on immune system of fish – this research is currently ongoing.

Conclusions

- Concern/effects could depend on particle type:
  - Mortality differs with particle type and structure.
  - Gene expression.
- Interference with filter feeders a possibility.
- Possible induction of immune response in fish.
- Environmental Risk Assessment considerations:
  - Exposure routes – differences from macro-particles? Fate in the environment, measurements.
  - Effects – differences in effects from various macro-particles? Testing issues: ecosystem interactions, persistence and effects.
  - Risk management – control of products, waste reduction.

Group Discussion

- Can we presume that NPs have different modes of toxicity?
  - Can genomics help elucidate this?
  - But need baseline data to assess this.
- Issues around availability of NP samples for testing – expensive (*e.g.* USD 300 for 250mg), as well as reliability/quality with respect to how samples were manufactured.
- Issues around solubilising some (hydrophobic) NPs, to ensure consistent test conditions.
- In a business environment, monitoring of exposure is a major expense.
- Need to be aware of dose effect.
  - May be different impacts at low dose.
- What is an appropriate metric for dose etc. in terms of biological impact.
  - Can you use surface area (or activity?) per litre (but how do you do this?).

3. Exposure

Issues Raised:

- What are categories of nanomaterials (NMs) could result in high exposure?
- What aspects of NMs are different and what are the implications for risk assessment approaches?
- What is the magnitude of exposure and effects?
- Discussion to focus on deliberately produced NPs and uses.
  - Incidental production not to be considered here.

Inventory of Known Uses/Categories[7]

- Coatings – roof, glass, paints – *e.g.* titanium dioxide, silver.
- Cosmetics – sunscreens, cleaning products – *e.g.* titanium dioxide, C60, Zinc Oxide, nano-proteins (anti-ageing), mascara.
- Environmental remediation – Zero valent FeO and other metals.
- Pesticides.
- Soil binding.
- Fuel Additives - Cerium Oxide.
- Nanotubes – for various uses.
- Consumer articles/products.
    - Incorporated into a matrix.
    - Coatings, including coatings on clothing.
        - Production, use and waste.
- Fuel additives - Catalysts – liquid phase – cerium oxide.
- Ingestibles and injectables, pharmaceuticals, contrast agents, *i.e.* excreted.
- Food and drink.
- Fillers, paper.
- Research use and waste.
- Energy production, storage and transmission.
- Weapons.

It is anticipated that uses of nanomaterials would result in both intentional and unintentional releases.

Unknowns

- What are major/significant uses and exposures of NMs?
- What levels of exposure for different types and sizes of NMs are likely to cause harm?
- Effects of chemical composition and structure?
- Particular property of NM is being deliberately exploited.
- Are there really any significant differences between use patterns of standard substances and NMs?

Linkages to Other Activities

- Need for further development of technology/expertise to characterise materials.
- NNI commissioned study of NMs.
- EPA white paper.
- Links to nomenclature and definitions (from group A).
- Paper by Robichaud, Tanzil, Weilenmann & Wiesner (2005) Relative risk analysis of several manufactured nanomaterials: An insurance industry context; *Environ. Sci. Technol.* 39; 8985 – 8994.

7. Known uses relative to experience/knowledge of Breakout Group participants

Exposure Messaging

NMs use patterns are understood to mirror the full range of materials covered by discrete/bulk chemicals. Notwithstanding this, NMs use patterns which have particular high release/high exposure include:

A. "Down the drain"

- Cosmetics – sunscreens, cleaning products – *e.g.* titanium dioxide, C60, Zinc Oxide, nano-proteins (anti-ageing products), mascara.

B. Intentional Direct Releases

- Environmental remediation – FeO and other metals
- Pesticides
- Soil binding

C. Unintentional Direct Releases

- Fuel Additives - Cerium Oxide
- Coatings – roof, glass, clothes, paints – *e.g.* titanium dioxide, silver

These uses and others may be considered in the development of priorities intended to address higher exposures of NMs to environmental media.

4. Transport, Fate and Monitoring

Issues Raised

- Once NMs enter the environment, is this material going to retain its unique size and properties (*i.e.* nanoness)? If a change occurs, is this change reversible (*e.g.* if subject to agglomeration)?
- How are we going to measure NMs in the environment?
- How do we define persistence of NMs in the environment?
- How valid are OECD test methods for predicting the fate of NMs and what can these tell us about behaviour and fate in the environment?
- Can we use bio-monitoring to make assessments of fate?

Routes of Entry into the Environment

NMs which are used in potential "down the drain" applications may be subject to degradation/ transformation processes within sanitary sewers and sewage treatment plants (STPs) "Down the drain" release routes include:

- Industrial waste water.
- Domestic waste water.

Other applications which are not "down the drain" but result in direct releases via the following routes:

- Storm water.
- Atmospheric – dry and wet deposition to waters – long range and local.
- Direct applications to ground water and surface water, as well as remediated groundwater seeping into surface water.

Properties

- What are the properties that characterise materials as existing in a "nano" form (*i.e.* nanoness)?
- What is the degree of agglomeration – there is a need for a test method for agglomeration/aggregation of a NM.
  - Is this controlled by hydrophobic or hydrophilicity?
  - How does this influence retention of the NM in a discrete (non-aggregated) form in the aquatic or terrestrial environment?
- How is the number of active sites at the surface a consideration?
- Structure.
  - Morphology of the particle, including surface area.
- Role of functionalisation?
- Persistence – we need to understand how to estimate the persistence of NM in the environment.

Loss/Transformation Processes

- Chemical transformations.
  - Indirect effects may occur as NMs react with or impacts on other materials or chemicals as it passes through the environment. Can we understand/monitor how an NPs move through the environment, and what would be the consequences to the NPs, or consequences of other substance as a result of interaction with the NPs?
- Is agglomeration irreversible?
- From an exposure assessment perspective, it may be best to start with a "no loss" assumption
  - Build on this and evaluate the loss processes?
- Is microbial breakdown (degradation or transformation) of an NP likely?
  - Is this a less important process of loss?
- What are the relative contribution of other processes, including:
  - Photochemical transformations?
  - Oxidation?
  - Hydrolysis?
  - Adsorption/desorption?
  - Reductive decomposition?
- What are the loss/degradation products – *e.g.* important for pesticides (and all chemicals). Are the degradates more or less toxic?
- How will disinfection (*e.g.* chlorination, ozonation) by-products in STP affect NPs?

Terrestrial Environmental entry points

Entry points for terrestrial exposure include:

- Land application of biosolids.
- Agricultural.
- Atmospheric.
- Deliberate remediation releases.

Terrestrial Exposure Consideration

- How do hydrophobic and hydrophilic particles behave in soils?

Total Environmental Compartmentalisation

- Traditional chemical compartmentalisation processes are expected to apply to NMs.
- The question is how do we predict into which compartments NMs will go? What different or additional data are required for NMs to make compartmentalisation predictions?
- Need to decide whether fate processes based on Kow and fugacity still apply to abiotic environment processes.
- Agglomeration is likely to be more significant for NMs versus chemicals.
- Compartmentalisation inputs:
  - Water availability.
  - Size.
  - Morphology – crystalline or amorphous, shape.
  - Surface area.
  - Surface charge & reactivity.
  - Size concentration – weight relative to surface area.
- Lack data and tools to undertake compartmentalisation studies.
  - How best to measure and assess these?

Persistence and transformations (see also loss processes, above)

- Do we understand the properties/tests necessary to determine/predict persistence?
- Do we need to measure different properties?
- Are we interested in atomic persistence or potency/effect persistence.
  - Are there parallels or lessons to be learned from defining persistence for metals, which could be applied to nanomaterials?
- Persistence could be related to structural aspects. For example, fullerene cages are different than most other molecules, in all aspects of chemistry, *i.e.* electronic, strength, etc. If the cage structure is broken, then the fullerene properties (including its cytotoxic properties) will no longer exist.
- Need to be clear of our definition of persistence.
  - This will vary depending on use of the definition.
  - Chemical, policy, risk assessment.
- If we assume that persistence is linked to retention of the nano-properties of NMs, then we need to test for the persistence of these properties.
- If property disappears via agglomeration, but reappears as agglomeration reverses, then this impacts interpretation of persistence.
- What are the quantum properties of NM?
- Cannot extrapolate from bulk materials to nano forms.

Bioaccumulation and biomagnification

- Similar to persistence issues.
- We know some NPs enter organisms and tissues.
- How does NP size and electrochemical properties affect this behaviour?
- Exposure may be more due to dietary exposure that for conventional chemicals.
- Range of properties that will impact on this – lipophilicity, size, morphology.
- Transformation of NP will differ in different parts of biological system.
- Difficult to measure NP in biological systems.
  - Potential to use labelled NMs (*i.e.* radio- or stable isotope labelling) in microcosm or mesocosm studies (may be limited applicability at a nano-scale since labelling may change properties of NP). Also, radio-labelling will not assist in environmental monitoring.

- Need to consider in terms of accumulation through the food web (*e.g.* algae to invertebrates to fish).
- Conventional means of assessing/predicting bioaccumulation not likely applicable; more empirical methods could be more appropriate.

Monitoring (see previous sections)

- There are measurement techniques available (refer to EPA White Paper).
  - Need to test these for NP in environmental compartments.
- Filtering and concentration of NM in environmental samples may be necessary to increase analytical sensitivity.
  - More work needed on practicality and feasibility of this.
  - Need to be careful about how these affect the properties of the NP (are they the same as in the environment).
- Do we have sufficient methods for detection of nanomaterials in various media? (*e.g.* biota, ambient water).

Links

- ILSI paper sets out some of these issues relative to dose metrics and material characterisation.
- US EPA White Paper includes discussion of environmental detection methods and analysis, in addition to providing an overview of characterisation, environmental fate, human health and ecological effects data and issues.
- German Chemical Industry Association (VCI) – have a working group to categorise and characterise nanomaterials to be able to have a discussion on persistence.
- Information from bio-medical research will provide data for bio-availability and bio-accumulation.
- Refer to information on fine and ultra-fine particles for some basic lessons - how they move and end up in an area of a biological system and why this happens?
- Uni. of Minnesota – working on occupational characterisation and monitoring.
- Letter from academics to journal editors.
  - Encouraging them not to use articles that do not provide characterisation of NPs.
  - How could this be extended to industry.

Recommendation

- Physico-chemical properties of NP appear to be matrix dependant.
  - The process of extracting form environmental samples may alter their properties.
  - Therefore monitoring may be a matter of knowing what is present in a chemical state but does not necessarily provide information on the physical form in the environment.
- Need to rely on empirical measures of losses and compartmentalisation.
- Develop tools/methods for assessing loss and compartmentalisation properties.
- Can OECD help develop and publicise methodologies for monitoring environment? Recommend that OECD sponsor a workshop to resolve these issues and provide guidance on appropriate characterisation of NM.

Fate Messaging

Entry into environment essentially mirrors non-nano counterparts.

Requires means of determining fate of various materials in various compartments, including STPs.

Requires an understanding of what transformation processes are important for various types of NMs.

How do we define persistence? Is persistence linked to loss of nanoness?

How do we determine bioaccumulation? Current predictive methods do not apply, so more empirical methods are required such as BCF or micro/mesocosm testing.

A number of methods for monitoring nanomaterials in the environment have been employed and can form a basis for more wide spread research into environmental concentrations.

5. Effects and hazard

- Nature of the risk – is it a chemical interaction, or more physical?
- Secondary considerations.
  - Could NMs induce potential effects on microbial community, especially in wastewater treatment plants, in agricultural soils and in sediments?
  - Are toxicity effects mediated by the effect of NM on other chemicals/substances? – are they mediated through catalysis to form a secondary product (*e.g.* radicals or reactive species)?
- What does knowledge of the bulk material tell us about the effects of the NMs – bulk material is not considered to be a reliable (or even related) predictor of toxicity to nanomaterials.
- Uncertainty factors - acute to chronic toxicity ratios.
  - Need to test/validate any assumptions on which these are based. These may vary and be specific to different categories of NMs.
- Do NMs have a sub-lethal effect at very low doses which we are unable to extrapolate from lethality test (*i.e.* acute to chronic ratios > 100)?
- Difficulty in extrapolation from short-term to long-term effects.
- Are conventional endpoints acceptable, and what other endpoints should we consider?
- Residue based dose expressions.
  - Internal dose (as opposed to external exposure level). Perhaps can be determined through use of radiolabelled NM mixed with unlabelled material.
  - Based on the assumption that labelled and unlabelled materials behave the same.
- Observed effects may be due to smaller particles that are present in colloidal mix, *i.e.* small molecular weight impurities intercalated within nanocrystal. This indicates the need for full characterisation of the NM tested in the cells/bacteria/environment.
- Ecotoxicity endpoints could be (likely) based on mortality, but need to consider possibility of effects related to morbidity/sub-lethal (chronic, repro, development) testing.
- Need to examine standard ecotoxicity data set as a starting point to address basic science issues and to establish a hazard assessment.
- Role for QSARs.
  - Data is not available but can plan experiments to provide data in support of development of predictive tools.
- Constraints in terms of amounts of material available - may need to develop tests that require the lower volume of NMs – different species or use of tissues. But need to be careful about cross-species extrapolation.

- May be appropriate to introduce multi-tier testing (*e.g.* in vitro, in vivo, microcosm).
- Issue around how to expose or dose organisms/tissues to NM.
- Identify major dispersive uses.
  - Review need for effect data requirements beyond the base data set.
- A large variety of modes of action from traditional chemicals.
  - Despite this the same type of tests and techniques are used. There may be modes of action that we have not experienced before but does not necessarily mean we need new tests and techniques.
- Acute-chronic data should focus on exposures that are most likely, large and/or continuous (*i.e.* intentional release and "down the drain").
- Need a data acquisition strategy to understand the universe of NMs and marry the results of this initial testing to predictive tools.
- The number of measures will vary depending on the breadth of exposure for each NM.
- Why are we not comfortable that NMs can be considered as conventional chemicals?
  - Understanding of quantum and other nano effects.
  - Are there unfamiliar modes of action – sub-lethal and long-term effects?
  - Characterisation of a diversity of physical chemical properties for different NM.
  - Uncertainty over use patterns and quantities of released (exposure).
  - Uncertainty of transport in the environment where would cause damage.
  - Uncertain as to how the chemical will change once it is in the environment and whether resulting by-products or breakdown products will be as damaging/less/more/inert.
  - Nanoparticles in smaller amounts have different properties than greater quantities of compound of same size distribution.
- NEED TO MAKE SURE THAT EVERY TEST WE CARRY OUT 'COUNTS' WITH RESPECT TO FEEDING INTO OUR KNOWLEDGE OF RISK ASSESSMENT.
- REQUIRE A COMMON STANDARD APPROAD TO HARMONISE EFFORTS ON A SUITE OF BASIC TESTS, USING STANDARD EXPOSURE/DOSING STRATEGIES (A RESEARCH TOOL).

Risk Quotient

- PEC/PNEC approach to risk characterisation still applies but need to consider what are the appropriate units of exposure. For instance, is surface area of NM per unit of environment (*e.g.* cm^3 per litre) a good unit of exposure?

Assumption

- NM will need treated as different from bulk materials.

Recommendations

- OECD needs to develop standard protocols for introduction of NMs into the exposure solution/suspension for us in ecotoxicity testing. There will not be a single answer for all NMs.
- OECD co-ordinated effort towards a standard approach to harmonise efforts on a suite of basic tests for determining the environmental fate and toxic effects of NM (research tools). Development of a proof-of-principle study that would demonstrate effects of a select and representative group of compounds to begin to assist with these discussions.

Links

- Group D – focus on how we get the information needs.
- Group A – characterisation and standard materials.

Effects/Risk Messaging

Currently there is very little information available on the ecotoxicological effects of NMs.

Lack of information also breeds uncertainty over issues such as the relationship between acute and chronic toxicity; whether sublethal effects that warrant concern; what are the modes of toxicity?

There is a need to standardise approaches to putting NMs into test solutions, and analytically determining material in tissue/media.

There is a need for a definitive testing strategy to ensure we develop a base set of information on a defined series of NMs which will aid us to answer some fundamental scientific questions.

6. Outcome Questions and Recommendations

- To establish an OECD Working Group to:
  - Help prioritise research needs in environmental risk assessment and environmental fate.
  - Bring together funding to enable funding mechanisms.
  - Assume responsibility for tracking research by assuming databases such as the Woodrow Wilson Center database and linking with other activities.
- Standardisation of methods/techniques:
  - To develop and co-ordinate on methods/techniques for defining and introduction of NMs into the appropriate exposure media (water, sediment etc.) for use in environmental testing and assessment.
  - Definition of the exposure media.
  - Characterisation of NM sample in the exposure media.
  - Characterisation of NMs.
  - Monitoring fate and transport in the environment.
- Facilitate an informed international discussion (to identify the factors that influence) the fate, compartmentalisation, persistence and bioaccumulation of NMs.
  - Need for microcosm work.
  - Defining data elements compatible with NMs.
  - Defining persistence in the context of NMs.
- Develop a strategy to develop knowledge base of the ecotoxicological effects of NMs.
  - Suite of standard ecotoxicological tests (acute and chronic) to determine environmental effects.
  - Co-ordinated proof of principle experiments on using pre-selected suite of samples and tests to maximise understanding of science as it related to environmental risk assessment.

Current Initiatives

- CBEN/ICON database.
- Woodrow Wilson Centre database.
- VCI (German chemical industry) development of NM definitions and categories in an effort to characterise NMs.
- University of Minnesota developing occupational characterisation and monitoring of NMs.

Breakout Session C
Human Health Effect
(Hazard identification; hazard and exposure assessment methods)

Agreed that focus of this workshop is manufactured nanomaterials, however, the group noted that there is a body of data on ultrafine particles that can assist in the discussions and evaluation of manufactured nanomaterials.

Exposure

- Potential sources of exposure include the development and manufacture, use of products (in particular dispersive uses), degradation of the product (*e.g.* release of NPs) and disposal. Concluded we need to consider the life cycle of the product when considering human exposure. At different stages of the life cycle, humans may be exposed to different forms of the nanomaterial (*e.g.* aggregates).
- Routes of exposure include inhalation, dermal, ingestion and injection. The discussion focused on inhalation and dermal exposure. However, it was noted that ingestion and injection routes would also be important routes of exposure.
- At the workplace, are the current personal protective equipment and engineering controls sufficient to minimise exposure?
- Consideration of exposure to known ambient ultrafines would inform discussion on exposure to manufactured nanoparticles.

Monitoring

- There is a need for standard, validated test methods for monitoring for nanoparticles and in particular at the workplace. The long-term goal would be to develop real time and personal sampling methods.
- Relevant parameters to monitor include particle size, number, distribution, surface area, shape, solubility, etc (see Group A discussions). Critical parameters should be identified, depending on the material.
- There was a proposal for a tiered approach to monitoring: first determine whether there is exposure and if so use additional monitoring methods to quantify and qualify exposure.

Health Effects

- It is acknowledged that it will not be possible to undertake full toxicity testing for all nanomaterials, and therefore we will need short-term strategies to address potential toxicity. We should refine these strategies as data accumulate.
- There is a need for a deeper understanding of the biological responses of a selected set of nanomaterials, in order to ensure that the data contribute to the broader understanding of the toxicity of nanomaterials, so that in future we can categorise and generalise.
- A tiered approach (such as described in the ILSI paper) and/or decision tree should be developed to determine the most appropriate testing regime for a nanomaterial. There is a question as to the extent to which short-term *in vivo* tests, complemented with *in vitro* tests, give an indication of potential chronic toxicity. Biological fate (absorption, distribution, metabolism, and elimination (ADME), biopersistence, and bioaccumulation) may be an important issue and gap in these considerations.

- A goal of testing strategies should be to inform the development of screening tests, such as *in vitro* methods and computer simulations, which have been validated against *in vivo* methods.
- Some OECD guidelines may need to be modified and new ones developed to assist in evaluating nanomaterials.
- There is a need for a minimum standard physical characterisation of the materials being tested.
- There is a need for internationally harmonised standard reference nanomaterials.
- When testing nanomaterials for toxicity, their dynamic natures, as well as stability in different media, need to be taken into account, such as potential for aggregation/disaggregation and agglomeration/deagglomeration.
- The potential range in variants for a given nanomaterial is an additional challenge for toxicity testing.
- Exposure data should be combined with medical screening data to facilitate epidemiological studies on nanomaterials.

Recommendations

- We recommend the development of a detailed tiered approach and/or decision tree (such as begun in the ILSI paper as well as in the SCENIHR), be developed to determine the most appropriate testing regime for a nanomaterial.
- We recommend that OECD facilitate efforts to develop a deeper understanding of the biological responses of a selected set of nanomaterials, one goal of which is to inform the development of more efficient approaches for toxicity testing.
- We recommend the development of validated exposure assessment methods for nanomaterials, including sampling/monitoring and analytical methodologies.
- We recommend establishing internationally harmonised standard reference nanomaterials.
- We recommend the development of harmonised test methods and performance criteria for personal protective equipment and engineering controls.
- We recommend that current OECD guidelines be evaluated to determine their applicability to the testing of nanomaterials, and modified or expanded as necessary.

It is recommended that the OECD establish a Working Group to move forward on these recommendations. The Working Group should take note of the efforts being undertaken by other organisations, such as ISO, and establish linkages and build on these efforts.

Breakout Session D
Regulatory Frameworks

The Questions

Do novel properties of existing substances used for nanomaterials create new risks which warrant notification as new substances?

- All regimes would generally treat nanomaterials with existing chemical identities as existing substances, novel properties alone wouldn't change that

BUT

- Novel properties trigger concerns about potential hazard and risk and this may not be fully addressed by current regulatory regimes

Do current regulatory exemptions, weight-based standards and notification and reporting thresholds developed for conventional chemicals apply or need to be revisited for application to nanomaterials?

- Current regulatory exemptions appear to apply to nanomaterials.

BUT

- Nanomaterials weren't specifically considered when current regulatory exemptions were put in place.
- Therefore existing exemptions may need to be revisited for nanomaterials.

Do regulatory assessments and policies address:
*** the high potential diversity of nanomaterials;**
*** their wide and expanding array of potential and actual uses;**
*** the potential for releases or exposures from activities occurring over their full lifecycle; and**
*** the rapidly evolving nature of nanotechnology?**

- Most jurisdictions currently address this to some extent.

How should regulatory assessments and policies address: the diversity of nanomaterials and their wide and expanding array of potential and actual uses

- Approach this considering techniques from traditional chemicals legislation *e.g.* complex mixtures, variable composition and grouping.
- Use of broad exposure categories *e.g.* industrial; closed; dispersive may be useful as an element in assessments and policies.
- Need to test against research output and understanding to see if this would work.

How should regulatory assessments and policies address: the potential for releases or exposures from activities occurring over their full lifecycle

- Current approach gives authority to cover these elements in most countries.

How should regulatory assessments and policies address: the rapidly evolving nature of nanotechnology

- Need to take care not to stifle innovation.
- Important to have ongoing dialogue at international level, and bi/multi-laterally (*e.g.* lead country initiatives).
- Need to look at rapid evaluation and control systems.
- Need to adapt to new paradigms without being too rigid at this stage.

How and under what preconditions should a precautionary approach be applied to nanomaterials?

- Need to gain understanding while at the same time taking steps to minimise exposure and attendant risks.
- Acknowledge known unknowns that relate to important and significant areas and proceed in measured and responsible manner with assessment.
- Any precautionary approach to nanomaterials should be fair, balanced and applied on a case by case basis.

What basic risk management practices are being used or should be encouraged or required?

- Good practice documents are being developed globally by governments, industry and other stakeholders.
- Such initiatives should be shared with the OECD.

Should on-going environmental and human exposure monitoring requirements be applied to production, use, and release of nanomaterials?

- Group D await outputs from other groups.
- A future group needs to return to this.

How can or should the effectiveness of risk management measures and controls be assessed?

- Need to ensure public confidence in risk management procedures.
- There are a number of processes and procedures already in place which should help to assess effectiveness in this area.

The Outcomes

Should nanomaterials be addressed through existing "new" and "existing" chemical assessment processes, or should they be addressed under a separate assessment regime or some alternate process?

- Regulatory regimes may be adequate in most jurisdictions, although further assessment may be required.
- A voluntary approach gathering and developing data and evidence could complement existing regulatory regimes, help to identify any gaps and inform future work.
- In the long term, a new approach may be needed depending on the evidence gathered.

What would be an adequate regulatory structure for addressing assessment of nanomaterials?

- Current structure may be adequate but further evaluation is required.
- Would like to examine if and when a 'nano data package' should be used.
- Exemptions and exposure categories may need to be reconsidered.
- Lifecycle may need to be further examined.

Is it necessary for jurisdictions to have a harmonised approach? If so, what process is necessary to harmonise such an approach?

- Unanimous desire to work towards harmonisation in some aspects, this could include an inventory of current research and research in hand.
- Recognition of the usefulness of co-ordination and collaboration, particularly re development of hazard and exposure data and methods.
- Lead country approach could be useful.

The Recommendations

Recommendations to the Joint Meeting

1. Continue work within OECD – ensure cross-cutting approach with other ongoing OECD areas.
2. EU and US offered to share and to bring forward their efforts to develop guidance on 'new' versus 'existing' chemicals and are open to collaboration with others.
3. Contribute to and get results from voluntary approaches –to feed results in to OECD.
4. OECD to be encouraged to take on the Woodrow Wilson database and use it as a starting point for gathering research.

Other points to consider

- Social and ethical issues.
- Risk benefit.
- Risk communication.

ANNEX III. References/ Background Documents

This is a list of the documents that were used as a background for the discussions during the workshop. In addition, it includes the documents that were circulated or referenced during the meeting.

All the documents, as well as the presentation given during the workshop, will be made available on the OECD website at: http://www.oecd.org/ehs.

Workshop Presentations

Experiences of delegations since the 38th meeting of the Chemicals Committee: National Events; Lessons learned

US
"Recent Experiences of the United States on Nanotechnology"

UK
"UK views on research needs to enable risk assessment of nanomaterials"

Germany
Results of the Workshop "Dialogue on evaluation of synthetic nanoparticles in work and environmental areas (Bonn, 11th/12th Oct. 2005)".

"Nanotechnology – BAuA Activities"

EC
"An EC update on nanomaterials with emphasis on risk assessment methods"

Japan
"Japan's approaches to risk assessment of manufactured nanomaterials"

Italy
"Nanotoxicity and health risks related to managing nanoparticles"

Environmental Defense
"What have NGOs (environmental and others) been up to?"

China
China`s Development for the Safety Assessment of Manufactured Nanomaterials"

India
"Nano Science and Technology: The Indian Scene"

Introduction to Breakout Sessions (Presentations)

Benefits/Application and Emerging Issues Related to the Risk Assessment of Manufactured Nanomaterials. (US)

Breakout Session A "Nanotechnologies - supporting industrial and societal needs through international standardisation" (UK)

Breakout Session B "Environmental effects of nanoparticles on aquatic organisms: toxicity, behavior, gene expression" (Invited Expert)

Breakout Session C "How can we evaluate the health-effect potency of nanoparticles?" (Japan)

Breakout Session D "Nanomaterials: A Comparative Look at Regulatory Frameworks" (Invited Expert)

Other Documents

US

EPA Nanotechnology White Paper
http://www.epa.gov/osa/nanotech.htm

UK

A scoping study to identify hazard data needs for addressing the risks presented by nanoparticles and nanotubes,
http://www2.defra.gov.uk/research/project_data/More.asp?I=CB01072&M=KWS&V=cb01072&SUBMIT1=Search&SCOPE=0

A scoping study to identify exposure data needs for addressing the risks presented by nanoparticles and nanotubes
http://www2.defra.gov.uk/research/project_data/More.asp?I=CB01071&M=KWS&V=cb01071&SUBMIT1=Search&SCOPE=0

ILSI Journal Article on Nanotechnology

"Principles for characterising the potential human health effects from exposure to nanomaterials: elements of a screening strategy." (PDF) (available at the password-protected web site).

EC

The Commission, in consultation with the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), invited stakeholders to comment on the scientific opinion on risk assessment methods for nanotechnology products.
The consultation ran until **Friday, 16 December 2005**. Please find the address to the public consultation (including the opinion and other relevant documents) below.
http://europa.eu.int/comm/health/ph_risk/committees/04_scenihr/scenihr_cons_01_en.htm

ANNEX IV. Results of the Questionnaire/Survey

TABLE OF CONTENTS

.

Survey/ Questionnaire on the Potential Implications of Manufactured Nanomaterials for Human Health and Environmental Safety

This Survey was completed by delegations before the Workshop. This survey provided delegations with a general background on the "state-of the art" of the regulatory framework related to the human and environmental safety. Therefore, it focused on activities that were relevant to the Workshop that have either been accomplished, or were underway, or were being planned.

The subject of this survey - the ***Potential Implications of Manufactured Nanomaterials for Human Health and Environmental Safety*** – is an issue which is still in the early stages of consideration in many member countries. It is recognised, therefore, that responses to the items identified below may only be partial.

The workshop was an opportunity to examine in more detail the issues related to our current capacity to assess and regulate nanomaterials.

Please note that this survey was completed in **October 2005**. Therefore it is only a snapshot of information updated until that time. Continuing progress has been done since then, which is not reflected in this annex.

THE SURVEY

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

We will also be pleased to receive any supplementary information, especially if available in electronic form including links to web sites.

Responses to the Survey/ Questionnaire

AUSTRALIA

QUESTION 1: Please identify work completed, underway or planned in your country or organisation, which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

Following a report on nanotechnology commissioned by the Prime Minister's Science Engineering Innovation Council (PMSEIC), the Australian Government has established a National Nanotechnology Strategy Taskforce. The taskforce will consider issues such as science capacity, industry awareness, skills, infrastructure, investment, standards, regulation and community acceptance.

Part of the work of the taskforce has involved the establishment of an Australian Government inter-departmental working group to explore, among other things, the adequacy of the current regulatory frameworks to address potential environmental and health impacts of nanomaterials. Issues such as definitions, nomenclature, measurement (including the measurement of diameter, shape, surface area etc) and the characterisation of manufactured nanomaterials will need to be addressed. A number of State Government agencies and State-based institutions are also pursuing regional nanotechnology strategies and projects with a view to clarifying the ethical, legal, and institutional implications of nantechnologies.

Australia does not currently have an agreed definition for nanomaterials, other than the definition from the PMSEIC report (nanotechnology is the collective term for a range of technologies, techniques and processes that involve the manipulation of matter at the smallest scale (from 1 to 100 nm)). Australia is engaged in international activities, including ISO standards and OECD work on nanotechnology, to ensure definitions and nomenclature for nanomaterials are based on internationally agreed terms.

QUESTION 2: Also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

There is no regulatory framework in place specifically applying to nanotechnology. For new industrial chemicals the data requirements and level of assessment are based on a combination of volume and hazard. For example, a new non-cosmetic chemical can be introduced at <100kg/yr without notification and assessment if it poses no unreasonable risk. Nanomaterials may present risks not presented by the existing bulk material, but under the current framework would not be considered new chemicals. The range of new chemical categories are listed in the NICNAS Handbook (http://www.nicnas.gov.au/Publications/NICNAS_Handbook/Handbook_For_Notifiers_Jan2005_S2_PDF.pdf)

These issues, including the potential application of existing regulatory instruments to new technologies, will be examined by the inter-departmental working group over the next 12 months.

QUESTION 3: Identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

The following information is drawn from *Nanotechnology: Enabling Technologies for Australian Innovative Industries*, the paper prepared by the independent working group for the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) published on 11 March 2005. (http://www.dest.gov.au/NR/rdonlyres/1E1B501A-727A-4153-85EF-134B2DAF0925/4112/nanotechnology_pmseic110305.pdf)

Mining and Agribusiness

Current: Alumina platelets
Separation
Bioextraction; applications for particles, oxide powders

Planned: Bio-leaching processes; mining without surface disturbance
Processes to eliminate tailings and mine wastes
Food process control systems to eliminate contamination
New taste and nutritional delivery systems

Energy and Environment

Current: Industrial catalysts
Fuel additives
Solid oxide fuel cells
Super capacitors
Membrane separation
Water/air purification, fuel cells/hydrogen technologies

Planned: Artificial photosynthesis; efficient energy from light
Paint on solar cells;
Membranes for bulk water desalination and purification
Particles to rapidly purify air
Silica membranes for H^2 separation, photocatalysis

Health and Medical

Current: Diagnostic markers
Dendrimer drug delivery
Particle engineering
Biosilicates for tissue engineering
Lab-on-a-chip devices

Planned:Real-time ultra-sensitive diagnostic devices
Point-of-care medicine
Personal monitoring
***In-vivo* applications; new surfaces and materials to replace or repair tissues**

Materials and Manufacturing

Current: Coatings; catalysts

Coatings for food protection
Zinc oxide (ZnO) in paints, sunscreens

Planned: Advanced sensory and control processes for manufacturing systems
Textiles with electronic and new mechanical properties
High-performance structural materials
New abrasives, lubricants
Intelligent packaging

Electronic and ICT

Current: Semiconductors

Memory applications

Positioning devices

Flexible displays

Atom-scale nanoelectronics

Planned:Organic computers; integration of IT and biological systems
Parallel computing capacity
Computing and telecommunications systems
Energy-conversion and lighting systems with greater efficiency

There are a number of Australian firms producing nanoparticles for use in industrial and consumer products.

- *Very Small Particle Company Pty Ltd* design and manufactures complex metal oxides.
- *Nanomics BioSystems Pty Ltd* is a biotechnology company focused on manufacturing nanotechnology tools which have application in the fields of genomics, proteomics, drug discovery, and human diagnostics.
- *Bio-Layer* produce polymeric coatings containing metal ions which can be coated directly onto microbeads or other substrates.
- *Cap-XX* develops nanostructured supercapacitors.
- *Orica Ltd* produces additives for paints.
- *Advanced Nano Technologies* manufacture nanomaterials with ceria, zinc oxide, alumina, zirconia.
- *Micronisers Pty Ltd* is a Melbourne based producer of ZnO nanopowders. This technology is found in coatings designed to offer protection against damaging ultra-violet radiation.
- *Sustainable Technologies International* make Dye solar cells.
- *Vanceva* make a heat blocking film that is laminated between sheets of glass. The film contains nanoparticles that absorb heat.
- *Lehmann Pacific Solar Pty Ltd* make Skycool, which is a radiative cooling paint that is used on metal roofs.
- *Bottle Magic Australia Pty Ltd* make polymer coating loaded with ZnO for UV protection of the contents of food storage containers.
- *PolyOptics* make a range of polymer optical fibres for use in illumination.
- *XeroCoat* make a permanent, multi-purpose coating that prevents fogging.
- *Ambri Pty Ltd* have led the way in the development of functional nanoscale sensors based on using antibody-antigen recognition as a mechanism for controlling ion flow across an artificial lipid bilayer membrane.
- *Olex* is marketing a ceramic polymer coating for electrical cables, developed in cooperation with the CRC for Polymers.

- *Proteome Systems Ltd* develops instruments, software and consumables that facilitate research into proteomics.
- *Quantum Precision Instruments* (QPI) is commercialising its nanoTrek™ high-precision metrology device that uses quantum tunneling technology to offer sub-nanometre accuracy for high-precision manufacturing industries.

There are also a number of research groups/consortiums in Australia investing in the development of nano materials and products.

- *The Australian Centre of Excellence in Electromaterials Science at the University of Wollongong is developing nanomaterials with improved efficiency in the generation and transfer of electrical charge. There are for use in a new generation of bionic ears, artificial muscles, nerve repairs, and the bio-batteries and bio-fuel cells.*
- *CSIRO Textile and Fibre Technology have developed filaments of pure carbon measuring about a millionth of a millimetre in diameter that possess amazing strength and excellent heat and electrical conductivity. Possible applications include electronic textiles and satellite tethers.*
- *The Centre for Quantum Computer Technology's applications of nanotechnology include linear optics (using single photons in optical fibres to encode quantum information), precise quantum control of atoms, atomic-level imaging and molecular modelling.*
- *The Quantum Optics Group at the Australian National University has made breakthroughs in quantum photonics by successfully teleporting a laser beam. Quantum teleportation could potentially allow fibre optic communication with faster bit transfer rates, 100% secure encryption of messages, and quantum computers with the ability to process complex mathematical problems millions of times faster than present day computers.*
- *The Centre for Microphotonics at Swinburne University develops photonic devices at the nanoscale for research into imaging and manipulating quantum dots, quantum electrodynamics, near-field scattering.*
- *The Centre for Ultrahigh bandwidth devices and optical systems is a research consortium involving the University of Sydney, Macquarie University, University of Technology Sydney, Australian National University and Swinburne University of Technology. Their two research themes of micro-photonics and nonlinear photonics contribute towards the Centre's main focus, development of a photonic chip for ultra-high bandwidth communications.*
- *The Microelectronics and Materials Technology Centre at RMIT specialises in microelectronics and materials research, and supports a range of major multi-disciplinary research programs and industry related projects in integrated optics, photonic systems, sensors, micro electromechanical systems (MEMS) and RF technology.*
- *The Queensland State Government has established the Australian Institute for Bioengineering and Nanotechnology at the University of Queensland*
- *Nanotechnnology Victoria is a consortium of Victorian universities (Monash, Swinburne, RMIT) and the CSIRO. It receives funding from the Victorian State Government. It operates as a contract research and development company with a focus on nanotechnology developments, and is a key player in the implementation of the Victorian State Government's Small Scale Technologies (SST) strategy.*

QUESTION 4: Has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifier as well as a description of its use. If available, please provide a summary of the findings

and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

To date no nanomaterials have been officially assessed by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) or any other relevant regulatory agency in Australia. Food Standards Australia New Zealand (FSANZ) has not evaluated any nanomaterials, but is aware of reported use overseas of nanoencapsulated food additives and packaging incorporating nanoparticles that could be in use here. FSANZ has not yet received any applications to amend the Australia New Zealand Food Standards Code regarding nanomaterials. The Therapeutic Goods Administration (TGA) is keeping a watching brief on the scientific literature with regard to the safety of nanoparticulate materials used in medicines (e.g. zinc oxide in sunscreens).

Some nanotechnology producing companies, such as Nanotechnology Victoria, have set up internal assessment and management systems for the nanoparticles they produce or store. These systems are based on standard chemical safety assessments, with additional information included on particle size and potential health issues.

QUESTION 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system, and any efforts to address such gaps/ needs.

An Australian Government inter-departmental working group has been established to explore a number of issues related to nanotechnology, including an evaluation of the current regulatory frameworks in relation to nanomaterials. The gaps and future needs in relation to regulation of nanotechnology in Australia are currently under investigation by a range of Australian regulatory agencies, including NICNAS, FSANZ, the Office of the Australian Safety and Compensation Council (ASCC), the Therapeutic Goods Administration (TGA), the Department of the Environment and Heritage (DEH), and (on metrology issues) the National Measurement Institute (NMI). These agencies have indicated that the challenge for regulators is to determine whether the existing risk analysis frameworks are adequate to assess nanomaterials or whether these frameworks need to be further developed to accommodate the regulatory requirements for nanomaterials.

NMI has indicated that there are problems in making accurate measurements at the nanometre level, and regulation will be dependent on our ability to accurately measure nanotechnology products and materials.

FSANZ generally regulates foods rather than processes and relies on internationally accepted specifications that do not usually relate to particle size.

Some areas where there may be gaps for industrial chemicals (NICNAS) include the following:

a. *Articles* are excluded from notification and assessment as industrial chemicals. Some nanomaterials may meet the definition of an article.
b. Some new industrial chemicals are exempt from notification and assessment if they are introduced into Australia in low volume. Many nanomaterials may fall into low volume categories.
c. A key determinant in how an industrial chemical is regulated is whether a chemical is a new or existing (ie on our Inventory). Which raises the question ‘when is a nanomaterial of an existing substance a new substance’?
d. Chemicals are currently not regulated on size, or other physical characteristics.

QUESTION 6: Identify any risk assessment-related research activities completed, underway or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

A consortium consisting of the Victorian and Queensland State Governments, the Australian Institute of BioEngineering and Nanotechnology, Nanotechnology Victoria, and Monash University is developing an initiative to conduct research into toxicology of nanoparticles and nanofibres.

A consortium of Micronisers Pty Ltd, Advanced Nano Technologies Pty Ltd and Macquarie University are conducting research into the biological activity (mainly transdermal activity) of metal oxides.

The Office of the Australian Safety and Compensation Council (ASCC) is planning to conduct a literature review of the most recent overseas research on the implications of nanotechnology on occupational health and safety, which should help identify research priorities.

QUESTION 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed, and how.

Australia supports the continuation of this work through OECD's Chemicals Programme. The OECD is in a good position to coordinate an internationally accepted process for classifying nanomaterials (including characterization, hazard identification, exposure methodology, definitions and nomenclature) in consultation with other international bodies such as ISO, the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Biochemistry and Molecular Biology (IUBMB). OECD should also evaluate whether the current test guidelines are adequate to identify the potential environmental and health impacts of nanomaterials.

The IUBMB should be included in the consultation process because of the potential biological/biochemical applications of nanotechnology e.g. in enzyme and medical technologies. Possible contacts within these organisations for the OECD could be the Nomenclature Committee of the International Union of Biochemistry and Molecular Biology (NC-IUBMB) and also the IUPAC-IUBMB Joint Commission on Biochemical Nomenclature (JCBN), which has a key role in Enzyme Nomenclature.

CANADA

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

The Canadian regulatory framework will be defined as the collective regulatory responsibilities and authorities in a variety of areas and across all levels of government. For the purpose of this preliminary survey, only the federal regulatory framework is considered.

i) Definitions of nanomaterials

Canada has not adopted an official definition of nanomaterials.

In the absence of a standard definition, the term "nanomaterials" is interpreted to refer to nanoscale structures rather than the products and potential products incorporating them.

ii) Nomenclature

At present, Canada is not undertaking any activity dedicated to resolving questions of nomenclature.

The need for standardized nomenclature for nanotechnology-related terms (such as nanomaterials, nanointermediates, and the science of naming nanomaterials) is accepted generally as being essential for the development of a regulatory framework, for the collection of meaningful statistics on the state of play of nanotechnology, and for the development of national policy and strategy.

iii) Characteristics of nanomaterials

To date there has been only limited research related to characterization and risk assessment of properties specific to nanomaterials (see answer to Question 6 below).

The ability to accurately characterize nanomaterials is a critical step in their development, use, trade, and regulation. From a regulatory perspective, reference standards for measurement will allow the accurate determination and characterization of the products of nanotechnology. Metrology will also play an important role in the calibration and standardization of devices and methods of detection at the nanoscale. At present, Canada does not have a dedicated nanometrology program; however, the National Research Council's Institute for National Measurement Standards (NRC-INMS) has the 2002-2007 Strategic Plan calling for $4.7M in new funding to develop a nanometrology laboratory in the Dimensional Metrology Program (DMP) to support Canadian partners in nanotechnology R&D and future nanotechnology-related manufacturing. In spite of attracting very limited new resources, three specific collaborative pilot initiatives are underway related to manufacturing, materials, and accurate calibration.

New nano-tools assist in characterization:

A recent consultation of the Canadian Council of Innovation with Canada's four major federal granting councils (Canadian Institute of Health Research, National Science and Engineering Research Council, Canada Foundation for Innovation, Social Science and Humanities Research Council 2002) identified four major areas that will underpin future advances in nanotechnology. These are: 1) fundamental understanding, 2) new instruments and tools, 3) synthesis and fabrication; and 4) novel applications.

New instrumentation and tools will help with the characterization of nanomaterials. Development of novel chemical, optical, and electronic analysis tools will be required. Nano-manipulation must be accompanied by new ways of imaging things at a small scale. Manipulation cannot be done properly without seeing what is being done.

Examples of novel techniques which could aid in characterization include:

- Contrast agent technology for all forms or imaging (confocal, two photon microscopy, MRI, X-ray for living systems)
- X-ray microscopy
- Development of direct phasing methods for structure determination – this is critical for the development of some structure diagnostic tools for macromolecular structures/drug deliver, as well as for complex nano-structures
- Optical tweezers

Metrology will also be critical for nanoscience especially to see the structures as they are being built. Canada has a strong tradition of such visualisation tools for optical imaging. To measure dimensions and characteristics of materials on a nanometer scale is a daunting task. Scanning Probe Microscopy (SPM) may offer techniques that will make the metrology of nanoelectronics realizable. Data from SPM lends itself favourably to analysis by digital image processing (DIP) techniques. The globally accredited ability of NRC-INMS to apply DIP to length calibrations, making them traceable to the SI definition of the metre and achieve smallest calibration uncertainty, will assure researchers that their nanoscale measurements will be traceable to international standards, and thus credible and reproducible by peers in other countries. It will also assure manufacturers that the dimensional attributed of their products will have the widest possible acceptance in the global marketplace. The need to find less costly and easier to use technology to ensure sustainable gains is also noted.

Robotic syntheses combined with combinatorial methodology will allow molecular chemists to obtain diverse compounds quickly, thereby accelerating the correlation of structure and properties, and allowing chemists to quickly identify compounds of special interest. For example, methods for covalently linking the tips of nanotubes or attaching complex molecular structures to bulk diamond can be expected to have important applications in nanotechnology. To reach some of these goals, molecular self-assembly will prove to be a powerful tool.

Electro-technology can be used for cellular processing but could be scaled using nanoscale microstructures to allow molecular processing. The ability to electro-manipulate macromolecules, such as DNA and other proteins, may prove useful in biological manipulation, dissection, and assembly. This non-invasive capability is readily automated when suitably integrated with signal and image processing electronics.

Canadian Departmental Activities:

Environment Canada is undertaking a review of the current regulatory framework under the Canadian Environmental Protections Act for controlling toxic substances to determine what, if any, new approaches might be required to accommodate the novel characteristics and properties that certain substances may

exhibit at the nanoscale. Note that other legislation and regulations which may apply to nanotechnology have not been determined yet.

Health Canada created a working group in August 2004 to serve as a forum to discuss and address nanotechnology issues impacting the department. One of the tasks of the working group is to analyze the current regulatory framework to determine if it is appropriate to handle nanotechnology-based products.

With respect to (potential) products that incorporate manufactured nanomaterials, the Canadian Food Inspection Agency (CFIA) will continue to consider and input to international developments such as the OIE (Office International des Epizooties) resolution to develop guidelines relevant to the application of nanoscience/nanotechnology as it relates to animal health (Resolution 28(7), May 2005). The CFIA will continue to evolve its regulations, guidelines, and assessments to keep pace with new scientific developments.

The National Research Council Institute for National Measurements Standards has the Dim Met Program which combines digital image processing with length calibrations by optical interferometry for the purpose of measurement and/or calibration of line scales or other specialty micro-scale artefacts. A wide variety of custom applications in the high-tech industries have been accommodated such as measuring the diameter of optical fibre ferrules. The Dim Met program also aims to develop a broader portfolio of R&D activities to respond to the maturing demand for calibration of nanoscale artefacts for those clients who are active in nanotechnologies. Still in the design phase, the NRC-built grating diffractometer instrument will calibrate the line spacing of reference grating samples used by others to calibrate the scales in their SPM systems. Calibrated reference grating standards will have expanded uncertainty of 30 pm for 300 nm line spacing.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

Environment Canada and Health Canada currently have no working definition or volume triggers specific to nanomaterials submitted to the New Substances Notification program. If nanomaterials are notified as New Substances they would be measured against the current chemical volume triggers:

<20 kg/yr – exempt from notification
≥20 – <1000 kg/yr – Schedule 1 notification (limited data requirements)
≥1000 – <10,000 kg/yr – Schedule 2 notification (more stringent data requirements)
≥10,000 – >50,000 kg/yr – Schedule 3 notification (most stringent data requirements)

Volume triggers are higher if the substance is present on the non-domestic substances list (US EPA TSCA inventory).

Under the Canadian Food Inspection Agency, for products that incorporate manufactured nanomaterials, the current regulatory trigger for agricultural products is novelty, specifically new trait(s) or characteristics(s); or changed trait(s) or characteristic(s); or a new use. The regulatory trigger is not process specific, and neither is the associated risk assessment framework.

There is no indication of risk assessment tools or methodologies specific to the assessment of nanomaterials.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

The planned uses of nanomaterials can be gauged from the academic research activity in Canada. Most academic nanotechnology research is concentrated in nanomaterials, with nanoelectronics and nanophotonics research also being pursued actively by a number of scientists. In the life sciences areas, nanomedicine research is focussed on imaging and diagnostic tools as well as related material science, and to a lesser degree targeted drug delivery systems.

A number of preliminary studies have been undertaken to determine industrial nanotechnology activities providing a range of estimates (89-150) of the number of Canadian companies engaged in these activities. According to one study, the materials and process sector accounts for roughly one-third of the companies engaged.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

Currently Canada does not have a working definition of a nanosubstance of nanomaterial, and therefore does not have a list of nanomaterials which have been assessed in the regulatory program. If a non-based substances has met the existing volume criteria and was notified to the New Substances Program, it would have been assessed for environmental or human health impacts in the manner prescribed for at typical chemical substance and would not have necessitated any additional data requirements beyond those required for other chemicals or polymers.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

The proper assessment of a nanomaterial will likely require additional pieces of information from that of other chemicals. The realization and identification of the information needs followed by the development of the test methods to obtain that information is an essential requirement for a regulatory program. Currently many gaps or issues need to be addressed before nanomaterials can be adequately assessed. The following list identifies the apparent issues or data gaps.

- Regulatory framework
    - Analysis of current legislation to determine how best to complete the notification and testing of new nanomaterials – are existing regulatory frameworks suitable?
    - Need to effectively integrate social issues
- Regulatory definition - Substance identification
    - Require internationally accepted definition of nanosubstances/nanomaterials
    - Measurement standards – particles, tubes, wires, nanolayers, nanopores
    - Analytical methods and techniques from all media including tissue
    - Nomenclature – standard nomenclature adequate?
    - Regulatory system based on CAS # – nanosubstances may be built from existing chemical? Same CAS #, different substance, properties, hazard, and use
- Are current chemical notification volume limits appropriate for nanomaterials?

  - Some nanomaterials likely require lower volume limits given low anticipated manufacture, import, and use volumes. Need to identify concentrations which could pose a risk to human health and the environment. This information would shed light on the adequacy of current trigger volumes.
- Are current chemical notification information requirements adequate?
  - Current understanding of the properties, fate, hazards, exposure routes, and applicability is lacking, but is necessary to identify potential risks to the environment. Once the basic information is known, an understanding of whether the current chemical notification requirements are adequate.
- Test methods - evaluation and development
  - If tests and test methods are inadequate, new methods need to be developed
    - Toxicity test requirements
    - Property determination – physical/chemical? Other?
    - Residue testing
    - Other
  - Are current computer based predictive tools adequate?
- Labelling requirements?
  - Voluntary or mandatory labelling considerations are warranted for public goods (including foods incorporating manufactured nanomaterials)
- Limited technical capacity of assessors
  - Novel substances may require non-traditional expertis to effectively assess and regulate
- Exposure assessment considerations
  - Lifecycle exposure – determine release of nanomaterials during manufacturing, processing, transportation, use, and disposal/recycling
  - How can the presence of nanomaterials be quantified?
  - Are novel analytical tools required to quantify nanomaterials?
  - Can exposure be adequately modelled?
  - Is monitoring data currently available?
- Environmental fate considerations
  - Bioaccumulation and biomagnification potential
  - Persistence
  - Environmental partitioning
  - Transformation products – identification and fate
- Toxicity considerations
  - Determination of levels of inducing adverse effects
  - Human and environmental hazards
  - Human health – dermal, inhalation, and oral exposure
  - Animal health – dermal, inhalation, and oral exposure
  - Metabolic processes and fate
  - Chronic and acute effects?
  - Can toxicity be modelled?

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

Apart from some preliminary research work underway by the federal departments of Health Canada and Environment Canada, the majority of research work in the areas of risk assessment related to environmental safety and human health are supported by two Canadian granting councils – the National

Science and Engineering Research Council (NSERC) and the Canadian Institute of Health Research (CIHR).

What makes risk assessment challenging is the fact that nanoparticles and nanomaterials have unique physicochemical properties. This challenge is rooted in a basic conundrum: the property that makes nanoparticles so promising – that they behave very differently from bulk forms of the same material – also makes their potential health and environmental effects difficult to predict (Science **304**, 1732 (2004)). Most, if not all studies so far, concentrate on toxicology of a particular material in a particular model system (e.g., carbon nanotubes in lungs of rats). As a consequence, it is unclear what general physicochemical properties are good indicators of toxicity in a given situation. Additionally, the toxicology of each material has to be tested separately without it being clear if anything can be extrapolated even for the same material in a different geometry, size, or environments.

Goal of the NSERC Nano Program

The Natural Sciences and Engineering Council's Nanotechnology Innovation Platform (NanoIP) Awards support projects in laying the foundation to understand the physicochemical basis of the toxicology and environmental impacts of nanoparticles and nanomaterials, as well as social and ethical inquiries. Nanomaterials have properties characteristically different because of their nanometer dimension. These awards will help to lay the scientific foundation to understand how dimension, chemical composition, and shape determine access (i.e., how do these particles get somewhere), chemical reactivity, as well as stability under various external stresses. The results of this program are expected to help in identifying and prioritizing targeted future toxicology as well as environmental studies. In this round, the NanoIP Awards will not support such toxicology studies, but will help provide a guiding physicochemical framework.

It is the goal of the NanoIP award program to gain a better understanding of the basic physicochemical properties of nanomaterials and nanoparticles. That is different about nanoparticles? Relevant issues that need to be addressed as they are important to toxicology and environmental aspects of particles are:

1. Access: How do nanoparticles get somewhere? How does this depend on particle size, shape, and external pressures such as light, time, and chemical and thermal gradients? It is necessary to understand diffusion, translocation across barriers, solubility, etc.
2. Reactivity: Chemical reactivity and changes thereof under arduous external pressures (pH changes, solubility, concentration, interaction with light, interaction/synergy with other particles, dependence on shape of particles, time, etc.)
3. Stability: What is the fate of the material when one uses it? What are the decay products and how do they depend on external pressures? What are the reactive intermediates and the relevant time scales?

The NanoIP Program has funded up to $1 million in university research annually dedicated to physicochemical issues underpinning nanotechnology development in Canada. The following researchers have received the NSERC Peer Review Nanotechnology Risk Assessment Awards for 2005-2007. also included are links to abstracts of their proposed research activities for 2005-2007.

* Antonella Badia, Department of Chemistry, Université de Montréal. **Nanoparticles in phospholipid membrane environments**. Co-applicant: L.A. Cuccia (Concordia Univeristy)- http://www.physics.mcgill.ca/NSERCnanIP/e/awards/2005_abstracts/abstract_badia.html

* Jake E. Barralet, Faculty of Dentistry, McGill University. **Fate of nanoparticles in mammalian cells: Effect of composition, shape, size, and surface charge.** Co-applicant: M. McKee (McGill University) - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_barralet.html

* Jillian Buriak, Department of Chemistry, University of Alberta and NINT. **Interactions between nanoscale materials and blood.** Co-applicant: B. Ritchie (University of Alberta) - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_buriak.html

* Warren Chan, Department of Biomaterials and Biomedical Engineering, University of Toronto. **Effect of a nanostructure's size and shape on uptake, degradation, and clearance in primary macrophages.** http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_chan.html

* David Cramb, Department of Chemistry, University of Calgary. **Dynamics, distribution, and photochemistry of quantum dots in blood vessels.** http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_cramb.html

* John Honek, Department of Chemistry, University of Waterloo. **Recognition and physicochemical characterization of nanomaterial-peptide interactions.** Co-applicant: K.T. Leung (University of Waterloo) - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_honek.html

* Bernie Kraatz, Department of Chemistry, University of Saskatchewan. **Understanding transport and association of nanoparticles in biological systems.** Co-applicants: M.F. Paige (University of Saskatchewan), R.W.J. Scott (University of Saskatchewan) - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_kraatz.html

* Ray LaPierre, Department of Engineering Physics, McMaster University. **Physicochemical properties of nanowires.** Co-applicant: C. Fradin (McMaster University) - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_lapierre.html

* Bruce Lennox, Department of Chemistry, McGill University. **The fate of ligand-capped nanoparticles under chemical, physical, and biomimetic pressures.** - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_lennox.html

* Jay Nadeau, Department of Biomedical Engineering, McGill University. **Interactions between semiconductor nanoparticles and biomembranes and DNA.** Co-applicant: H. Vali (McGill University) - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_nadeau.html

* Baljit Singh, Department of Veterinary Biomedical Sciences, University of Saskatchewan. **Mechanisms of cellular interactions of functionalized rosette nanotubes.** Co-applicant: H. Fenniri (University of Alberta/NINT)- http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_singh.html

* Francoise Winnik, Department of Chemistry, Université de Montréal. **Understanding the light-induced cytotoxicity of quantum dots: a cellular, phototophysical and analytical mechanistic approach.** Co-applicants: D. Maysinger (McGill University), S. Sauvé (Université de Montréal) - http://www.physics.mcgill.ca/NSERCnanoIP/e/awards/2005_abstracts/abstract_winnik.html

Canadian Institutes for Health Research

The CIHR is Canada's premier health research funding agency. It is responsible for funding over 8,500 researchers in universities, teaching hospitals, and research institutes across Canada. Its budget for 2004-2005 is $662 million. CIHR has provided operating funds for nanomedicine research for sometime now through their open competitions and initiated strategic operational funding in nanomedicine and regenerative medicine in 2003. The core 2003 request for application resulted in $12.3 million over five years with special emphasis on the following five areas of research endeavour:

- Cellular and molecular measurement and imaging;
- Clinical and diagnostic imaging;
- Interaction between biological systems and materials;
- Drug delivery and targeting;
- Ethical, economic, environmental, legal, and social issues (E3Ls)

Public opinion research

Initial results from recent surveys and focus group work[8] conducted by university-based researchers to gauge Canadian public opinion on nanotechnology, report that a strong majority of Canadians (79%) approve of nanotechnology. However, this support is to a large degree contingent upon the assurance that corresponding regulatory systems be put in place.

The study noted that "in focus groups, particularly among involved Canadians/Americans, many are very vocal about the importance of nanotechnology and the revolutionary nature of this area of technology:, but "the main area where concerns arise, more so in focus groups than in the survey, regards the regulatory oversight processes and mechanisms that govern nanotechnology." in addition to such surveys, a number of researchers across the country are currently engaged in studies in order to better understand the social and ethical dimensions of nanotechnology; to that end, a number of scholarly papers have been published.[9] Overall, it appears that public opinion of nanotechnology in Canada is very positive, but existing concerns underline the fact that there remain a number of outstanding social, ethical, regulatory, and legal issues to be addressed.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Issue	How should be addressed
Definition of nanomaterial/nanosubstance	Coordination and international agreement
Nomenclature	Coordination and international agreement
Measurement	Coordination and international agreement
Toxicity test methodology	OECD should coordinate through the test guidelines program standard toxicity and physical/chemical property test methods
Regulatory test requirements	Coordination and international agreement
Exposure assessment methodology	Special focussed sessions
Risk assessment methodology	Special focussed sessions
Persistence	Special focussed sessions
Bioaccumulation	Special focussed sessions
Multi-media assessment	Special focussed sessions

8. Public Attitudes toward Emerging Technologies: a Canada-US Comparison, Jeff Walker, Veraxis Research and Communication, June 2005.

9. See for example: Health Law Review Volume 12, Number 3 (2004) published by the Health Law Institute at the University of Alberta; 'Mind the gap': science and ethics in nanotechnology, A. Mnyusiwalla, A. Daar and P. Singer, Nanotechnology 14, R9 2003.

FRANCE (Original French)

1. Travail effectué, en cours ou planifié concernant :

i) Définitions
ii) et Nomenclature

Le CEN (Comité Européen de Normalisation) BTWG 166 auquel participe la France (ministère de l'Industrie, Cea, Afnor, Ineris) travaille sur la terminologie et les définitions. Le ministère de l'Industrie (DIGITIP/DGE) a réalisé une étude prospective[10] qui propose des définitions.

Le ministère de l'Industrie rappelle ce travail de normalisation entrepris par le CEN en terme de terminologie et nomenclature auquel doit contribuer l'Afnor et le LNE (Laboratoire National d'Essais).[11]

En matière d'hygiène et de sécurité au travail, il est nécessaire de préciser à court terme une nomenclature propre aux PUF (particules ultra-fines) et de définir ce qu'est une nanoparticule, [le consensus actuel « particule de taille inférieure ou égale à 100 nm » est trop imprécis et mal justifié], la distribution granulométrique, comment tenir compte de l'agglomération, nommer des nanoparticules composées, etc..[12]

iii) Caractérisation

« Lors de l'enquête réalisée au niveau national, les laboratoires de recherche évoquent la nécessité de collaborer avec les industriels pour comprendre leurs besoins et ainsi aller plus loin dans l'élaboration ou la caractérisation des nanomatériaux. »[13] Il y a en plus la caractérisation des effets sur l'homme, la caractérisation des expositions, la caractérisation des concentrations en masse, nombre, et surface.

iv) Métrologie

« Comme l'écrit la Commission européenne dans sa présentation du programme " Nanosafe " (CE FP6, document non daté), " l'évaluation des risques potentiels pour la santé associés à ces matériaux nouveaux requiert la compréhension des mécanismes toxiques, l'identification d'une propriété ou d'une métrique reliant l'exposition au risque pour la santé, et une méthode de mesure de l'exposition en lien avec cette métrique. " Il n'est en effet pas simple, en tout cas pas actuellement résolu de façon simple, de prélever et évaluer en temps réel (ou peu différé) des caractéristiques comme le nombre et/ou la surface des particules. Des évaluations d'exposition seraient nécessaires, " en caractérisant les concentrations en masse, nombre, et surface ", et " en incluant des situations déjà connues pour exposer aux particules ultra-fines, telles que le soudage, la fonderie, le chauffage des polymères, l'ablation par laser et les procédés utilisant la combustion " (CE FP6).

La spécialisation nécessaire, le coût et l'encombrement des appareils, la complexité de leur utilisation et de l'interprétation des données montrent qu'il reste encore beaucoup de progrès à faire (Maynard, 2001). Ces

10. « Etude prospective sur les nanomatériaux », Ministère de l'économie et des finances DIGITIP mai 2004, 2.1.1.3 Synthèse sur les définitions des nanomatériaux, p. 12.

11. « Plan matériaux, 10 propositions d'actions concrètes », 29 septembre 2005, Fiche 3.1 « réglementation des nanomatériaux», Ministère de l'Industrie, DGE/SIMAP/VICM, p. 25.

12. « Particules ultra-fines : bref aperçu des connaissances toxicologiques », Projet pour le PNSE - Janvier 2005, Benoît Hervé-Bazin, Institut national de recherche et de sécurité (INRS).

13. « Etude prospective sur les nanomatériaux », op cit. Conclusions, p. 101.

progrès sont toutefois indispensables pour mieux caractériser et comprendre les risques résultant de l'exposition à des particules ultra-fines, et optimiser les efforts de prévention.[14] »

2. Quels sont les critères qui déclenchent des actions réglementaires ?

Le développement des nanosciences/nanotechnologies et nanomatériaux, qui apparaît comme inéluctable, nécessite de prendre des mesures réglementaires pour prévenir les risques sanitaires et environnementaux. Les réglementations actuelles sont inadaptées, car elles ne tiennent pas compte des propriétés particulières des matériaux de taille nanométrique.

Volume ? Risque sanitaire ou environnemental ? Autres ?
Masse des particules, nombre des particules ou surface ? La surface et le nombre des particules semblent jouer un rôle prépondérant dans la toxicité chez les animaux et l'homme. Il ne faut pas négliger cependant le rôle d'autres facteurs : HAP (d'hydrocarbures aromatiques polycycliques) ou dérivés nitrés ou métaux adsorbés sur les particules.[15]

A la demande du Ministre de la recherche, les aspects éthiques devraient être abordés : « le R3N (Réseau National en Nanosciences et Nanotechnologies), devra définir les quelques grandes priorités de recherche sur lesquelles il concentrera la plus grande partie de son effort. En particulier il coordonnera la réflexion sur les problématiques éthiques et sanitaires liées au développement et à l'emploi de nanotechnologies, notamment concernant les problèmes de pollution et de développement de pathologies. En rassemblant la réflexion existante dans ce domaine et en suscitant de nouvelles études, il permettra d'éclairer nos concitoyens ; et mènera une activité d'observatoire des meilleures pratiques internationales. »[16]

Le Comité de la Prévention et de la Précaution (CPP) dont le Ministère de l'Ecologie assure le secrétariat, a été requis pour proposer des recommandations dans le domaine des risques des nanomatériaux. Il devrait rendre son avis d'ici la fin de l'année 2005.

Nous noterons qu'aucune considération sur un éventuel arrêt de la production de nanomatériaux, ne serait-ce qu'en l'attente de plus d'informations sur leurs effets sur la santé et l'environnement, n'est envisagée, que ce soit par l'OCDE dans son questionnaire ou de la part des autorités françaises ou européennes. La Grande-Bretagne a formellement écarté la possibilité d'un moratoire en supposant que le gouvernement saura mettre en place très rapidement un cadre réglementaire pertinent et efficace pour gérer les risques. Notons cependant que la Société Royale Britannique et l'Académie Royale d'ingénierie17, tout en disant leur opposition à un moratoire, recommandent ce qui suit : éviter autant que possible la diffusion de nanomatériaux manufacturés et les nanotubes dans l'environnement (Recommandation 4) ; les usines et laboratoires de recherche les traitent comme s'ils étaient dangereux et cherchent à les réduire ou les éliminer des flux de déchets et que l'utilisation de ces matériaux non fixés sur une matrice doit être prohibée jusqu'à ce que les recherches démontrent que les bénéfices potentiels dépassent les risques potentiels (Recommandation 5) ; pour ce qui concerne les nouveaux produits contenant des nanomatériaux, l'industrie doit évaluer le risque de diffusion durant tout le cycle de vie et mettre cette information à

14. « De la nécessité de faire un point sur les dangers des particules ultra-fines », Benoît Hervé-Bazin, INRS.

15. Particules ultra-fines : où en est-on des connaissances toxicologiques ?, Benoît Hervé-Bazin, INRS, Intervention à la journée de sensibilisation " Hygiène et sécurité avec les nanopoudres ", le 25 mai 2004 à l'école des mines de Paris.

16. Voir : http://www.recherche.gouv.fr/discours/2004/dnanotech.htm.

17. "Nanoscience and nanotechnologies: opportunities and uncertainties", juillet 2004, Chapitre 10 : Recommandations [http://www.nanotec.org.uk/finalReport.htm].

disposition des autorités (Recommandation 6) : un quasi moratoire de fait. La position des autorités britanniques nous semble intéressante.

3. Utilisations des nanomatériaux

Actuelles
Prévues

4. Y-a-t-il des nanomatériaux évalués ou en cours d'évaluation ?

5. Manques dans le système réglementaire et futurs besoins, efforts entrepris ?

Compte-tenu des propriétés toutes particulières des nanomatériaux, il est nécessaire d'établir d'autres normes, d'autres tests, une autre métrologie… pour une meilleure estimation des effets possibles sur l'homme et l'environnement.

« Diverses initiatives en cours visent à mieux connaître ces matériaux, caractériser leurs propriétés et évaluer leur impact HSE (Hygiène, Sécurité, Environnement). Il s'agit tout d'abord de recenser et de coordonner ces différentes initiatives. Parmi celles-ci, on peut d'ores et déjà en identifier 3 types, auxquelles nous proposons d'apporter à court terme un soutien et/ou un accompagnement :

- les programmes de recherche destinés à acquérir de la connaissance sur le comportement de ces nano-objets,
- la démarche de normalisation, menée en partenariat à l'échelle européenne, qui, en permettant de donner un cadre juridique et réglementaire, devrait faciliter l'industrialisation des nanomatériaux,
- les saisines des ministères de la santé et de l'écologie d'examens par des comités experts des risques potentiels liés aux nanoparticules et des recommandations de politique publique à faire. »[18]

Le système réglementaire actuel, basé essentiellement sur l'évaluation des risques, ne semble plus très adapté face aux risques technologiques actuels. Il montre ses limites en matière de produits chimiques : pour les substances perturbant le système endocrine, par exemple, la meilleure évaluation des risques donna longtemps, et jusqu'à récemment, la réponse suivante : "pas de problèmes" alors qu'il y en avait de significatifs. Le cadre conceptuel est donc à revoir, pour, notamment, permettre la prise de décision sur la seule base du « danger », en l'absence d'éléments d'évaluation des risques, adopter une attitude de précaution, en somme.

6. Activités relatives à l'évaluation des risques, finies, en cours ou prévues, concernant la sécurité environnementale et la santé humaine ?

« Plusieurs laboratoires français (INRS, INSERM, INERIS, CNRS, CEA...) conduisent ou sont impliqués dans des programmes de recherche européens, soit sur l'évaluation des risques soit sur de nouvelles approches dans le but d'apporter des réponses aux problématiques HSE. L'ANR (Agence Nationale de la Recherche) a lancé un appel à projets dans le cadre du programme « Santé-environnement et Santé-travail », qui inclut un volet sur l'impact des nanoparticules. Ces recherches sont indispensables pour acquérir les connaissances scientifiques nécessaires à une évaluation rationnelle des risques et à la mise en place de bonnes pratiques. Les activités de recherche en instrumentation, et métrologie conduiront à

18. « Plan Nanomatériaux, 10 propositions d'actions concrètes », Ministère de l'Industrie, DGE/SIMAP/VICM, 29 septembre 2005, Fiche 3.1 « réglementation des nanomatériaux», pp. 25-28.

améliorer, développer et évaluer des outils de mesure dont les nouvelles performances permettront aux industriels de disposer de résultats de mesure plus fiables. Ces travaux s'inscrivent en support de la partie « mesure et caractérisation » de la normalisation. Pour structurer les activités de recherches, un groupe miroir soutenu par l'association Ecrin a été mis en place et a ouvert un nouveau site Internet : http://www.nanomateriauxetsecurite.fr. Dans ce contexte, nous proposons de renforcer le rôle de coordination de l'association dans ce domaine de travaux de recherche et de faire de l'association un partenaire privilégié des administrations concernées. »[19]

INRS : Institut national de recherche et de sécurité
Benoît Hervé Bazin, a produit plusieurs écrits et exposés sur l'état des lieux scientifique des connaissances toxicologiques des particules ultrafines. Il anime un groupe de travail au sein d'ECRIN visant à identifier les points de recherche nécessitant un effort particulier et les manques dans les programmes actuels. Le point de vue est pragmatique : savoir s'il est nécessaire et possible d'avoir des valeurs limites pour les PUF, traiter des substances les plus abondantes (nanotubes, oxydes, céramiques, etc.), aspects scientifiques sont à creuser (passage percutané, transplacentaire, etc.)[20].

INERIS : L'Institut National de l'environnement industriel et des risques
NANORIS : Evaluation et Prévention des Risques accidentels et chroniques liés à la production et à l'utilisation de nanoparticules : 2005 ;
PREF'AIR Prévision et Cartographie de la qualité de l'air - module pollution par les aérosols ;
Effet des particules de diesel (F. Bois avec INSERM, CERTAM) ;
Etude pour le Ministère de l'Industrie : Nanopoussières minérales (Métrologie, effet pour la santé, prévention) : 2003.

CNRS : Centre National de la Recherche Scientifique
Action Concertée Incitative relative aux nanotechnologies comporte un volet ECODYN pour l'étude de la

dissémination environnementale ;

DINANO (dispersion de Nanopoudres), ACI « Energie Conception Durable », CNRS, dispersion d'aérosols Ultra-fins lors de la manipulation de Nanopoudres, Toulouse (2004-2007).

AFSSE : Agence Française de Sécurité Sanitaire Environnementale
Elle a été saisie par les Ministères de la Santé, du Travail et de l'Ecologie pour réaliser une synthèse des connaissances scientifiques et techniques disponibles sur :

- la typologie, les propriétés physico-chimiques, les caractéristiques toxicologiques et les effets biologiques et sanitaires des nanomatériaux ;
- les domaines d'utilisation actuels et futurs de ces nanomatériaux ;
- les outils métrologiques disponibles ou en cours de développement ;
- les données d'exposition (actuelle et potentielle) de la population générale et des travailleurs et notamment les paramètres pertinents permettant de la caractériser ;
- les impacts sanitaires.

19. « Plan Nanomatériaux, 10 propositions d'actions concrètes », Ministère de l'Industrie, DGE/SIMAP/VICM, 29 septembre 2005, Fiche 3.1 « réglementation des nanomatériaux», pp. 26.

20. ECRIN a établi un groupe de travail « Détection et caractérisation des nanoparticules » et un autre « Intégration de systèmes industriels sécurisés ». cf. http://www.ecrin.asso.fr.

Et proposer des pistes prioritaires pour la réalisation d'études et de recherches (métrologie, toxicologie, épidémiologie, etc.) permettant d'améliorer l'évaluation des risques sanitaires, notamment en milieu professionnel.

7. Un prochain travail doit-il être mené au sein du Programme sur les produits chimiques de l'OCDE ?

La prise en compte des conséquences potentielles sur la santé humaine et l'environnement des naonomatériaux manufacturés au sein du Programme des produits chimiques de l'OCDE est une bonne initiative.

Nous souhaitons que l'OCDE élargisse le champ de son investigation aux effets de la convergence des technologies NBIC (Nanotechnologie Biotechnologie, Infotechnologie, technologie Cognitive) : effets sur les relations de domination (effets de pouvoir), effets sur le rapport à la nature (effets ontologiques), effets sur le rapport à la connaissance (effets épistémiques).

D'autres dimensions ont été abordées, de nature moins économique : effets sur la possibilité même de l'éthique (effets éthiques) et effets métaphysiques[21] , sachant que « […] les risques ne sont qu'un type d'effets parmi beaucoup d'autres, et certainement ni les plus importants ni les plus intéressants [et que] le calcul des risques, qui est la seule méthode d'évaluation envisagée (sous divers avatars - calcul économique, démarche coûts-avantages, etc. [...]), est complètement inadapté à l'appréhension normative de la plupart des effets. »[22].

FRANCE (English version)

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

i) Definitions and,

ii) Nomenclature

21. Cf. "Les Nanotechnologies : Ethique et Prospective Industrielle", Jean-Pierre Dupuy et Françoise Roure, 15 novembre 2004 [http://www.cgm.org/themes/deveco/develop/nanofinal.doc] ; "Le problème théologico-scientifique et la responsabilité de la science" et "Complexity and Uncertainty A Prudential Approach To Nanotechnology, Jean-Pierre Dupuy, in "Nanotechnologies : Preleminary Risk Analysis on the Basis of a Workshop organized in Brussels on 1-2 March 2004 by the Health and Consumer Protection Directorate General of the European Commission", pp. 53-70 et 71-93, respectivement

[http://europa.eu.int/comm/health/ph_risk/documents/ev_20040301_en.pdf].

22. Jean-Pierre Dupuy [http://europa.eu.int/comm/health/ph_risk/documents/ev_20040301_en.pdf], p. 60.

CEN (European Committee for Standardization) Working Group BTWG 166, of which France is a member (Ministry of Industry, CEA, AFNOR, INERIS), is working on terminology and definitions. The Ministry of Industry (DIGITIP/DGE) has conducted a future study[23] which proposes definitions.

The Ministry of Industry would like to draw attention to this standardization work which the CEN is currently performing in the field of terminology and nomenclature, to which AFNOR (the standards agency) and the LNE (National Testing Laboratory)[24] are expected to contribute.

With regard to occupational hygiene and safety, what we need to do in the short term is establish a special nomenclature for UFPs (ultra-fine particles) a definition of what constitutes a nanoparticle (the current consensus namely. "a particle up to 100 nm in size", is too vague and poorly substantiated) that takes account of given distribution, agglomeration, composite nanoparticles, etc.[25]

(iii) Characterisation

"During the national survey, research laboratories mentioned the need to work with industry in order to understand its requirements and thereby make advances in developing or characterising nanomaterials".[26] In addition there is also the characterising of the impacts on humans, exposure rates, and concentrations in terms of mass, number and surface area.

(iv) Metrology

"As stated by the European Commission in its presentation of the "Nanosafe" programme (EC FP6, undated), assessing the potential health risks associated with these new materials calls for greater insight into toxic mechanisms, identification of a property or metrics linking exposure with health risks, and a way of measuring exposure in relation to those metrics. It is not easy, at least not at present, to sample and assess in real time (or with a short lag) characteristics such as the number and/or surface area of particles. It would require exposure assessments "characterising concentrations in terms of mass, number and surface area" and "including situations already known for exposure to ultrafine particles, such as welding, smelting, the heating of polymers, laser cutting and procedures involving combustion" (CE FP6).

The specialisation required, the cost and the size of the equipment, together with the complexity of its operation and the subsequent interpretation of data all show that there is still a long way to go (Maynard, 2001). These advances are nevertheless crucial if we are to improve our characterisation and understanding of the hazards of exposure to ultrafine particles, and thereby optimise prevention.[27]

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

23. "Etude prospective sur les nanomateriaux", French Ministry of the Economy and Finance, DIGITIP, May 2004, 2.1.1.3. Summary on the definitions of nanomaterials, p. 12.

24. "Plan matériaux: 10 propositions d'actions concrètes" 29 September 2005, Fiche 3.1 "règlementation des nanomatériaux", French Ministry of Industry, DGE/SIMAP/VICM, p. 25.

25. "Particules ultra-fines: bref apercu des conniassances toxicologiques", Project for the PNSE, January 2005, Benoît Hervé-Bazin, INRS (French National Research and Safety Institute).

26. "Future study on nanomaterials", op.cit. Conclusions, p. 101.

27. "De la nécessité de faire un point sur les dangers des particules ultra-fines", Benoît Hervé-Bazin, INRS.

Advances in nanoscience/nanotechnology and nanomaterials, which appear to be inevitable, call for regulatory measures to prevent any risk to health and the environment. The current regulations are inappropriate, as they take no account of the specific properties of nanometric materials.

Volume? Health or environmental risks? Others? Mass, number or surface area of such particles? The surface area and number of particles seem to play a major role in animal and human toxicity. However, we should not overlook the role of other factors, such as PAHs (Polycyclic Aromatic Hydrocarbons), nitro compounds or metals adsorbed on particles.[28]

Further to a request made by the French Minister for Research, the ethical aspects also need to be addressed: "R3N (the national network for nanoscience and nanotechnologies) should define a small number of key research priorities on which to focus its main effort. In particular it should co-ordinate thinking on the ethical and health issues relating to the development and use of nanotechnologies, with a special focus on the problems of pollution and the development of pathologies. By compiling current studies in this field and by fostering further research, it will provide the public with information; it will also serve as a monitoring unit for best practice throughout the world."[29]

The "Comité de la Prévention et de la Précaution" (committee for prevention and precaution), whose Secretariat is provided by the Ministry of the Environment, has been asked to put forward recommendations on the risks from nanomaterials. It is expected to report by the end of 2005.

We should point out that there is no mention, either by the OECD in its questionnaire or by French or European authorities, of any plans to call for a halt to the production of nanomaterials, if only to await further insight into their impact on health and the environment, The United Kingdom has formally ruled out the possibility of a moratorium, assuming that the government will very rapidly introduce a relevant and effective regulatory framework for risk management. Nevertheless, the Royal Society and the Royal Academy of Engineering[30,] while voicing their opposition to a moratorium, do recommend "that the release of manufactured nanoparticles and nanotubes into the environment be avoided as far as possible" (Recommendation 4); that factories and research laboratories treat manufactured nanoparticles and nanotubes as if they were hazardous, and seek to reduce or remove them from waste streams; and that the use of free (that is, not fixed in a matrix) manufactured nanoparticles in environmental applications such as remediation be prohibited until appropriate research has been undertaken and it can be demonstrated that the potential benefits outweigh the potential risks (Recommendation 5); that, with regard to new products containing nanomaterials, industry should assess the risk of release of these components throughout the lifecycle of the product and make this information available to the relevant regulatory authorities (Recommendation 6): this is a virtually de facto moratorium. We find the UK stance interesting.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Current

Planned

---

28. "Nanoscience and nanotechnologies: opportunities and uncertainties", July 2004, Chapter 10: Recommendations [http://www.nanotec.org.uk/finalReport.htm]

29. See ministerial speech: http://www.recherche.gouv.fr/discours/2004/dnanotech.htm

30. "Nanoscience and nanotechnologies: opportunities and uncertainties", juillet 2004, Chapitre 10: Recommandations [http://www.nanotec.org.uk/finalReport.htm].

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

No answer

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

Given the very specific properties of nanomaterials, there will have to be other standards, other tests and another type of metrology, for instance, to improve the assessment of the possible impacts on man and the environment.

A variety of initiatives are under way to gain more insight into these materials, characterise their properties and assess their HSE impact (Hygiene, Safety and the Environment). First these initiatives should be listed and co-ordinated. They can already be said to fall into three categories, for which we propose short-term support and/or monitoring:

- Research programmes aimed at gaining insight into the behaviour of these nano-objects;
- A standardisation drive, conducted in partnership with others at the European level, which, by providing a legal and regulatory framework, should facilitate the industrialisation of nanomaterials;
- The commissioning by the Ministries of Health and the Environment of reviews by expert committees of the potential risks linked to nanoparticles with a view to obtaining policy recommendations."[31]

The present regulatory system, based mainly on risk assessment, no longer appears to be very appropriate given the current technological risks. It reveals its limits with regard to chemicals: for a long time and until recently, for instance, in the case of substances that affect the endocrine system, for instance, the best risk assessment found there to be "no problem" whereas there were in fact significant problems.

The conceptual framework should therefore be revised, notably so that decisions can be taken on the basis of the existence of a potential hazard alone in cases where no risk assessment has been made. In other words, we should adopt a precautionary approach.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

Several French laboratories (including INRS, INSERM, INERIS, CNRS and CEA) are conducting or involved in European research programmes, either on risk assessment or on new approaches with a view to providing answers to MSE issues. The ANR (*Agence Nationale de la Recherche* or national research agency) has launched a call for projects as part of a programme on "Health and the Environment" "Health and Work", part of which focuses on the impact of nanoparticles. This research is crucial to acquiring the scientific knowledge required for rational risk assessment and the introduction of good practices. Research work in instrumentation and metrology will lead to the improvement, development and assessment of the

31. "Plan Nanomatériaux: 10 propositions d'actions concrètes" Ministry of Industry, DGE/SIMAP/VICM, 29 September 2005, Fiche 3.1 "règlementation des nanomatériaux", p. 25.-28

measurement tools whose new performance will enable industry to obtain more reliable measurements. This work backs up the "measurement and characterisation" side of standardization. In order to structure research work, a mirror group supported by the *ECRIN* association has been set up with a new Internet site: http://www.nanomateriauxetsecurite.fr. In this context, we propose stepping up the association's co-ordinating role in this field of research and making the association a close partner of the relevant government departments."[32]

INRS: *Institut national de recherche et de sécurité* (national research and safety institute)

Benoît Hervé-Bazin has written several works and papers that take stock of current toxicological knowledge on ultrafine particles. He runs a working party within the *ECRIN* association, aimed at identifying the areas of research requiring a special effort, as well as gaps in the current programmes. He takes a pragmatic standpoint, i.e. finding out whether it is necessary and indeed possible to have limit values for UFP, addressing the more common substances (nanotubes, oxides, ceramics, etc.), the scientific aspects that require more in-depth work (absorption through the skin/placenta, etc.)[33]

INERIS*: Institut National de l'environnement industriel et des risques* (national institute for the industrial environment and risk)

NANORIS: Assessment and prevention of accidental and chronic risk linked to the production and use of nanoparticles: 2005;
PREF'AIR: Air quality forecasting and mapping – aerosol pollution module; effects of diesel particles (F. Bois with INSERM, CERTAM);
Study commissioned by the Ministry of Industry: Mineral nanodust (metrology, health effects, prevention): 2003.

CNRS: *Centre National de la Recherche Scientifique* (national centre for scientific research)

The "concerted initiative" (ACI) on nanotechnology includes ECODYN, for the study of environmental releases;
DINANO (dispersal of nanopowder), ACI on "Sustainable Energy", CNRS, dispersal of ultrafine aerosols when manipulating nanopowder, Toulouse (2004/2007).

AFSSE: *Agence Française de Sécurité Sanitaire Environnementale* (French agency for environmental health and safety)

The Agency has been asked by the Ministries of Health, Labour and the Environment to draw up a summary of the scientific and technological knowledge available on:

- the typology, physical/chemical properties, toxicological characteristics and biological/health-related impacts of nanomaterials;
- current and future areas of use for these nanomaterials;
- the metrological tools already available or under development;

32. "Plan Nanomatériaux: 10 propositions d'actions concrètes" Ministry of Industry, DGE/SIMAP/VICM, 29 September 2005, Fiche 3.1 "règlementation des nanomatériaux", p. 26.

33. ECRIN has set up a working party « Détection et caractérisation des nanoparticules » and another on the « Intégration de systèmes industriels sécurisés ». cf. http://www.ecrin.asso.fr.

- exposure data (current and potential) on the general public and workers, in particular the appropriate parameters for characterisation;
- health impacts.

It has also been asked to propose key avenues for future studies and research (including metrology, toxicology and epidemiology) that will enhance health risk assessment, particular in the occupational field.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

The fact that the OECD Chemicals Programmes takes into account the potential implications of manufactured nanomaterials for human health and the environment is a sound initiative.

We hope that the OECD broadens the scope of its investigation to the implications of the convergence of NBIC technologies (nanotechnology, biotechnology, information technology and cognitive technology): i.e. effects on power relationships (power effects), effects on nature (ontological effects), and effects on knowledge (epistemological effects).

Other dimensions, of a less economic nature, have been addressed: effects on the possibility of ethics (ethical effects) and metaphysical effects[34], given that "risks are only one of many types of effect, and certainly not the most important or the most interesting [and that] risk calculation, which is the only method of assessment envisaged (in various manifestations, including economic calculations and cost-benefit analysis), is completely inappropriate for the prescriptive understanding of most effects".[35]

GERMANY

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

The German Standardisation Institute (DIN) is in the process of setting up a national mirror committee to the ISO activities. The International Organization for Standardization (ISO) has formed a new (provisional) Technical Committee in Nanotechnologies (TC 229). Its scope broadly includes standardization in the field of nanotechnologies, with specific tasks being classification, terminology and

34. See "Les Nanotechnologies: Ethique et Prospective Industrielle", Jean-Pierre Dupuy and Françoise Roure, 15 November 2004 [http://www.cgm.org/themes/devec/develop/nanofinal.doc]; "Le problème théologico-scientifique et la responsabilité de la science" and "Complexity and Uncertainty A Prudential Approach to Nanotechnology", Jean-Pierre Dupuy in "Nanotechnologies: Preliminary Risk Analysis on the Basis of a Workshop organized in Brussels on 1-2 March 2004 by the Health and Consumer Protection Directorate General of the European Commission" pp. 53-70 and 71-93, respectively. [http://wwweuropa.eu.int/comm/health/ph_risk/documents/ev_20040301_en.pdf].

35. Jean-Pierre Dupuy [http://europa.eu.int/comm/health/ph_risk/documents/ev_20040301_en.pdf], p. 60.

nomenclature, basic metrology, characterization, including calibration and certification, risk and environmental issues (Categories: "Systematic terminology for nanomaterials and their properties", "General Terminology", "Metrology, analytics, test methods" and "Toxicology, environment"). The British Standard Organisation (BSI) has successfully applied to CEN and ISO for a lead in the development of nanotechnology standards. They serve as the secretariat for TC 229. The German standardization organization (DIN) organized a kick-off meeting in June 2005 to identify the relevant topics in the field of nanotechnology. Prof. Reiners (Federal Institute for Materials Research and Testing (BAM) will be the head of the German delegation at the inauguration meeting of ISO TC229 "Nanotechnology" (Nov 9-11, BSI, London), he also will be the head of the mirror committee in the German standardization organisation DIN, organising the input to ISO/TC 229. DIN is contributing to ISO TC 24/SC4 (sizing by methods other than sieving), i.e. laser scattering, PCS at high concentrations and electrical mobility analysis of aerosols.

The Hauptverband der gewerblichen Berufsgenossenschaften, St. Augustin has elaborates preliminary definitions for measuring ultrafine particles in air commonly issued by several European institutes for occupational safety (see BGIA folder, section 0412-4, Erich Schmidt Verlag, Bielefeld). In the Institute und Outpatient Clinic of Occupational and Social Medicine, Justus-Liebig University, Giessen the project „Characterisation of ultrafine particles for work place protection" is performed which mainly concerns the characterisation *of manufactured nanomaterials* and of aerosols emitted from these materials by electron microscopy.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

At present no regulations exist which refer specifically to the production and application of nanomaterials or nanoparticles. Relevant factors which can give a first estimation of potential risks of nanomaterials/-particles could be:

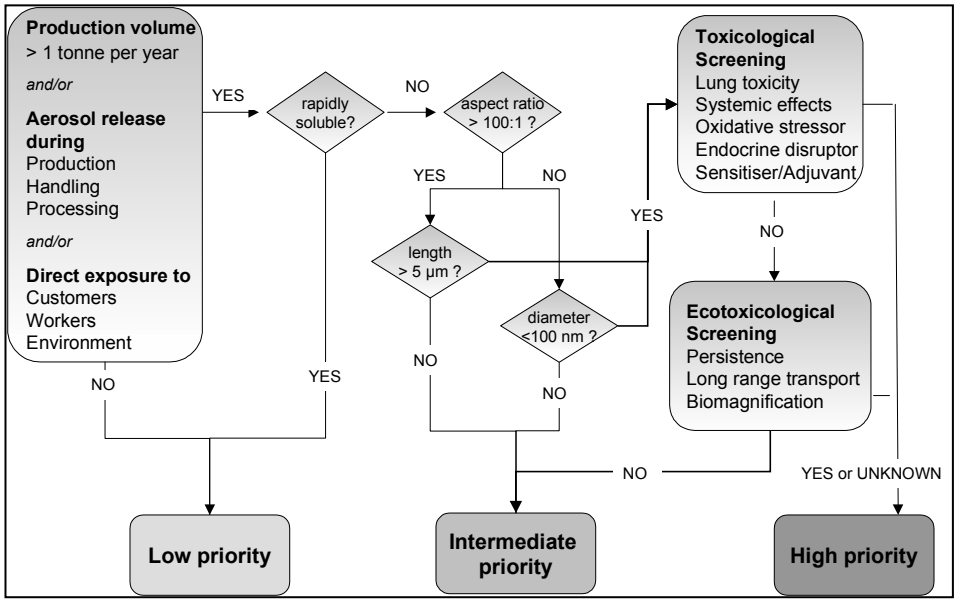
- Production volume
- Potential exposure to customers, workers, environment
- Potential aerosol release during production, handling, processing
- Solubility
- Aspect ratio (to distinguish between fibers and particles)
- Particle diameter (taking into account a potential deagglomeration in body liquids)
- Toxicological and ecotoxicological parameters.
- A potential trigger would be proven toxicological evidence on an adverse effect of a defined nanoparticle species on human health. Risk assessment would then be carried out in accordance with the Ordinance on Hazardous Substances (Gefahrstoffverordnung).

What the regulatory framework is concerned, German Chemical Industry Association (VCI) is convinced that all nanomaterials produced by the German chemical industry which are currently on the market or in the development pipeline are sufficiently regulated by the German chemicals act (Chemikaliengesetz). As all products, nanomaterials must be individually labelled and have their own MSDS. The German chemical industry is finalising some "best practice"-recommendations on a responsible production and use of nanomaterials.

The identification of data gaps and the work to be done to assure sound risk assessment and risk management should be preceded by a framework that specifies nanomaterials by a generally accepted nomenclature and by classification rules.

There are specific studies that indicate small size may accentuate toxicity in some cases, and others indicating small size does not accentuate toxicity. According to the current scientific debate, particle size, morphology and chemical surface properties should be taken into account for any risk assessment approach. There are no integrated, peer-reviewed studies pointing to a broadly based increased hazard potential of nanomaterials.

A concept scheme for assessing the risks of nanomaterials is depicted in the following figure. This scheme is to be regarded separately from registration processes of new chemical substances in the frame of existing chemical regulations, because particle size does not play a role in current chemical legislation. Until now producers are not obliged to declare particle size of the substances in the frame of registration processes. Therefore, the proposed scheme should be applied also for already registered substances which are re-manufactured as nanoparticulate materials and therefore might differ significantly from bulk materials in their physical and toxicological properties.



Scheme for a preliminary risk assessment of nanoparticulate materials (source: VDI-TZ, modified form Howard and de Jong 2004).

Further investigations could lead to more suitable parameters for risk assessing, e.g. surface properties (area, bioavailability). It can be assumed that many parameters of nanoparticulate materials with regard to toxicological and ecotoxicological properties will be unknown. Here standardised screening test would be of great use which can give a first assessment of potential risks. Nanoparticulate materials assessed with a high priority should be subject to further investigations and/or regulatory measures.

Some representatives from industry firmly believe that the existing legislation in most of the OECD countries (incl. Germany) is appropriate to accommodate the evaluation of nanoscaled materials and no further triggers are needed.

In case that an existing substance is marketed in a physically modified state (nanoscale) or new insights about potential hazards get available the supplier is obliged to re-evaluate the substance and assess potentially related risks and take adequate risk management measures. This procedure is for example reflected in Europe in such a way that all products, including nanoscale materials, are classified and labelled according to their properties resulting in a SDS, giving proper advice to the customer. In any case the company is liable for the safe manufacturing and use.

In case a new substance has to be notified which in addition has nanoscale properties, the normal notification procedure for new chemicals will be followed which is sufficient.

Public discussions between stakeholders and authorities of Germany have started on Oct 11th-12th to discuss issues related to a common understanding of how nanoscaled materials should be assessed under the existing regulatory framework.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Nanomaterials already have a broad range of application in Germany. So a short description of theirs use is not possible. We refer to the manufacturers like BASF, Degussa, Nanogate and Sachtleben.

As long as there is no generally accepted terminology and definition for nanomaterials the question can only be answered on a general basis. In principle nanotechnology promises significant societal benefits. As innovations continue to mature, nanoscale materials have the potential to be used in many industrial sectors, including chemicals, electronics, automotives, medicine, energy storage and conversion as well as in pollution control and environmental cleanup.

In general almost every solid substance could be produced as nanoscaled product. They are usually embedded in a matrix or composite. Nanoscaled products are e.g. pure or mixed oxides, salts, metals, carbon black, organic compounds and composites. They are used for numerous innovations in medicine, in the electronics and automotive sectors.

Some types of nanoparticulate materials like carbon black, polymer dispersions or micronised drugs have been produced on industrial scale for a long time. A further commercially important class of nanoparticulate materials are metal oxide nanopowders, such as silica (SiO2), titania (TiO2), alumina (Al2O3) or iron oxide (Fe3O4, Fe2O3). But also other nanoparticulate substances like compound semiconductors (e.g. cadmium telluride, CdTe, or gallium arsenide, GaAs) metals (especially precious metals such as Ag, Au) and alloys are finding increasing product application.

Nanoparticles have very broad application ranges and potential markets. This includes automotive industry (catalysts, fillers for tyres and lacquers etc.), medicine (drug delivery systems, active agents, contrast media etc.), construction (facade coatings, concrete, insulation materials, flame retardants etc.) textiles (surface-processed textiles, smart clothes etc.), food (additives, package materials etc.), cosmetics (sun protection, tooth paste etc.) environment protection and many other industry sectors. Some further examples for products: antifingerprint surfaces in kitchen, catheters (bleb and heart) with nanocoatings are provided since 2 years, numerous application in the packaging sector, biocide nano-materials in sanitary installations aircraft construction, dozen of applications in automobiles. Application in purifying agents for windows (Henkel KGaA, Duesseldorf) (http://www.henkel.com/int_henkel/innovation_de/cf_press/pressdetail.cfm?docID=5C7CB024742407B5 C1256EC8004D2223), application in flexible solar cells, RFID etc. (Degussa / Creavis , Marl): „Nanotronics“ (http://www.creavis.com/files/Das_Ende_ist_der_Anfang.pdf','popup',800,600 http://www.creavis.com/site_creavis/de/default.cfm?content=download&cat=16), pigments (Degussa / Creavis , Marl): (http://www.nanomat.de/partner.htm#part1), sensor systems / smart materials / micro- and nanostructures (http://www.caesar.de/572.0.html), nanoparticles in vapour phase: origin, structure, characteristics / magnetic hetero layers: structure and electronic transport / energy dissipation on surfaces (University Duisburg-Essen)(http://nano.uni-duisburg-essen.de).

Market potentials for different nanoparticles can vary between several tens of thousands of Euro per year for laboratory scale particles like quantum dots and several billions of Euro for industrial mass products like polymer dispersions or Carbon Black.
Concerning food additives there are some potential applications described (Silicon Dioxide (E551), Titan Dioxide (E171), Beta Carotene (E160a ii), Beta Cyclodextrine (E459), Polysorbate (E432-E436), Novel Carriers). A survey concerning applications of nanotechnology in the food sector is underway.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

There are several ultrafine materials as Al_2O_3-particles and Al-welding fume or TiO_2-particles where an assessment according to the regulation of this commission is underway. An assessment of carbon black and ZnO-fume has been performed in 1999 and 2000 and was published (Gesundheitsschädliche Arbeitsstoffe - Toxikologisch-arbeitsmedizinische Begründungen von MAK-Werten. Begründungen für die Empfehlungen der Senatskommission zur Prüfung gesundheitsschädlicher Arbeitsstoffe. Verlag Wiley-VCH).

An assessment of nanoparticles within the framework of the admission procedure of food additives is not known. It is not evident, which particle size distribution was analyzed in toxicological assessment of inorganic food additives (Silicon Dioxide (E551) or Titan Dioxide (E171)). So it is not clear, whether these nanoparticles are assessed. If there exist no document, a reassessment of nanoparticles in admitted additives is taken for necessary.

No knowledge of manufactured nanomaterials. In the COMMISSION DIRECTIVE 96/77/EC of 2 December 1996 laying down specific purity criteria on food additives other than colours and sweeteners a minimal particle size of microcrystalline cellulose (E460) has been defined: 5 µm, and not exceeding 10 percent of the particles are allowed to be smaller than 5 µm. Microcrystalline cellulose has been assessed extensively within the scope of approval as technological additive.

Conventional nanostructured materials like Carbon Black and silica have been subject to extensive toxicological and epidemiological testing studies. Other official assessments are not known.

German Chemical Industry Association (VCI) is not aware of any recent official assessment of nanomaterials.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

At present no regulations exist which refer specifically to the production and application of nanomaterials or nanoparticles neither for worker and consumer safety nor for environmental protection. Also in the frame of chemical legislation particle size does not play a role for the registration of new substances. In the future a major task will be to check if the existing legislation and regulation framework can cover the range of nanotechnology or if and how it should be modified. With regard to legislation the following areas should be included into the discussion:

- Immission control

- Chemicals
- Labour protection
- Pharmaceutical and medicine
- Food, consumer goods and cosmetics
- Novel-Food.

Within this legal framework there are manifold instruments to protect people and the environment against potential risks of nanomaterials and –particles- as for all hazardous substances in general. Some of these optional measures, which differ significantly between different countries and economic areas, but are more or less harmonized on European Level, see table.

Area of interest	Safety Measure
Drugs	• Drug approval application process
Food	• Impose conditions for manufacturing processes • Obligations for indication and permission of producing and selling • Prohibitions • Labeling and warning notices
Consumer products cosmetics	• Product safety standards • Establish obligations for the indication and permission of producing and selling
Air pollution	• Limit values for emission and immission
Worker safety	• Exposure limits • Safety standards and guidelines
Hazardous substances and chemicals	• Registration of substances/chemicals • Guidelines for handling of hazardous substances

Optional regulation measures for nanoparticle based products

The establishment of appropriate safety standards and regulations with regard to nanoparticles will strongly depend on reliable measurement techniques to assess air quality, workplace exposures, toxicological effects and the fate and transportation of nanoparticles in the environment and biosphere. Even though the mechanisms and particle characteristics causing negative health effects are heavily debated, it is necessary to determine all particle characteristics at various locations, e.g. in ambient air and working areas, to enable detailed toxicological studies and to produce a data base for particle exposure assessments. The problem is that so far all existing standards for the measurement of particulate matter in the atmosphere like EN 13205:2002, ISO 14966:2002 or ISO 7708 do not include the range of ultrafine particles. Another point is that at present no uniform nomenclature for nanomaterials exists. Only if various classes of substances are precisely defined, the results of risk assessment of different institutions or countries can be compared, thus facilitating progress in the clarification of potential risks. Without a consistent nomenclature regulative measures can not be implemented, and even the labelling of products becomes a difficult task.

Some further gaps and needs:

The health adverse effects of nanoparticles in the atmosphere at working place are assessed scarcely. There is urgent need for research referring to the pollution by welding fume, inorganic and organic dust, e.g. in paint finishing systems, in processing of rocks and in agriculture.

There is seen a gap within our regulatory system, which refers not only to nanomaterials. The EU Guideline 67/548/EWG, annex VI gives no consideration to the size or the surface of bulk material to be classified.

Also in food sector the application of nanotechnology is not yet regulated.

It is recommended a word-wide accepted framework that specifies nanomaterials by a generally accepted nomenclature and by classification rules.

Nanoparticles should be put on par with unevaluated chemicals until knowledge and informations about toxicology and assessment methods exist. Research activities on environmental behaviour and toxicological data are pressing.

Impact of nano-particles to cell reactions should be compared to the impact of micro-particles.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

A. Toxicology and health and safety research

The toxicological and eco-toxicological research goals call for a further development of new testing methodology (reproducible particle generation, detection and characterisation of atmospheric nanoparticles and of nanoparticles in biological tissue, in vitro/in vivo screening models) and the amendment of existing toxicity models.

Furthermore, basic toxicology and environmental research (genetic toxicity, pulmonary inflammation, extra-pulmonary distribution, bioavailability and chronic effects) is to be promoted.

International protocols for monitoring methodologies assessing occupational exposure at the workplace should be established.

In Germany, in a survey conducted by the joint DECHEMA-VCI working group "Responsible Use and Production of Nanomaterials" in September 2005, some 40 focal points of different priority were identified regarding safety research for nanoparticles [DECHEMA: Society for chemical engineering and biotechnology; VCI: German Chemical Industry Association]. The following toxicological research subjects were identified as highest priority subjects:

- Studying parameters decisive for toxicological effects
- Measuring types and quantities of nanoparticle release at the working place and from products
- Measuring types and quantities of nanoparticles in organisms and in individual organs, tissues and cells after inhalation, skin contact and ingestion
- Studying how nanoparticles are incorporated in body cells, whether adverse health effects must be expected due to the incorporation of nanoparticles in the body, and if there are threshold limits for possible adverse effects
- Studying whether and which risks are posed by individual products manufactured from nanoparticles, taking into account their respective benefits
- Making available validated in-vitro methods for the toxicological assessment of new nanoparticles, also in aerosols.

In March 2005, a number of companies from the German chemical industry submitted the project "NanoCare: Safety-relevant factors for chemical nanotechnologies" to the German federal ministry of education and research (BMBF). The scope of NanoCare is:

- Studying the desaggregation and deagglomeration of new nanoscale and/or nanostructured materials, solubility and binding forces
- Studying dustiness in dependence on particle size distribution
- Establishing a testing method for carbon nanotubes and particles
- Determining the transfer of nanoparticles from the gaseous phase to the liquid lung milieu
- Studying the behaviour of nanoparticles in the lungs
- Studying the ability of particles to penetrate the lung epithelium, skin and intestines
- Studying the distribution of nanoparticles in the organism
- Developing a bio-ranking for a comparison of new and known nanostructured materials
- Collecting results from safety research, coordinated research discussion, dialogue with stakeholders
- Discussing threshold limits, preventive measures.

B. Required research to measure nanoparticles

Toxicological and eco-toxicological research goals call for a further development of methods to measure atmospheric nanoparticles and to detect nanoparticles in biological tissue. A major problem is the lack of suitable, common testing methods for particles. Currently available are only non-validated "university methods" that do not allow comparison.

Existing coverage of all types of particles in air focuses mainly on the determination of total mass ($\mu g/m^3$) but this value provides for nanoparticles – with their very high surface-to-volume ratio – only limited information regarding possible harmful effects. With techniques to be newly developed, surface and number concentration, morphology of particles and their chemical composition are to become measurable. These techniques must be suitable for use under real workplace and environmental conditions

The characterization of atmospheric nanoparticles in and from industrial processes is mostly based on the measuring of agglomerates. The measuring of individual particles is highly sophisticated in respect of sampling and evaluation and mostly takes place in basic research. Therefore, novel robust and fast methods are needed for measuring at the workplace and in production processes to determine the size distribution for high number concentrations.

To assess the behaviour and the life span of ultra fine particles in air, it is also necessary to learn more about the aggregation and agglomeration properties of very small particles. The knowledge of the adhesion of particles to each other and to other surfaces must be improved.

In the atmospheric particle range, especially particles sized between 0.5 and 20 nm are most difficult to cover with today's measuring techniques. Here, suitable methods for environmental analysis need to be developed, and a comparison of existing methods is called for.

To improve the quality of nanoparticles in application technology, processes must be developed to determine the particle size during synthesis in the range between 1 and 100 nm with high dissolution. Furthermore, processes are needed to analyze non-spherical forms of nanoparticles (tubes, plates etc).

Research is also required toward new methods to determine the number, size and composition of nanoscale products in the liquid phase. Especially for toxicological studies in various organisms and different

biological compartments there are, until now, only inadequate approaches or no starting points at all. Therefore, it is of great importance to identify real forms of nanoscale products (isolated nanoparticles, aggregates, agglomerates, particle/protein or particle/DNA complexes etc) in the body.

The toxicological and eco-toxicological research goals call for a further development of new testing methodology (reproducible particle generation, detection and characterisation of atmospheric nanoparticles and of nanoparticles in biological tissue, in vitro/in vivo screening models) and the amendment of existing toxicity models. Furthermore, basic toxicology and environmental research (genetic toxicity, pulmonary inflammation, extra-pulmonary distribution, bioavailability and chronic effects) is to be promoted.
International protocols for monitoring methodologies assessing occupational exposure at the workplace should be established.

Some further activities:

In the Institute und Outpatient Clinic of Occupational and Social Medicine, Justus-Liebig University, Giessen the project „Characterisation of ultrafine particles for work place protection" is performed which mainly concerns the characterisation of manufactured nanomaterials and of aerosols emitted from these materials by electron microscopy.

Since 1998 a measurement campaign to determine exposure to ultrafine aerosols at workplaces is organized and conducted by the Hauptverband der gewerblichen Berufsgenossneschaften, St. Augustin, HVBG-BGIA (http://www.hvbg.de/d/bia/akt/nanopartikeln/index.html). HVBG-BGIAS is part of the ongoing EU project NANOSAFE 2 (see www.nanosafe.org).

Risk assessment-related research activities with relevance to environmental safety or human health in the Federal Institute for Materials Research and Testing (BAM)):

- Impact of nano-particles to cell reactions in comparison to micro-particles (See attachment 7)
- Investigations on emissions of nano particles into air – in a first step for electronic business machines like printers and copiers due to the use of toners (and paper). The project, financed by the German Federal Environmental Agency, is running already and will be finished at the end of 2006. In 2006 the project will focus on particle emissions (including nano-particles) and a possible exposition of users via air.

Carbon nanotubes have a real hazard potential which has to be assessed: Actually there are many projects (BMBF, EU) to this issue. As from December 2005 there will be a doctoral thesis in cooperation with the University of Saarland and NanoBioNet about the impact of nanoparticles on the human system.

There are some efforts on development of testing methods, classification of hazard, risk assessment of exposure scenarios, threshold determination.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Generally future work on nanomaterials by OECD´s Chemicals Programme is approved:

The work should be coordinated with other programs planned or underway.

The attainment of scientific knowledge in identifying of hazard, assessment of exposition and risk is helpful also for the food sector.

Research activities to health adverse effects of nanomaterials are urgent, especially with reference to the risks of disease of respiratory tract, disease of heart circulation system und tumours.

Main topics should be a valid dose-risk estimate and - minimum requirements for the information of users of nanomaterials.

- A multi-stakeholder effort comprised of academia, government agencies, industry and non-government organisations.
- The development of a broadly accepted mechanism to collect and share existing and future data on the human and environmental toxicology of nanomaterials, and on their fate and effect in the environment. Such mechanism must provide for sufficient protection of intellectual property and proprietary information.
- The development of a broadly accepted mechanism to collect and share existing and future data on the workplace tests and procedures for insuring worker safety and appropriate manufacturing containment. Such mechanism must provide for sufficient protection of intellectual property and proprietary information.
- The development of guidelines and procedures for tiered testing to determining the hazards, if any, associated with the uses of nanomaterials and to establish appropriate guidelines for maintaining safety in the workplace.
- An on-going effort in the regulatory arena to harmonize the protocols, the hazard determination, and the rules, internationally.
- Increased governmental funding on the environmental, health and safety issues of nanomaterials.

Taking into account the discussions after the OECD June 2005 meeting, OECD member states should therefore support:

- Funding the development of new testing methodology (reproducible particle generation, detection and characterization of atmospheric nanoparticles and of nanoparticles in biological tissue, in vitro/in vivo screening models).
- Funding basic toxicology research.
- Funding basic environmental research.
- The establishment of international protocols for monitoring methodologies assessing occupational exposure at the workplace.
- Stakeholder and public communication on applications, chances and risks of nanomaterials.
- The need for increased governmental funding on the environmental, health and safety issues of nanomaterials.
- The concept that government research should focus on fundamental method development (e.g. analytical methods for detection and characterisation of nanoparticles, basic toxicological research)
- While industrial firms focus on testing their products.
- The development of guidelines and procedures for tiered testing and review leading to determining the hazards, if any, associated with the uses of nanomaterials and to setting appropriate guidelines for maintaining safety in the workplace.
- The need for global coordination in research, regulatory and standard setting activities to avoid patchwork regulation of nanomaterials.

OECD should focus on issues assumed to be common to all stakeholders in the process. Examples for those issues are

- Global coordination of international activities in setting terminology, definitions and standards

- Global coordination regulatory and research activities to avoid patchwork regulations of nanomaterials and help prioritizing and proper investment of resources.

All results of measurements and characterization of nano-particles in the human body and in the environment world-wide should be made available through an appropriate data base.

HUNGARY

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

There is no regulatory framework concerning nanomaterials yet.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

There is no triggers to investigate nanomaterials yet.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

There is no current or planned use of nanomaterials yet.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

There is no nanomaterial officially assessed yet, not even under the chemicals legislation..

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

There is no gaps or future needs identified yet.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

Nanotechnology is one of the research fields, notwithstanding assessment of risk to environment or human health is not involved, even not yet planned.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Yes, we agree on future work through OECD's Chemicals Programme. Our interests involve information on the state-of –art of nanotechnology (research, manufacturing and use of nanomaterials) and regulatory aspects of the issue, focussing on, but not limited to health and environmental safety.

ITALY

Italy has just recently begun to carry out assessments of nanotechnologies implications on human health and environment.

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

At a National level, no activities are underway with respect to definitions, nomenclature and characterization of manufactured nanomaterials.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

The European Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) has drawn up a document on the appropriateness of existing methodologies to assess the potential risks associated with engineering. It was submitted to MS for examination.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Italy has carried out a census of public and private research centres. Coordination of initiatives in progress and data gathering on obtained and patented products and their use will follow.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has

involved standard methodology and was based on information typical of traditional chemical safety assessment.

No nanomaterials have been officially assessed in Italy. Studies are underway aimed at defining whether traditional chemical safety assessment applied to substances and preparations could be also extended to cover nanomaterials.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

Such evaluation doesn't exist at National level. We are actively participating within EU for a where several gaps have been identified (e.g. lacking of technical guidance on how to assess the risks related to the exposure to nanomaterials; constitution of an ad-hoc expert group for identifying priorities for assessing the risks).

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

No risk assessment-related research activities have been completed, planned or are presently underway.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Yes. Future work should focus risk assessment and social and economic implications within the OECD Chemicals Programme.

JAPAN

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

The National Institute of Advanced Industrial Science and Technology (AIST) is joining the committee of ASTM for nanotechnology standardization.

Japan has a national committee for ISO/TC229 that deals Nanotechnologies' standardization. (Japan is the P member of ISO/TC229.)

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

There are no regulatory frameworks which are applied solely for nanomaterials in Japan. Since some nanomaterials are new chemical substances, unless used for the purpose of research or analysis, they are subject to the criteria of the Law Concerning the Evaluation of Chemical Substance and Regulation of Their manufacture, etc., which requires the follows:

- if the production/import volume is up to 1 ton, notification only;
- if it is not lower than 1 ton and less than 10 tons, submission of data with regard to biodegradability and bioaccumulation; and
- if it is 10 tons or over, submission of data obtained from toxicological tests: the Repeated Dose 28-day Oral Toxicity Study in Rodents, the Bacterial Reverse Mutation Test and the In Vitro Mammalian Chromosome Aberration Test and from ecotoxicological assessment, as well as the aforementioned data.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Current known uses are as follows:

1) Metal and ceramic nanoparticles such as Ni, Fe, Co, TiO_2, ZnO, Fe_3O_4, and so on – composite materials, catalysts
2) Carbon nanotubes – composite materials, field emission displays (FED), semiconductor devices, planned uses for electronic devices
3) Fullerene – composite materials, medicine, bowling balls
4) fluorescent materials (quantum dots) - FED
5) Titania (Titan Oxide: TiO_2): Photocatalytic materials, Cosmetics (make-up materials)
6) Zinc Oxide (ZnO): Cosmetics (make-up materials)

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

No, it has not.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

1) Funding for studying on health and environmental influences of nanomaterials is too little compared with funding for R&D.
2) Interdisciplinary, inter-organizational and international cooperation is necessary,
3) The Science Council of Japan (SCJ) is making efforts for the solution of the above problems by interdisciplinary, inter-organizational and international communication.
4) Our regulations regarding Chemical Substances do not focus on the substance's scale. Therefore, we may have to consider further influence due to the nano-size.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

1) The Ministry of Education, Culture, Sports, Science and Technology (MEXT), has a funding programme to facilitate public acceptance of nanotechnology. research and surveys on 1) risk assessment of nanomaterials, 2) health issues of nanomaterials, 3) environmental issues of nanomaterials, 4) ethical and societal issues of nanotechnology, and 5) technology assessment for promoting the public acceptance of nanotechnology and its economic effects. The National Institute of Advanced Industrial Science and Technology (AIST), the National Institute of Health Science (NIHS), the National Institute for Environmental Studies (NIES), the National Institute of Materials Science (NIMS), and universities are involved.
2) The Ministry of Economy, Trade and Industry (METI) has recently started funding the programme on standardisation of testing methods for evaluation of the safety of nanoparticles. AIST will conduct this research project aimed at identifying toxicity and exposure associated with manufactured nanoparticles which are well characterized. Prior to toxicity tests, AIST concentrates its efforts on the characterization of test nanoparticles.
3) The Science Council of Japan (SCJ) is coordinating UK-Japan workshops on potential health, environmental and societal impacts of nanotechnologies with the Royal Society of the UK. The first workshop took place in July, 2005 in London.
4) The Nanotechnology Researchers Network Center of Japan (Nanonet), the core center of the Nanotechnology Support Project funded by MEXT, has been studying the potential health, environmental and societal impact of nanotechnologies and supporting the creation of domestic and international networks of nano-scientists, toxicologists, and social scientists.
5) The research project on establishment of health risk assessment methodology for nanomaterials is supported by Health and Labour Sciences Research Grants (Ministry of Health, Labour and Welfare). This initial research project on health risk assessment of nanomaterials focuses mainly on the verification of the detecting methodology of nanomaterials in the biological samples, and on the material absorption & distribution in the experimental animal body after exposure. As evaluation materials, fullerene & titanium oxide were chosen, because both materials are considered to have a high production volume at present.
6) The National Institute for Environmental Studies (NIES), Japan, has been conducting research in relation to human health effects of nanotechnologies as follows. A brief summary of the results is shown in the annex.
    - Since FY 2003, NIES has been conducting a series of research projects on the health effects of nanoparticles such as carbon black (CB), aiming to examine how physical and chemical characteristics of nano-sized particles impact on living organisms. While the purpose of the research is to examine the effect of nanoparticles originating from diesel engine exhaust by using simulated particles (CB, etc.), the findings should be applicable and beneficial in research on the effects of manufactured nanomaterials. As NIES established the nanoparticle health effect laboratory in FY 2005, a new series of research projects using nanoparticles generated from diesel engines is planned.
    - NIES started research regarding exposure assessment and health effects of manufactured nanomaterials such as carbon nanotubes in FY2005, and the evaluation methods and the required responses will be examined.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Yes.

1) The program should be started with the examination of existing systems and obtain new elements to be established.
2) Specialists of nanomaterials should be also involved in the program.
3) Manufactured nanomaterials may need to be registered through alternate or additional procedure in addition to bulk chemicals registration if such material causes different health and environmental effects due to different chemical and physical properties from bulk chemicals. In such case, registering procedures in governmental agencies need to be harmonized. As for evaluation of environmental and health effects, kinds of standardized or harmonized guidance may be useful to member countries.

NETHERLANDS

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

a. NEN (Dutch National Standardization Body) is following the work in ISO/TC229 and CEN/BT/WG166 concerning Nanotechnologies.
b. EC DG Enterprise - Medical Devices Expert Group has installed a working group on "New & Emerging Technologies (NET)", which will discuss regulatory consequences related to such technologies – NL is chairing this WG (Ministry of Public Health, Welfare and Sports) ; first subject to be discussed is nanotechnology.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

Unknown.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Unknown.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has

involved standard methodology and was based on information typical of traditional chemical safety assessment.

No. The same holds for medical devices.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

a. See under 1. – EC WG on New & Emerging Technologies will identify such gaps or future needs within the context of Medical Devices, and if any gaps/needs are identified, they will be addressed.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

a. Jong WH de, Roszek B, Geertsma RE. Nanotechnology in medical applications: Possible risks for human health. RIVM-report 265001 002, 2005.
b. Vitro and vivo laboratory research activities related to effects of nanoparticles on cell systems and experimental animals
c. Participation in proposals in 6th Framework Programme: Quantic Biology: focus on effects of nanoparticels on foetus, transport across the placenta and embryotoxicity

NANORiSK: risk assessment both for environment and public health. Includes studies on toxicokinetics and toxicology of nanoparticles NanoToxTools: toxicity of nanoparticles in general.

Additional efforts: In various Ministeries a.o. Public Health, Sports and Wellbeing and Housing, Spatial Planning and the Environment, the risks and benefits of nanotechnology are listed. Further research will also depend on the outcomes of these national inventories.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Yes. Information that is essential for conducting risk assessment for various nano application areas within chemicals/drugs/medical technology.

OECD may play an important role in streamlining worldwide activities that are currently emerging on the nano issue. However, close cooperation with current pilot EC activities (DG ENV etc.) on regulatory aspects of nanomaterials is crucial.

SWITZERLAND

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

No activity

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

Manufactured nanomaterials are in principle covered by the chemicals law and the food law. However, there are no special triggers and no special testing or assessment tools available yet.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

To date there is no complete and list of nanomaterials and nanomaterials containing products available. The product register which is kept by the Swiss Agency of public health may contain some indications regarding nanomaterials if the name of the product gives an indication on this.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

To data information on particle distribution in the nanometer range is not included in minimal data set for the notification of new chemicals. If a new chemical would contain nanomaterials it would have been assessed according to the methodology for “normal” chemicals.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

The present regulatory system is not aligned to the specific properties of natomaterials. Effect and fate characteristics are not assessed in dependency of the size of a chemical. There is a need for harmonised definitions, nomenclature and characterisation. Furthermore the methodology for hazard identification, exposure assessment and risk assessment used for chemicals should be reviewed carefully in the light of its applicability for nanomaterials.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research

related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

There are several research activities ongoing or planned. Some results are already published:

Publishes research projects:

a. ROTHEN-RUTISHAUSER, B.M., KIAMA, S.G. and GEHR, P.A three dimensional cellular model of the human airway barrier with epithelial cells, macrophages and dendritic cells to study the interplay of these cells during particle uptake. *Amer. J. Respir. Cell Molec. Biol*. 32: 290-300, 2005;
b. GEISER, M., B.M. ROTHEN-RUTISHAUSER N. KAPP, S. SCHÜRCH, W. KREYLING, H. SCHULZ, M. SEMMLER, V. IM HOF, J. HEYDER, and P. GEHR. Ultrafine particles cross cellular membranes by non-phagocyticv mechanisms in lungs and in cultured cells. Environmental Health Perspectives. 2005 (accepted). http://ehp.niehs.nih.gov/docs/2005/8006/abstract.html ;
c. W.J. Stark et al., Oxide Nanoparticle Uptake in Human Lung Fibroblasts: Effect of Particle Size, Agglomeration and Diffusion at Low Concentration. Environmental Science and Technology (2005) (accepted).

Ongoing and planned research projects:

Nanorisks: Safety and Risks of Carbon Nanotubes (CNT). Aims: to present the status quo of existing knowledge and uncertainties regarding safety and risks of CNT; to performe research to obtain toxicological in vitro data for hazard identification, to identify the CNT toxicomechanism, to perform a forsight ofwhich potential problems that can arise in order to be able to take precautionary measures right during the R&D process. The work is carried out by the Swiss materials science & technology institute (EMPA)

Cyto-toxicity of nanoparticles. Aims: Identification of early toxicology indicator for nanoparticle containing consumer products and elucidations of major parameters governing nanoparticles toxicology with a focus on oxide nanoparticles. The work is carried out by W. Stark ETH Zurich.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Within the test guideline program OECD should be active in the development of hazard identification and exposure assessment methodology

UNITED KINGDOM

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

The UK have established a national standardization committee in the area (NTI/1). NTI/1 recognises that robust, and meaningful, control of the risks posed by nanotechnologies, will depend upon the existence and use of well founded standards in metrology and test/characterization methods in the area. In order to ensure the efficient development of meaningful and implementation of viable, scientifically based regulation for manufactured nanomaterials, NTI/1 encourages OECD and ISO to quickly establish a memorandum of understanding to cover this important technology area.

The UK Government commissioned PAS 71 - vocabulary for nanoparticles - which was published in June 2005 (available at http://www.bsi-global.com/Manufacturing/Nano/index.xalter). The scope of this document was carefully defined and it does not purport to be, and neither is there an intention to produce a separate, nomenclature for either nanoparticles or for nanomaterials in general.

The UK proposed and subsequently chaired the CEN Technical Board Working Group 166 on nanotechnologies, which delivered a strategy for European standardization to CEN/BT in June 2005 (recommendations attached).

The UK put forward a proposal (attached), and now provide the chair and secretary for the newly established ISO/TC 229 on nanotechnologies. The UK is currently formulating its needs and priorities for standardization, which will be submitted to the inaugural meeting of the ISO committee in November or very soon thereafter. Work is ongoing to define the scope and structure for approval at the first meeting, though it is likely that the preferred format will be to cover three areas:

- Terminology and nomenclature,
- Health, safety and the environment,
- Metrology and test methods.

The UK supports international action on standardization for nanotechnologies through ISO, and also recognises the possibility of action at a regional level and therefore fully supports the proposal of CEN/BT WG 166 for the establishment of a CEN Technical Committee in the area to address specific European needs, particularly in the area of regulation.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

UK chemicals regulation stems from agreement at the EU level. There are currently two key pieces of legislation, the Existing Substances Regulation (ESR) and the Notification of New Substances regulation

(NONS). It is likely that these will be repealed in 2007, to be replaced by a new Regulation known as REACH.

ESR aims to ensure the collection of available data, filling data gaps and assessment of selected substances (from EINECS) manufactured in quantities in excess of 10 tonnes per year.

NONS deals with new substances, that were first marketed since September 1981 (and therefore are not covered under ESR). This requires a notification be prepared and provided to the Competent Authority by the manufacturer. The amount of data is tonnage dependent, with very minimal data requirements commencing at 10kgs and increasing data requirements up to 1,000T per year.

Future management of chemicals in the EU (and therefore UK) will be regulated by the Registration, Evaluation and Authorisation of Chemicals regulation (REACH). Under REACH all chemicals (existing and new) will only need to be registered if they are produced or imported at levels of greater than one tonne.

Details of the regimes can be found at http://ecb.jrc.it/

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Defra, the Environment Agency and the Health and Safety Executive have funded a study of the landscape of current and emerging nano-scale material production, import and use in the UK (We will forward the report when it is finalised). This information is to be included in a publicly accessible online database (details of how to access this to follow when it is finalised). The database and report are to be peer reviewed by a range of key stakeholders and experts.

Information is also available in a directory on the Micro and Nanotechnology Network (MNT) at: www.microandnanotech.info/ and from the Institute of Nanotechnology at: www.nano.org.uk/.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

In 1993, a substance, reported to be containing up to 10% nano-scale material, for use in teaching establishments as a teaching aid, was notified under the regulations in force at the time (Notification of New Substances (NONS) Regulation 1993). This notification was unusual in that an advert for the material was spotted by a chemist in NONS team, and given it was decided that the substance contained an allotrope of the substance, the supplier submitted a notification. Given the anticipated level of supply (<1 kg) recorded, it is unclear from the electronic record why a notification was required given that the cut-off for notification for the intended use of this substance is 10 kg /annum. Given the low amounts intended to be available for supply, the lowest level of notification available in 1993 was made. Other than a description of the material, the expected level of supply (<1kg/annum) and its intended use, no other information was submitted or requested. It was agreed, in accordance with the regulations in force at that time, that the substance was to be labelled "Caution - substance not yet fully tested".

More recently Health and Safety Executive (HSE) has had an enquiry regarding the need to notify the aforementioned nano-scale material. This issue is under consideration within the EU.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

The Environment and Chemicals
The Department for Environment, Food and Rural Affairs (Defra) are funding a review of environmental regulatory gaps. The project is due to start at the began in September 2005 and will report in mid-November 2005. The final report of the study will be completed in November 2005 and will published on the Defra website in early 2006 (we will forward the final report when completed).

The review will cover regulations relating to:

- industrial emissions;
- waste management;
- environmental contamination and remediation;
- emissions to water from industrial use;
- transport emissions; and
- chemicals manufacture and marketing, including pesticides.

This is likely to cover most aspects, but the study is not limited to these regulatory areas if others of relevance are identified.

The lack or absence of evidence of any risks of pollution to the environment or harm to human health or the health of animals and plants, associated with nanotechnologies, means that in the UK the Government cannot take action under Section 140 of the Environment Protection Act. This allows the Secretary of State to make regulations to prohibit or restrict the importation, use, supply or storage of injurious substances or articles.

In an EU context, the Government response to the RS/RAEng report[36] sets out the Government's view of the situation relating to REACH (key phrases in bold):

> *"The Registration, Evaluation and Authorisation of Chemicals (REACH) proposal is currently being negotiated at European level, and is expected to replace existing chemicals legislation within two to three years. Central to the new legislation is the requirement that chemicals should only be registered at production or importation levels greater than one tonne per annum and the Government believes that this is an appropriate trigger level for conventional chemicals. For some applications of nanotechnologies it is, however, possible that substances may be produced or imported in a commercial setting at levels below this current threshold. But, to reduce the threshold dramatically to take account of potential issues arising from nanotechnologies would result in a large number chemicals (in addition to the products of nanotechnologies) that are not being produced on an industrial scale being subject to regulations designed for industrial products.* ***As a result, and to ensure that the products of nanotechnologies are properly regulated in line with this recommendation, the Government considers it likely that regulations, in addition REACH, may be required,*** *and this will be a key question addressed in the study initiated into Recommendation 8.* ***In this context, it is important to note that any new regulations could be implemented independently of REACH, and would require development at European level****."*

36. HM Government, Response to the Royal Society and Royal Academy of Engineering report: 'Nanoscience and nanotechnologies: opportunities and uncertainties', DTI, London, February 2005. Available at: http://www.ost.gov.uk/policy/issues/index.htm. Paragraph 54, with the last line amended to reflect current thinking.

Food Safety

The Food Standards Agency (FSA) is carrying out a review of regulations in its area of responsibility to identify any gaps and, where these are identified, to identify options and proposed actions to address them. The review should be complete by September 2005, with publication of a report likely in October 2005.

The Advisory Committee on Novel Foods and Processes held a preliminary discussion on nanoparticles in food at its meeting on 26 January 2005. The paper (ACNFP/70/4) and minutes are available on the Agency's website[37]. The Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT), the Committee on Carcinogenity of Chemicals in Food, Consumer Products and the Environment (COC), and the Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment (COM) have all had some discussions on generic issues related to nanomaterials. Papers and minutes are on the committee websites. The most recent discussion was at COT on 12 July 2005[38]

The information from this review will depend to some extent on the responses received, but it is intended to:

- Cover how current regulations and regulatory processes would address manufactured nanomaterials.
- Identify any gaps.
- Identify options to address any gaps and any current or planned actions in the UK or internationally to address them. (As nearly all food regulation is determined at EU level, actions are likely to focus at this level.)

The FSA is also gathering information on corresponding gaps in the risk assessment processes and options and actions to address them. Food regulation in many areas is closely linked to risk assessment (e.g. in approval of 'novel' foods and processes) so it seems sensible to consider them together.

Health & Safety

The Health and Safety Executive (HSE) has reviewed the adequacy of the regulatory framework to address potential concerns for health and safety in the workplace arising from the supply, use and production of nanomaterials. A report will be available in autumn 2005. The focus of the review was substances in the form of nanomaterials, with a particular focus on nanoparticulates.

The relevant regulations are:

- CHIP - Chemicals (Hazard Information and Packaging for Supply) Regulations;
- COMAH - Control of Major Hazards;
- COSHH - Control of Substances Hazardous to Health Regulations;
- ESR - Existing Substances Regulations;
- NONS -The Notification of New Substances Regulations; and
- PPEW - The Personal Protective Equipment At Work Regulations.

The review indicates that supplied substances containing nanomaterials are within the scope of the various supply-side regulations. These and other regulations require information on hazardous substances in

37. http://www.food.gov.uk/science/ouradvisors/novelfood/acnfpmeets/acnfpmeet2005/acnfpmeet26jan05/

38. Draft minutes at: http://www.food.gov.uk/science/ouradvisors/toxicity/cotmeets/cot_2005/281778/

whatever form to be transmitted to the user/employer, and that employers assess the risks from exposure to hazardous substance, and if necessary, control or manage those risks.

In conclusion, in principle the current regulations apply to nanomaterials, but changes may need to be made to fine-tune the regulatory framework as more is known about the hazards posed by these substances.

Medical Devices and Medicines

The Medicine and Healthcare products Regulatory Agency (MHRA) is of the view that the existing regulations for medical devices and medicines are sufficiently broad in scope to cover risks associated with nanotechnology[39].

MHRA is organising a conference on 27 October 2005 in London, entitled: "Nanotechnology: Impact on Health and Regulation", aimed at informing healthcare sector stakeholders about nanotechnology implications.

A sub-group was created at the European Commission's Medical Devices Expert Group (MDEG) meeting on 6 July 2005 that will look into new, emerging and converging technologies, taking nanotechnology as one of its first subjects. This group will look into whether the current regulatory regime at a European level suffices to address the risks posed by nanotechnologies used in medical devices.

The Committee for Medicinal Products for Human Use (CHMP), the main expert advisory committee of the European Agency for the Evaluation of Medicinal Products (EMEA), will discuss the potential risk implications of nanotechnology use in medicines and whether anything needs to be done in a future meeting.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

The Nanotechnology Research Coordination Group (NRCG) (of UK Government departments, regulatory agencies and research councils) has the aim of identifying research priorities in the area of identification, assessment and control of risks posed to the environment and human health by nano-scale materials and coordinating research activity to fill these gaps.

As part of this process the NRCG is producing a report of research gaps and priorities which will be published towards the end of 2005. This was a commitment in the Government's Response (at www.ost.gov.uk/policy/issues/nanotech_final.pdf) to the Royal Society and Royal Academy of Engineering Report "Nanoscience and nanotechnologies: opportunities and uncertainties" (at www.nanotec.org.uk/finalReport.htm).

The NRCG report will set out the science and social science research priorities and our plans for addressing these, including funding issues, research capacity and international collaboration. The report will be based on a range of evidence including two scoping studies, looking at hazard data gaps and exposure data gaps. The final reports of these two studies are undergoing peer review including by the Advisory Committee on Hazardous Substances (ACHS, at:

39. This position is publicly available at: http://devices.mhra.gov.uk/mda/mdawebsitev2.nsf/webvwSearchResults/78BDA6BD0D707D4980256FA900315CED?OPEN

www.defra.gov.uk/environment/chemicals/achs/). We will forward the scoping study reports when they are finalised. Stakeholder views are also being incorporated into the NRCG report, with two general stakeholder meetings held to discuss the planning and draft of the report, We will forward the NRCG report when it has been cleared for publication.

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Yes, we feel that it is an appropriate forum. Issues to focus on are:

- International collaboration and coordination of research effort on identification, assessment and management/control of risks posed by nano-scale materials, including social and ethical dimensions.
- International harmonisation and standardisation of methods for the identification and assessment of risks in particular for hazard and exposure data.
- And, as a longer term goal, the international harmonisation of control and regulatory frameworks to allow for sustainable, consistent and appropriate development of nanotechnologies

UNITED STATES

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

Most United States government agencies involved with development or oversight of nanotechnology are participating in the development of international standards in nanotechnology. They are members of the ANSI Nanotechnology Standards Panel, the US Technical Advisory Group to ISO Technical Committee 229 (Nanotechnology) and the ASTM E56 Committee on Nanotechnology.
EPA's Office of Pollution Prevention and Toxics (OPPT) has been identifying policy issues such as: whether certain nanoscale materials are considered new or existing chemicals under the Toxic Substances Control Act (TSCA), research needs for characterization, risk assessment and mitigation of nanomaterials, and preparing for review of new chemical notices of nanoscale materials under TSCA.

OPPT has reviewed four New Chemical Notices for nanoscale materials to date under TSCA. OPPT has permitted limited manufacture of one notice for a carbon nanotube after review. Other reviews are pending. OPPT will continue to review of New Chemical Notices of nanoscale materials as received. An increasing number of notifications are expected in FY 06.

OPPT is developing a Voluntary Notification Program for nanoscale materials under TSCA in FY 06. OPPT held a public meeting on June 23 to receive public input on elements of the voluntary program. OPPT is working with an advisory body, the National Pollution Prevention and Toxics Advisory Committee (NPPTAC) to receive input on issues regarding the voluntary program. OPPT hopes to announce the voluntary program by the end 2005.
Many US regulatory agencies use some form of the following definition for "nanotechnology":
Research and technology or development of matter that involve all of the following:

1. the existence of materials or products at the atomic, molecular or macromolecular levels, where at least one dimension that affects the functional behavior of the drug/device product is in the length scale range of approximately 1-100 nanometers;

2. the creation and use of structures, devices and systems that have novel properties and functions because of their small size; and,

3. the ability to control or manipulate the product on the atomic scale.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

Reporting of New and Existing Chemicals under TSCA to EPA.
Reporting of Fuel Additives under Section 211 of the Clean Air Act to EPA.
Registration of Pesticide products under FIFRA.
Registration of Drugs by the Food and Drug Administration.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Nanoscale materials are used in electronic, magnetic and optoelectronic, biomedical, pharmaceutical, cosmetic, energy, catalytic and materials applications. Areas producing the greatest revenue for nanoparticles reportedly are chemical-mechanical polishing, magnetic recording tapes, sunscreens, automotive catalyst supports, biolabeling, electro conductive coatings and optical fibers.

Most computer hard drives contain giant magneto resistance (GMR) heads that, through nano-thin layers of magnetic materials, allow for an order of magnitude increase in storage capacity. Other electronic applications include non-volatile magnetic memory, automotive sensors, landmine detectors and solid-state compasses. Nanomaterials, which can be purchased in dry powder form or in liquid dispersions, often are combined with other materials today to improve product functionality. Additional products, available today, containing nanoscale materials, include:

• Step assists on vans
• Bumpers on cars
• Paints and coatings to protect against corrosion, scratches and radiation
• Protective and glare-reducing coatings for eyeglasses and cars
• Metal-cutting tools
• Sunscreens and cosmetics
• Longer-lasting tennis balls
• Light-weight, stronger tennis racquets
• Stain-free clothing and mattresses
• Dental-bonding agent
• Burn and wound dressings
• Ink
• Automobile catalytic converters.

One of the most innovative new products is one that enhances biological imaging for medical diagnostics and drug discovery. Quantum dots are semi-conducting nanocrystals that, when illuminated with

ultraviolet light, emit a vast spectrum of bright colors that can be used to identify and locate cells and other biological activities. These crystals offer optical detection up to a thousand times brighter than conventional dyes used in many biological tests, such as MRIs, and render significantly more information.

The latest display technology for laptops, cell phones, digital cameras and other uses are made of nanostructured polymer films. Known as OLEDs, or organic light emitting diodes.

Nanoparticles are used in catalysis, where the large surface area per unit volume of nanosized catalysts enhances reactions. Greater reactivity of these smaller agents reduces the quantity of catalytic materials necessary to produce desired results. The oil industry relies on nanoscale catalysts for refining petroleum, while the automobile industry is saving large sums of money by using nanosized – in place of larger – platinum particles in its catalytic converters.

Because of their size, filters made of nanoparticles also have been found to be excellent for liquid filtration. Several products are now available for large-scale water purification that can take out the tiniest bacteria and viruses from water systems, in addition to chemicals and particulate matter.

For further information go to: http://www.nano.gov/html/facts/appsprod.html

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

EPA has reviewed/is reviewing several substances as nanomaterials that were submitted to EPA as new chemicals under TSCA. Confidential Business Information issues preclude any detailed description of the substances. At least one of the substances was a carbon nanotube. EPA suspects other substances that are "nanotechnology" or nanomaterials have been reviewed as new chemicals under TSCA, however new chemical submissions do not have to be identified as "nanotechnology" or nanomaterials.
EPA has permitted manufacture of the carbon nanotube under limited conditions. The reviews of the other known nanomaterials are pending.

Reviews involved standard methodology but at this point EPA scientists and reviewers are taking a cautious approach, as it is not known to what extent the standard methodology is applicable to nanomaterials. The most exceptional issue for all of these reviews is determining to what extent that current risk assessment methods, risk mitigation techniques, and toxicity/fate testing are applicable to nanomaterials.

Additives to gasoline and diesel fuel are required to be registered by EPA under the Clean Air Act. The manufacturer of a diesel additive containing cerium oxide has applied for registration and represents this additive as being based on nanotechnology. The manufacturer operated an engine on diesel fuel containing the additive and identified the compounds in the exhaust. Cerium oxide was the only compound found in the exhaust that is not found in the exhaust of conventional diesel fuel. The manufacturer conducted a literature search for information on the health effects of cerium oxide and submitted that information, and a summary, to EPA. That information is under review in order to determine whether further data development will be required.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

EPA's Office of Pollution Prevention and Toxics (OPPT) has been identifying policy issues such as whether certain nanoscale materials are considered new or existing chemicals under the Toxic Substances Control Act (TSCA). Chemicals with molecular identities not listed on EPA's TSCA inventory are subject to new chemical notification and review provisions.
EPA is considering developing a Voluntary Reporting Program for nanoscale materials under TSCA. EPA already has taken steps to obtain public feedback on issues, alternative approaches, and decisions. The information derived from a pilot program will allow EPA and the affected industry to better understand the issues with respect to potential risks and for EPA to gain experience in the characterization and assessment of such types of chemical substances.

Until adequate nomenclature conventions are developed, it will be difficult to determine in some instances if the use of a nanoscale material results in a change to a pesticide product already registered under FIFRA.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

1) ***Principles for Characterizing the Potential Human Health Effects from Exposure to Nanomaterials: Elements of a Screening Strategy***

The object of the RSI Nanomaterial Toxicity Screening Working Group was to identify the key elements of a toxicity screening strategy for engineered nanomaterials. The group considered potential effects of exposure to nanomaterials by inhalation, dermal, oral, and injection routes; discussed how mechanisms of nanoparticle toxicity may differ from those exhibited by larger particles of the same substance; and identified significant data needs for designing a robust screening strategy.
You can download the paper from:
http://www.particleandfibretoxicology.com/

2) ***The National Nanotechnology Initiative (NNI)***

The NNI was launched in 2001 to coordinate nanotechnology research and development across the federal government. Twenty-four federal agencies currently participate in the NNI, eleven of which have budgets dedicated to nanotechnology research and development. Nine federal agencies are investing in implications research including the National Science Foundation, the National Institutes of Health, the National Institute of Occupational Health and Safety (NIOSH), and the EPA. Attached as ANNEX A is further details on the research sponsored by NIOSH For further information on the activities of other agencies attached is a paper, titled Research Strategies for Safety Evaluation of Nanomaterials, published in Toxicological Sciences 87(2), 316-321 (July 27, 2005).
During the fiscal year 2005, the Nanoscale Science, Engineering, and Technology Subcommittee of the National Nanotechnology Initiative formally established the Nanotechnology Environmental and Health Implications (NEHI) Working Group to:

- provide for exchange of information among agencies that support nanotechnology research and those responsible for regulation and guidelines related to nanoproducts (defined as engineered nanoscale materials, nanostructured materials or nanotechnology-based devices, and their byproducts);

- facilitate the identification, prioritization, and implementation of research and other activities required for the responsible research and development, utilization, and oversight of nanotechnology, including research methods of life-cycle analysis; and

- promote communication of information related to research on environmental and health implications of nanotechnology to other Government agencies and non-Government parties.

3) ***EPA's Science Policy Council White Paper***

The EPA Science Policy Council White Paper on Nanotechnology will describe the science policy issues that EPA is addressing now, and will address in the future, regarding the potential environmental benefits and impacts of nanotechnology. It also recommends actions the Agency should take to best position its research program to address nanotechnology. In particular, the paper discusses what scientific information EPA will need, and how it will use that information, to address nanotechnology in environmental decision-making. It is currently scheduled to be issued in January 2006.

4) ***EPA's Office of Research and Development (ORD), the National Center for Environmental Research (NCER).***

Since 2001 through the Science to Achieve Results program, ORD has funded 39 research grants for more than $11 million in the applications of nanotechnology to protect the environment, including the following: development of low-cost, rapid, and simplified methods of removing toxic contaminants from surface water; new sensors that are more sensitive for measuring pollutants; green manufacturing of nanomaterials; and more efficient, selective catalysts. Additional projects have been funded through the Small Business Innovative Research (SBIR) program. In addition, 14 recent projects focus on studying the possible harmful effects of manufactured nanomaterials; i.e., toxicity; fate, transport, and transformation; and exposure and bioaccumulation. NCER has awarded or selected 32 grants to date in this area, totaling $10 million. The most-recent research solicitations include partnerships with the National Science Foundation, the National Institute for Occupational Safety and Health, and the National Institute for Environmental Health Sciences. Research areas of interest for this proposal include the toxicology, fate, transport and transformation, bioavailability, human exposure, and life cycle assessment of nanomaterials.
For more information and details on these grants please go to http://es.epa.gov/ncer/nano/

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

The OECD could support existing work on characterization and definition of nanomaterials. It could encourage OECD members to adopt common standards for characterizing and defining nanomaterials.

The OECD could continue its work in harmonizing testing guidelines to adopt any necessary changes for testing of nanomaterials.

The OECD could coordinate nanotechnology health and safety research among member countries.

The OECD could coordinate regulatory activities pertaining to nanotechnology among member countries.

EPA's Office of Research and Development (ORD), the National Center for Environmental Research (NCER).

Since 2001 through the Science to Achieve Results program, ORD has funded 39 research grants for more than $11 million in the applications of nanotechnology to protect the environment, including the following:

development of low-cost, rapid, and simplified methods of removing toxic contaminants from surface water; new sensors that are more sensitive for measuring pollutants; green manufacturing of nanomaterials; and more efficient, selective catalysts. Additional projects have been funded through the Small Business Innovative Research (SBIR) program. In addition, 14 recent projects focus on studying the possible harmful effects of manufactured nanomaterials; i.e., toxicity; fate, transport, and transformation; and exposure and bioaccumulation. NCER has awarded or selected 32 grants to date in this area, totaling $10 million. The most-recent research solicitations include partnerships with the National Science Foundation, the National Institute for Occupational Safety and Health, and the National Institute for Environmental Health Sciences. Research areas of interest for this proposal include the toxicology, fate, transport and transformation, bioavailability, human exposure, and life cycle assessment of nanomaterials.

EC

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

CEN has launched a consultation of their national members for the creation of a new Technical Committee (TC) on nanotechnologies. If created this TC would include standards for terminology, classification, measurements, health, safety, environment, products and processes. The Secretariat would perhaps be allocated to BSI (UK). The CEN Technical Board (TB) has not yet decided if this will be installed. This will be discussed during the next TB-meeting on the 29th November 2005. In this respect an opinion from the Commission is also sought.

ISO has confirmed the establishment of TC 229 Nanotechnologies with BSI providing the secretariat and with BSI as chair and secretariat. The inaugural meeting will take place in central London on 9 - 11 November. Currently there are 23 "P" members (including all of the main players - US, Japan, China, Korea, Germany, France, UK, etc, etc) and 7 "O" members.

The Vienna Agreement *Guidelines for implementation of the Agreement on technical co-operation between ISO and CEN*[40] rules the mutual acceptance of standards/norms between CEN and ISO in relation to terminology, classification, sampling, measurements, processes, and process control. The agreement sets out two essential modes for collaborative development of standards: the mode under ISO lead and the mode under CEN lead, in which documents developed within one body are notified for the simultaneous approval by the other.

Moreover, there are two different types of standards: performance standards/norms, and descriptive standards/norms. Descriptive standards/norms are e.g. standardised/normalised sampling and measurement procedures that are described in details, while performance standards/norms specify acceptance criteria based on the performance of such methodologies. Any methodology would be accepted when it can be demonstrated that the standardised performance criteria are adhered to. This would provide more flexibility for all parties involved and would allow keeping up with the current speed of developments such as new

40. ISO Council Resolution 35/2001 & CEN Administrative Board Resolution 2/200

analytical methods and sampling approaches that would appear from research projects such as those supported within the 6th and 7th Framework Programme of Research.

From a regulatory risk management perspective the CEN/ISO activities will need to be complemented. For example, in the field of chemicals, development of test methods in relation to e.g. hazard identification and hazard characterisation could be better performed under the OECD-umbrella, given their expertise and experience in the chemicals regulatory area. The OECD test guidelines and guidance for the testing of chemicals are widely accepted, also within the EU. Also, the incorporation of the harmonised/standardised sampling and measurement techniques and/or acceptance criteria that forms an integral part of risk assessment methodologies could be better performed by OECD.

In both cases industry, regulatory and enforcement bodies would benefit from internationally agreed methodologies facilitating trade and regulation.

In the context of the two European Commission Communications *Towards a European Strategy for Nanotechnology*[41] and the *Action Plan on Nanosciences and Nanotechnologies 2005-2009*[42] the Commission supports pre-normative R&D for Nanosciences and Nanotechnology in synergy with the activities of European Standards Bodies.

The Commission had a call for proposals open until 15 September 2005[43], which identifies as specific target activities related to standardisation. In this call "the standardisation needs for Europe should be reviewed in consultation with key stakeholders so as to facilitate industrial take up and development by providing harmonised quality standards and measurement techniques. The expected project should have the objective of identifying measurement tools and standards, as well as priorities for pre-normative research and elaborating a standards foresight and roadmap for nanotechnology. Participation of research teams from all over the world is encouraged, according to rules, as well as the participation of industry and standardisation bodies."

Further information can be found at http://fp6.cordis.lu/nmp/call_details.cfm?CALL_ID=182

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

The European Commission is currently compiling an inventory of existing legislation that potentially may apply to nanomaterials.

Chemicals legislation

There are a number of EU legislations regarding chemical substances[44], preparations and products. Some general frameworks are the *Existing Substances Regulation* (Regulation (EEC) No. 793/93) on the

41. COM(2004)338

42. COM(2005(243)

43. [FP6-2004-NMP-NI-4]

44. Definition of substance: "Substance means a chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition"

evaluation and control of the risks of existing substances and the *Dangerous Substances Directive* (Dir. 67/548/EEC), covering classification and labelling of substances in general and, through its amendments, providing for a pre-marketing notification system for New Chemicals. Risk management, including request for information and risk reduction measures, may be triggered by e.g. classification of substances and risk assessments.

The Directive 67/548/EEC requires all new substances introduced on the market in a volume of *10 kg/year or more* to be notified. The purpose is to provide information on chemicals, to allow for classification and labelling and safe handling and use. The Directive contains information requirements for different tonnage intervals (tiered testing) in the Annexes. Full notification dossiers are required for substances produced in volumes from 1 tonnes per year, and allow for risk assessment to be performed, followed by risk reduction strategies where necessary.

Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and control of the risks of existing substances[45] involves the data reporting, priority setting, risk evaluation and, where necessary, development of strategies for limiting the risks of existing substances. The regulation obliged industry to report data (for production volumes above 10 tonnes/year) and update information on significantly new uses. Priority lists have been published for substances to go through a Community risk assessment and risk reduction strategy are developed where appropriate. The regulation can also require industry to provide additional testing or information if data is lacking. A prerequisite is that the substance is on a priority list or for any other Einecs[46] substance, that there is a valid reason for believing that the substance may present a serious risk to man or the environment.

Classification and labelling criteria have been laid down in Annex VI of Directive 67/548/EEC. Guidance for risk assessment of new and existing substances as well as biocides has been provided in the Technical Guidance Documents (TGD), and a computerised risk assessment tool, the EU System for Evaluation of Substances (EUSES) is used. Furthermore guidance for development of Risk Reduction Strategies is available. It needs to be investigated if and how the current legislation and implementation tools for new and existing chemicals may be applied to ensure that possible risks of nanoparticles are adequately addressed at an early stage.

The current legislative framework will be replaced by *REACH*, the proposed Regulation concerning the Registration, Evaluation, Authorisation and Restrictions of Chemicals. The provisions of REACH shall apply to the manufacture, import, placing on the market or use of substances on their own, in preparations or in articles, if so stated. Any substance that is produced or imported in annual volumes of at least *1 tonne/year and manufacturer has to be registered*. No registration for polymers (monomer less than 2%w/w) and on-site isolated intermediates.

Any risk to man, including workers and consumers, and to the environment will be covered by REACH. If the annual volume is ≥ 10 tonnes, mandatory preparation of a chemical safety report (CSR) which contains chemical safety assessments (CSA) for each identified use is required. A CSA shall include the following steps in accordance with the respective sections of this Annex: human health hazard assessment, human health hazard assessment of physicochemical properties, environmental hazard assessment, PBT and vPvB assessment. If as a result of these steps the manufacturer or importer concludes that the substance or the preparation meets the criteria for classification as dangerous according to Directive 67/548/EEC or Directive 1999/45/EC or is assessed to be a PBT or vPvB, the CSA shall also consider the following steps:

45. OJ L 84, 5.4.1993, p.1.

46. European Inventory of Existing commercial chemical substances OJ C146A, 15.6.90). Substances in this inventory were on the EU market in the 10 year period before 18 September 1981

exposure assessment and risk characterisation. The main element of the exposure part of the CSR is the description of the manufacturer's or importer's exposure scenario(s) and the exposure scenario(s) recommended by the manufacturer or importer to be implemented for the identified use(s). The exposure scenarios contain a description of the risk management measures which the manufacturer or importer has implemented and recommends to be implemented by downstream users. If the substance is placed on the market, these exposure scenarios including the risk management measures shall be summarised in an annex to the safety data sheet in accordance with Annex IA. Nanoparticles having different hazard properties than the "bulk" substance would require individual treatment under REACH.

Worker protection

The most important piece of legislation in the area of health and safety at work is the Framework Directive 89/391/EEC "on the introduction of measures to encourage improvements in the safety and health of workers" to ensure a higher degree of protection of workers at work.
The model for health and safety management in the Framework Directive places *prevention* in a central position. Equally important are the provisions regulating the *obligations of the employers* for planning, organising and regulating the protection of workers at work. The employer is obliged to make an a priori overall risk assessment and to undertake measures to prevent occupational risks; in the first place to combat risks at source either by eliminating/avoiding or, if not possible, by taking the appropriate control measures in order to reduce them (e.g. selecting personal protective equipment (Directive 89/656/EEC) .
In the case of nanotechnologies the risks are neither known nor predictable; further research should be carried out in order to evaluate the risks they could entail to the health and safety of the workers. Methods for risk assessment in relation to worker protection need to be developed and made available to the employers.
In addition to the Framework Directive, there are two other Directives that could be applied, namely: 1/ Council Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) and 2/ in case any nanoparticle would be shown carcinogenic or mutagenic, Council Directive 1999/38/EC of 29 April 1999 amending for the second time Directive 90/394/EEC on the protection of workers from the risks related to exposure to carcinogens at work and extending it to mutagens, could be applicable

Consumer protection

For consumer products there is no trigger limit. Generally a consumer product having undergone an industrial manufacturing process has to be reasonably safe before it is introduced on the market independently of the quantity produced.

Many different regulation concerns the free movement of consumer products within the Community. It goes from regulation on textile, where mainly the manufacturer has to check that his products are safe, to the regulation of pharmaceutical products where very strict procedure are in place to give the possibility to competent authorities to control the safety of the products. All those regulations are requesting the highest reasonable standards for user safety as far as risks related to the products are known (not always known for nanotechnological components). All the regulations imply that the Member states have the duty to maintain market surveillance and can under specific conditions forbid the entrance on their national market if it considers the product as too hazardous for the health of its citizens.

Following those regulations the manufacturers have always to do, implicitly or explicitly, a risk assessment before placing a product on the market. This is sometime very difficult for products including nanotechnological components.

Environment legislation

A preliminary assessment of legislation to protect environment (air, water, waste, chemical accidents etc.) shows that a number of legislative acts *in principle* would cover nanoparticles that pose a risk to human health and the environment. However, as a trigger either a risk assessment or a classification according to the chemicals legislation is normally required to demonstrate their hazard/risk. Often existing triggers are expressed in mass concentrations.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

The European Commission has so far not made a general inventory of the planned uses, apart from in the area of pharmaceutical products and medical devices. In those areas it was found that more than forty products are already on the market in Europe. They all had to undergo a very strict procedure to get a market authorisation. The procedures are so strict that they are fully sufficient to ensure the safety of the user. Those products are mainly for Nano Drug Delivery Systems (e.g. cancer therapies), Nanotechnology Based Drugs and Therapies (e.g. Alzheimer or cancer therapies) and Tissue Engineering. An inventory of companies active in those areas is in preparation; there are more currently more than a hundred active in Europe. For reference see: ftp://ftp.jrc.es/pub/EURdoc/eur21000en.pdf .

Several types of nanoparticles have been produced at industrial scale such as carbon black and synthetic amorphous pyrogenic silica particles. Moreover, another class of nanoparticles characterised by a large market are metal oxides such as titanium dioxide (TiO_2) and alumina (Al_2O_3). Some products containing nanoparticles/materials existed as early as 1979 for precipitation processes, particles, coatings, surfaces, or a combination of these (e.g. metal objects coatings could be achieved involving co-polyamides and silicic acid particles with a size of as low as 7nm to 18nm. Patent holder: Huels Chemische Werke AG, DE – n°EP0004859; other nanoparticles/materials include graphite particles used in steel treatments and for lubricants). However, these materials/particles were those days frequently called "*micro micron sized particles (i.e. one-millionth of a micron)*" and their production levels were most probably very low. Moreover, the particle/materials size ranges were most probably larger compared to today given the dramatic improvement in the production technologies.

Some overall figures on uses of nano-materials, taken from publications of European Technology Platforms, are presented in the Annex (see Index).

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

No, except for pharmaceutical products and medical devices.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

Research and development in this area is needed to obtain internationally agreed "working definitions, characterisations and nomenclature", including exposure (i.e. sampling and measurement approaches & certified reference materials), bioassays (i.e. screening techniques), and toxicity tests. Internationally agreed minimum acceptance criteria for these approaches are needed to allow development of new and improvement of current techniques. The work needs therefore to be linked with OECD-and ISO/CEN-activities.

There is a need to evaluate the applicability of current chemicals test guidelines and risk assessment methods and tools for risk management of nanomaterials. The EU Scientific Committee on Emerging Risk will provide its first scientific opinion on this issue by mid October in relation to nanotechnologies

In summary: main R&D needs identified from a regulatory perspective:

- nomenclature, definitions, physicochemical characterization and properties of nanomaterials (particle size, particle surface characteristics, substances on particle surface, particle charging, agglomeration characteristics including kinetics, solubility etc.);
- hazard characterisation;
- exposure and effects assessment;
- fate, transport, persistence etc. in environmental media;
- measurement, sampling and monitoring;

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

The Action Plan aims at boosting support for collaborative R&D into the potential impact of nanomaterials on human health and the environment via toxicological and ecotoxicological studies as well as developing appropriate methodologies and instrumentation for monitoring and minimising exposure in the workplace.

In this context, the Commission has already funded different projects which are listed below. These are projects under previous Framework Programmes and deal specifically with risks related to manufactured nanoparticles:

FP5 (projects already completed)

- *Nanoforum*

Nanoforum is an EU sponsored Thematic Network which provides a source of information on nanotechnology to the business, the scientific and social communities.
In June 2004 they issued a report that includes a review of the potential risks of nanotechnology (Benefits, Risks, Ethical, Legal and Social Aspects of Nanotechnology). Find more information at http://web6.vdi.net-build.de/

- *Nanosafe*

Title: Risk assessment in production and use of nanoparticles with the development of preventive measures and practice codes.
This completed project has produced a detailed report available at
http://www.vdi.de/vdi/organisation/schnellauswahl/techno/arbeitsgebiete/zukunft/sub/10803/index.php

- *Nanoderm*

Title: The quality of Skin as a barrier to Nanoparticles.
More information on this completed project is available at www.uni-leipzig.de/~nanoderm

- *Nano-pathology*

Title: The role of micro and nanoparticles in biomaterial-inducing pathologies.
More information available at www.nanopathology.it

Some other projects focused principally upon air pollution but contributed to a better understanding of the toxicity of nanoparticles.

- *MAAPHRI* Multidisciplinary approach to airborne pollutant health related issues: modelization with combustion engine exhausts. http://www.aramis-research.ch/d/17569.html
- *AIRNET:* Network on Air Pollution and Health http://airnet.iras.uu.nl/index.html
- *HEPMEAP*: Health effects of particles from motor engine exhaust and ambient air pollution http://www.hepmeap.org/
- *ULTRA:* Exposure and risk assessment for fine and ultrafine particles in ambient air http://www.ktl.fi/ultra/

FP6 (ongoing projects)

- *Nanotox*

  Title "Investigative support for the elucidation of the toxicological impact of nanoparticles on human health and the environment"

  Objective: to provide support for the elucidation of the toxicological impact of nanoparticles on human health and the environment, investigating potential methods of dispersal and contamination by nanoparticles. Standards, legislation, ethical issues, policies and codes of practice, at international and European level will be assessed and reviewed. Guidelines and recommendations for the institution of future European standards, legislation, ethics, policies, and codes of practise, for the safe production and use of nanoparticles will be produced.

More information is available at http://www.impart-nanotox.org/

- *Impart*

  Title "Improving the understanding of the impact of nanoparticles on human health and the environment"
  Objective: to prevent knowledge of the health and environmental implications of nanoparticles from lagging behind the technological advances.

More information is available at http://www.impart-nanotox.org/

- *Nanosafe2*

Title: Safe Production and Use of Nanomaterials
Objective: The overall aim of NANOSAFE2 is to develop risk assessment and management for secure industrial production of nanoparticles
Further information can be accessed at http://www.nanosafe.org/

FP6 (ongoing call for proposals)

In line with the identified need "to promote safe and cost-effective measures to minimise exposure of workers, consumers and the environment to manufactured nano-scale entities ant to support a studies to evaluate current and future projected levels of exposure, evaluate the adequacy of current approaches to control exposure and launch appropriate initiatives, propose measures and/or issue recommendations", the Commission has launched a call for proposals, which closed on 15th September 2005.

The call addresses specifically the

"***Interaction of engineered nanoparticles with the environment and the living world"***
"Projects should address interdisciplinary toxicological and eco-toxicological research on as many aspects as possible of the interaction of nanoparticles with the environment and the living world, i.e. exposure, including intake, uptake, time scale; dose and response, including cellular and molecular mechanisms, bio-persistence, biokinetics, etc. Emphasis is to be put on a systemic view of exposure, dose and response to better understand the underlying molecular and bio-molecular phenomena."

Further information on this call is available at
http://fp6.cordis.lu/nmp/call_details.cfm?CALL_ID=182

More information will be available by the end of the year, after the proposals have been evaluated and selected.

Future activities: FP7

In its action plan the Commission has stated its will to reinforce N&N R&D in the European Union's seventh framework programme for research, technological development and demonstration activities (FP7) COM(2005) 119, and has proposed a doubling of the budget compared to FP6. Interdisciplinary R&D should be strengthened along the entire chain for knowledge creation, transfer, production and use.
In particular, the proposals for FP7 explicitly identify the need to support "…impact on human safety, health and the environment; metrology, nomenclature and standards;"

The Commission acknowledges that international cooperation in N&N is needed both with countries that are economically and industrially advanced and with those less advanced, in particular to address issues of mutual benefit at global level.

In this context a coordinated or joint call in the future between the European Commission and concerned agencies of the USA (such as EPA, NIOSH, NIEHS…) and similar institutions in other countries in the research area of (eco)toxicology of nanoparticles is currently under consideration.

Additional information on the European Commission activities on Nanotechnologies can be found at www.cordis.lu/nanotechnology

Other activities

DG RTD has carried out other activities such as the EC Workshop organised in January on Research Needs for Nanoparticles. In the proceedings of this workshop (available at http://www.cordis.lu/nanotechnology/src/pe_workshop_reports.htm), several recommendations related to toxicology and ecotoxicology were made.

There are several activities described under the umbrella of the European Technology Platform on Industrial Safety (ETIPS) (here: Nano Safety HUB & EC, Nanosafe2-project – see www.industrialsafety-tp.org). This work will be complemented by the one envisaged within the European Technology Platform on Sustainable Chemistry (SUSCHEM) (see their draft Strategic Research Agenda (SRA) in www.suschem.org).

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

Given the expertise of the OECD Chemicals Programme and its current activities, it would be very valuable that activities in the field of chemicals test guidelines and information exchange on applicable screening methods and risk assessment methods could be performed within this programme.

BIAC

Question 1: Please identify work completed, underway or planned in your country or organisation which pertains to regulatory frameworks especially concerning: i) definitions; ii) nomenclature; and iii) the characterisation of manufactured nanomaterials. [This could also include activities related to national or international standardisation efforts e.g. those of ISO, IUPAC, and the American Standards Institute - ANSI]. Please forward any supporting documentation to the Secretariat, including any definitions which have been used.

Many national and international standards organizations have recently begun the task of characterizing nanomaterials, including developing appropriate definitions and nomenclature. However, engineered nanomaterials represent a wide array of materials produced across a diverse set of processes. This diversity is well-reflected in the assortment of terminologies used and the challenges in communicating about nanomaterials. Harmonization of these standardization activities, in particular on an international scale, is a top priority for BIAC.

Examples of recent activities include:

> The **International Organization for Standardization's** (ISO) has formed a new (provisional) Technical Committee in Nanotechnologies (TC 229). Its scope broadly includes standardization in the field of nanotechnologies, with specific tasks being classification, terminology and nomenclature, basic metrology, characterization, including calibration and certification, risk and environmental issues.
>
> The British Standard Organisation (BSI) has successfully applied to CEN and ISO for a lead in the development of nanotechnology standards. They serve as the secretariat for TC 229. In

addition, in June 2005, the UK Department of Trade and Industry (DTI) in collaboration with the British Standards Institution (BSI) commissioned a Publicly Available Specification (PAS) for the purposes of developing and encouraging the use of a common language for nanoparticle technologies.(PAS 71:2005).

The American National Standards Institute - The Nanotechnology Standards Panel (ANSI-NSP) serves as the cross-sector coordinating body for the purposes of developing standards in the area of nanotechnology including, but not limited to, nomenclature/terminology; materials properties; and testing, measurement and characterization procedures. ANSI NSP has formed a Technical Advisory Group (TAG) to ISO TC229. The US chemical industry is participating in this ANSI effort through such groups as the American Chemical Council's CHEMSTAR Panel on Nanotechnology.

The Japanese Industrial Standards Committee (JISC) coordinates Japan's standardization activities. In November 2004, a working group on nanotechnology was formed also that will provide input into ISO TC 229.

The American Society for Testing and Materials (ASTM) International has formed a committee (E56) to address issues related to standards and guidance materials for nanotechnology & nanomaterials, as well as the coordination of existing ASTM standardization related to nanotechnology needs. This group aims to develop a 'dictionary for the nanoscale.' ASTM already has a ballot available on terminology and nomenclature, and representatives of nanomaterials manufactures and users, the academic and research communities, and industrial hygiene experts from NIOSH and private industry have been working together for several months in the ASTM nanomaterial risk management and product stewardship subcommittee to develop a consensus standard guide for safe handling of unbound engineered nanoparticles in occupational settings.

The Japanese Industrial Standards Committee (JISC) coordinates Japanese standardisation activities at international level. In November 2004, a working group was set up to standardize nanotechnology that has already established international contacts.

In April 2005, the Standardization Administration of China developed its first national standards for nanomaterials, which includes a glossary. Although detailed information is not available at this point, it appears that the Chinese quality control authority has defined four product standards for nanoparticulate nickel, tin oxide, titanium oxide and calcium carbonate as well as two standards for the measuring of specific product characteristics.

Question 2: also within the context of regulatory frameworks, please identify any triggers (used to determine when to initiate or undertake regulatory-related investigation or action) based on volume or other criteria - as well as any risk assessment tools associated with the framework. Please forward any supporting documentation to the Secretariat.

At the moment, we are aware of no regulatory triggers specific to industrial nanomaterials. However, BIAC is aware that in a number of OECD member countries, discussions have started between industry and authorities how to shape an appropriate procedure for the evaluations of nanomaterials under the existing regulatory frameworks. Examples of recent activities are:

The American Chemistry Council (ACC) has started a dialog with the US Environmental Protection Agency (USEPA) and other stakeholders to consider issues related to a common understanding of how

nanomaterials should be assessed under the TSCA framework. On June 23, 2005, the USEPA held a public meeting to discuss a potential voluntary program for reporting information pertaining to existing nanoscale materials and the information needed to adequately inform the conduct of a pilot program. Thereafter, the USEPA established an interim *ad hoc* stakeholder work group on nanoscale materials. On September 29, 2005 the workgroup held a public meeting to receive input on approaches and options for USEPA to consider.

In Germany, the Chemical Industry Association (VCI), the Environment Ministry and several agencies (Environment, Occupational Health and Consumer Health) have started a similar dialogue. On September 26, 2005, VCI has invited the stakeholders to a workshop on occupational health. On October 11/12, 2005 the Environment Ministry and two agencies will discuss with industry amongst other issues the suitability of the existing European framework of chemical regulations.

Question 3: identify the current known and planned uses of nanomaterials in your country. Please also identify the applications or products involved.

Nanotechnology promises significant societal benefits. As innovations continue to mature, nanomaterials have the potential to be used in all industrial sectors, including chemicals, electronics, and automotives, in medicine, as well as in pollution control and environmental cleanup.

Question 4: has any nanomaterial been officially assessed (or is under assessment) in your current chemicals regulatory system? If so, please provide the name of the substance or other identifiers as well as a description of its use. If available, please provide a summary of the findings and any exceptional issues which were faced. In particular, please indicate whether the assessment has involved standard methodology and was based on information typical of traditional chemical safety assessment.

At this point, BIAC is not aware of any completed official assessment of nanomaterials.

Question 5: Please describe any gaps or future needs which have been identified within the context of your regulatory system and any efforts to address such gaps/needs.

BIAC members operate under a variety of regulatory systems, making a comprehensive answer to this question difficult. Although we believe that the regulatory systems of most OECD countries are sufficiently robust to accommodate the evaluation of nanoscale materials, we suggest that OECD should focus on issues more likely to be common to all countries, such as identification and validation of methods for evaluation and assessment, sharing experience in evaluation and approaches, and identification of research needs.

Nanotechnology promises significant societal benefits. The technology should be developed in a way that not only identifies and minimizes potential risks to human health and the environment but also helps preserve the potential market for the technology against unwarranted claims of adverse impact. BIAC supports the safe use and manufacture of the products of nanotechnology. The following four main areas have been specifically identified as deserving of further focused discussion and/or development of additional information.

1) Need for global coordination of regulatory, research and standard-setting activities to avoid patch work regulation of nanomaterials. This effort could promote regulatory convergence in the major

regulatory systems and help avoid duplication in research programs. This area includes work on nomenclature, definitions and characterizations of nanoscale engineered materials.

2) Need for increased government funding for research and development of methods for assessing the impact of nanotechnology on environment, health and safety, and for programs to apply those methods in research on nanoscale materials. While several government agencies internationally have begun to shape these efforts, global coordination would help prioritize research needs and ensure proper investment of scarce research funds. Research appears to be needed in developing methods of reproducible particle generation, models for identification of specific effects, screening models toxicology and environmental fate, and occupational research.

Question 6: Identify any risk assessment -related research activities completed, underway, or planned in your country that are relevant to environmental safety or human health (e.g., research related to toxicity, ecotoxicity, exposure, etc.). Please provide a brief description. Are there any additional efforts underway to identify and address research needs?

Characterizing environmental health and safety or nanomaterials requires and understanding of the exposure, dose, and effect continuum of risk characterization. Ignoring the elements of this continuum may lead to under- or over prediction of risk-neither of which serves society. Nanomaterials encompass a diverse array of materials. In order to enhance our understanding of their safety, it will be necessary to have a better understanding of first principles of exposure, dose, and response. With this information, we can rationally extrapolate from one material to another, develop effective and efficient test methods, and prioritize research and testing.

In August 2005, the International Council on Nanotechnology (ICON) and Rice University's Center for Biological and Environmental Nanotechnology (CBEN) launched an online database of scientific findings related to the benefits and risks of nanotechnology. The database can be accessed at http://icon.rice.edu/research.cfm. This environmental health and safety (nano-EHS) database attempts to integrate the vast and diverse scientific literature on the impacts of nanoparticles. The database is the result of the collected efforts of Rice researchers, the chemical industry and the U.S. Department of Energy. This database will be updated and enhanced over the next year.

Examples of other, as yet unpublished health, and safety research projects planned or underway include:

- The **European Union (EU)** project "Nanosafe I" studied the development of specific experimental methods to possible environmental and health risks due to ultra fine particles and nanoparticles. In addition, risk assessment methods were evaluated. The EU project "Nanosafe II" has just been launched to establish methods for the safe detection, traceability in organs and the environment and characterization of nanoparticles. Furthermore, the entire life cycle of nanoparticles is studied. The EU project "Nanoderm" will research the protective function of the skin as a barrier against nanoparticles and develop new analytical methods to measure the ability of nanoparticles to penetrate the skin.
- In **Germany**, in a survey conducted by the joint DECHEMA-VCI working group "Responsible Use and Production of Nanomaterials" in September 2005, some 40 focal points of different priority were identified regarding safety research for nanoparticles [DECHEMA: Society for chemical engineering and biotechnology; VCI: German Chemical Industry Association]. The following toxicological research subjects were identified as highest priority subjects:

    - Studying parameters decisive for toxicological effects
    - Measuring types and quantities of nanoparticle release at the working place and from products

- Measuring types and quantities of nanoparticles in organisms and in individual organs, tissues and cells after inhalation, skin contact and ingestion
- Studying how nanoparticles are incorporated in body cells, whether adverse health effects must be expected due to the incorporation of nanoparticles in the body, and if there are threshold limits for possible adverse effects
- Studying whether and which risks are posed by individual products manufactured from nanoparticles, taking into account their respective benefits
- Making available validated in-vitro methods for the toxicological assessment of new nanoparticles, also in aerosols.

- In March 2005 a number of companies from the **German** chemical industry submitted the project "NanoCare: Safety-relevant factors for chemical nanotechnologies" to the German federal ministry of education and research (BMBF). The scope of NanoCare:

  - Studying the desaggregation and deagglomeration of new nanoscale and/or nanostructured materials, solubility and binding forces
  - Studying dustiness in dependence on particle size distribution
  - Establishing a testing method for carbon nanotubes and particles
  - Determing the transfer of nanoparticles from the gaseous phase to the liquid lung milieu
  - Studying the behaviour of nanoparticles in the lungs
  - Studying the ability of particles to penetrate the lung epithelium, skin and intestines
  - Studying the distribution of nanoparticles in the organism
  - Developing a bio-ranking for a comparison of new and known nanostructured materials
  - Collecting results from safety research, coordinated research discussion, dialogue with stakeholders
  - Discussing threshold limits, preventive measures.

- In the **United States** more than ten (10) corporations and other organizations have formed the Nanoparticle Occupational Safety & Health Consortium (NOSH). The research sponsored by this consortium has three major objectives: (1) generate engineered nanoparticle aerosols and measure their behavior as a function of time; (2) develop a simple, robust, portable device to measure airborne nanoparticles; and (3) measure the barrier efficiency of various materials to nanoparticles. This research will provide a foundation for a better understanding of how airborne nanoparticles may behave in the workplace, how to assess potential occupational exposures to airborne nanoparticles, and how to assess the penetration of engineered nanoparticles through candidate barrier materials.

  Also in the US, several agencies have begun planning for or preliminary research in risk assessment of nanomaterials, including, for example, National Science Foundation (cellular response) and National Toxicology Program (dermal absorption).

  In addition, ILSI/HESI is preparing a review of a subset of existing health studies with the ultimate goal to coordinate international risk assessment efforts. The first study (Thomas & Sayre, Research Strategies for Safety Evaluations of Nanomaterials, Part 1: Evaluating the Human Health Implications of Exposure to Nanoscale Materials) was published on September 21, 2005, and is available on-line at
  http://toxsci.oxfordjournals.org/cgi/content/abstract/87/2/316

For (funded) studies and new initiatives on (toxicity of) nanoparticles see here:
http://www.cordis.lu/nanotechnology/src/pressroom_projects.htm

For more information on actual projects referring to the toxicity of minerals (IMPART and NANOTOX) see:
http://www.impart-nanotox.org/

Question 7: Do you believe that future work on nanomaterials should be undertaken through OECD's Chemicals Programme? If so, please identify the issues which should be addressed and how.

BIAC strongly believes that a number of issues should be processed through the OECD's Chemicals programme and advocates:

- The need for increased funding on the environmental, health and safety issues of nanomaterials;
- The concept that government research should focus on fundamental method development (reproducible particle generation, detection and characterization of atmospheric nanoparticles and of nanoparticles in biological tissue, in vitro/in vivo screening models, basic toxicological and environmental research), to ensure that appropriate methods are available in a timely mannerwhile industrial firms focus on testing their products;
- The development of guidelines and procedures for tiered testing to determining the hazards, if any, associated with the uses of nanomaterials and to establish appropriate guidelines for maintaining safety in the workplace;
- An on-going effort in the regulatory arena to harmonize and/or coordinate the protocols, the hazard determination, and the rules, internationally; and
- The need for global coordination of regulatory, research and standard-setting activities to avoid patch work regulation of nanomaterials.

Annex to the Survey

Supplementary Information provided with the Survey Responses

JAPAN

RESEARCH ACTIVITY OF NATIONAL INSTITUTE FOR ENVIRONENTAL STUDIES

RESEARCH ACTIVITY OF NATIONAL INSTITUTE FOR ENVIRONENTAL STUDIES JAPAN
(FACT SHEET)

I. Introduction of the NIES

Since its establishment in 1974, National Institute for Environmental Studies (NIES) has been playing a major role in environmental research in Japan. With the integrative expertise that we enjoy in the Institute, we tackle environmental issues through the collaboration of our researchers and supporting staff with diverse specialties such as physics, chemistry, engineering, agriculture, fisheries, medicine, pharmacology, law/politics and economics.

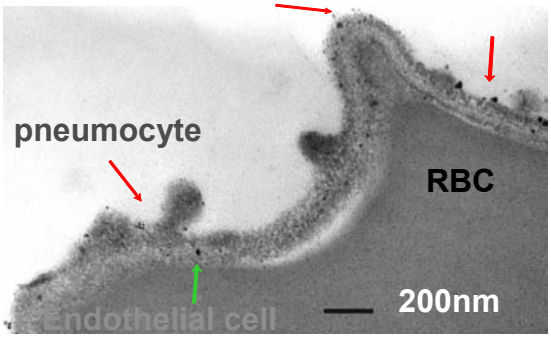
II. Background of the research regarding nanoparticles

Concerns for social effects of nanotechnologies have been increasing recently in Japan. The NIES has been conducting research regarding health effects of nanoparticles emitted from diesel vehicles with sponsorship of Ministry of Environment since 2003. As a part of the research, we are investigating health effects of *manufactured* nanoparticles such as carbon black and TiO_2 as well.

III. Major Results

A. Toxicokinetic Behavior of Nanoparticles

Nanoparticles less than 20 nm were found to reach endothelial cells through epithelial pneumocytes in mice using gold colloidal or fluorescence-labeled polystyrene particles (5/ 20/ 200 nm). In addition, a small amount of nanoparticles appeared to translocate from alveoli to the circulation.



(Provided by Dr. Furuyama)

B. Oxidative Stress of nanoparticles

The oxidative potency of carbonblack particles was inversely related to the particle size (14/ 56/ 95 nm) in the lung epithelial cells.

C. Effects on immune responses in the lung

In vivo study of intra tracheal instillation of carbonblack particles (14/ 95 nm) suggested that smaller size particles (14nm) induced more serious inflammatory responses and produced a larger amount of proinflammatory chemokine in the lung. Additionally, smaller particles were found to aggravate allergic asthma-like symptoms.

Ⅳ. Future Research Plans

Researches below are being planned in FY 2005 and following years.

- Preliminary study on health risk assessment of nanomaterials such as carbon nanotube-

Exposure assessment of nanomaterials to the environment

Contact address ; National Institute for Environmental Studies (NIES)
16-2 Onogawa, Tsukuba, Ibaraki, 305-8506 Japan
TEL; ＋81-29-850-2310
URL; http://www.nies.go.jp/

Nobuhiro KINO, Research Planning & Coordination Division
e-mail; kino@nies.go.jp

Takahiro KOBAYASHI, Environmental Health Science Division
e-mail; takakoba@nies.go.jp

Seishiro HIRANO, Environmental Health Science Division
e-mail; seishiro@nies.go.jp

Supplementary Information provided with the Survey Responses (cont.)

UNITED KINGDOM

UK ISO Proposal Form

PROPOSAL FOR A NEW FIELD OF TECHNICAL ACTIVITY	
Date of proposal 2005-01-13	Reference number (to be given by Central Secretariat) **ISO/TS/P**
Proposer UK	

A proposal for a new field of technical activity shall be submitted to the Central Secretariat, which will assign it a reference number and process the proposal in accordance with the ISO/IEC Directives (part 1, subclause 1.5). The proposer may be a member body of ISO, a technical committee or subcommittee, the Technical Management Board or a General Assembly committee, the Secretary-General, a body responsible for managing a certification system operating under the auspices of ISO, or another international organization with national body membership. Guidelines for proposing and justifying a new field of technical activity are given in the ISO/IEC Directives (part 1, annex Q).

The proposal (to be completed by the proposer)

Subject (the subject shall be described unambiguously and as concisely as possible)

Nanotechnologies

Scope (the scope shall define precisely the limits of the proposed new field of activity and shall begin with "Standardization of ..." or "Standardization in the field of ...")

Standardization in the field of nanotechnologies, with specific tasks being classification, terminology and nomenclature, basic metrology, characterization, including calibration and certification, risk and environmental issues. The methods of test are to include methods for determining physical, chemical, structural and biological properties of materials or devices for which the performance, in the chosen application, is critically dependent on one or more dimension of <100nm. Test methods for applications, and product standards shall come within the scope of the TC.

Purpose and justification (the justification shall endeavour to assess the economic and social advantages which would result from the adoption of International Standards in the proposed new field)

Purpose: to provide industry, research and regulators with a coherent set of robust and well founded standards in the area of nanotechnologies to assist the efficient and effective development of world and local markets for nanotechnology products, whilst at the same time providing regulators, and society in general, with suitable and appropriate instruments for the evaluation of risk and the protection of health and the environment.

Justification: many authorities predict that nanotechnologies will become the most important driver for economic growth in the 21st century. Applications of nanotechnologies will pervade all areas of life and will enable dramatic advances to be realized in all areas of communication, health, manufacturing, materials, and knowledge-based technologies. Industrial and consumer applications and uses of Nanotechnologies are expected to rise dramatically during the coming years, with the world market predicted to be in excess of one trillion dollars by 2015. Sustaining the growth necessary to achieve such a figure from current, relatively modest levels, will require considerable investment in technological and manufacturing/business related infrastructure, especially standards. The opportunities offered by nanotechnologies have been clearly recognized by the world's leading economies, with "federal" spending on nanotechnology research in Europe, the US and Japan in year 2003 reaching more than $3 BN, a rise of approximately 10 fold on 1997. The current spend on nanotechnology research by business is impossible to estimate but is likely to be the same as the federal spend.

Programme of work (list of principal questions which the proposer wishes to be included within the limits given in the proposed scope, indicating what aspects of the subject should be dealt with, e.g. terminology, test methods, dimensions and tolerances, performance requirements, technical specifications, etc.)

Advances in nanotechnologies are expected to be extremely rapid during the coming years. In the early stages of development it will be crucial to provide industry and research with suitable tools to aid the development and application of the technologies. Care will need to be taken in the selection of appropriate instruments so as to enhance progress and not impede it. The programme of work will therefore develop over time. Initially the emphasis will be on developing infrastructural standards in the areas of: terminology and nomenclature to support efficient and unambiguous communication within and between industrial, scientific, regulatory, legal and intellectual property disciplines; basic metrology in support of nanotechnology standardization, to include techniques for the determination of length (including thickness of ultra-thin films), surface area, volume, flow, force, etc. at the nanoscale; physical, structural, chemical and biological characterization at the nanoscale, including standards for manufacture and calibration of equipment; and risk and societal issues including risk evaluation, societal (health, environmental and social) impact, including protocols for impact assessment of new products, new manufacturing facilities, new research directions, outsourcing, etc., and life cycle analysis of products and manufacturing facilities. The focus will then move to generic product standards, paralleling industrial and commercial requirements. Finally these two areas can be expected to combine with the development of product standards, with standards in these three areas – underpinning terminology and technology, generic product needs and product requirements - continuing to be developed over time.

Survey of similar work undertaken in other bodies (relevant documents to be considered: national standards or other normative documents)

Although some work on standards development in nanotechnologies is underway, principally development of a terminology document in the USA and of a Publicly Available Specification (PAS) vocabulary for nanoparticles within BSI, only three national nanotechnology committees are known to exist – in the UK, USA and Japan – with the oldest of these, NTI/1 in the UK, having been in existence for less than 9 months. Each of these bodies is engaged in developing their own strategy for standardization and none yet has a clearly defined work programme for the future. In addition, CEN has established a Technical Management Board Working Group charged with developing a strategy for nanotechnologies standardization for Europe. Some standards development relevant to nanotechnologies is being undertaken within existing ISO and CEN committees but it appears to be minimal and there is currently no effective coordination of this work. However, given the global nature and reach of nanotechnologies together with the very rapid rate of development within different sectors and trading blocks, it makes undeniable sense to establish the necessary structure within ISO, as soon as possible, to allow for the rapid development and deployment of international standards to support industrial development in a well-regulated and coordinated environment.

Liaison organizations (list of organizations or external or internal bodies with which cooperation and liaison should be established)

Standards organisations. A range of organisations with an interest in the subject E.G IUPAC, VAMAS, Asia Pacific Nanotechnology Forum, National Nanotechnology Initiative, European Nanobusiness Association.

Other comments (if any)

Given the magnitude of the potential world market offered by nanotechnologies, it is clear that an appropriate standards infrastructure needs to be in place as soon as possible to ensure that organizations can take full advantage of the opportunities as and when they become available. Indeed, in their position paper on The Need for Measurement and Testing in Nanotechnology, published in February 2002, the European Union High Level Expert Group on Measurement and Testing concluded that "Prosperous industrial sectors such as Precision Engineering, Micro- & Optoelectronics, as well as Bio-molecular technology will not be able to develop to their full potential without associated developments in measurement, testing and related disciplines." Additionally, a number of studies on nanotechnologies have highlighted the need for standardization, and standardization is highlighted as being critical for many of the "9 Grand Challenges" for the National Nanotechnology Initiative in the US. Furthermore, serious concern is beginning to be expressed in some quarters about potential negative health and environmental impacts of nanotechnologies, and it is therefore essential that regulators and health and environmental protection agencies have available reliable measurement systems and evaluation protocols supported by well founded and robust standards.

Signature of the proposer

Comments of the Secretary-General (to be completed by the Central Secretariat)

Signature

Supplementary Information provided with the Survey Responses (cont.)

CEN Resolution

BT N 7373
(Draft Resolution BT C037/2005)
Issue date : 2005-07-07
Target Date : 2005-09-01

BT - TECHNICAL BOARD

1 TO DECIDE

---

2 SUBJECT: Nanotechnologies – Setting up of a CEN/TC

---

3 BACKGROUND:

By Resolution BT C005/2004, BT created BT/WG 166 in the new promising area "Nanotechnologies". BT agreed (BT C096/2004) to BT/WG 166 final title and scope. The Secretariat is held by BSI.

Nanotechnologies are predicted to be the most important driver for economic growth in the 21st century. Applications of nanotechnologies will have an impact on all aspects of life and will enable dramatic advances to be realized in all areas of communication, health, manufacturing, materials, and knowledge-based technologies. Industrial and consumer applications and uses of nanotechnologies are expected to grow dramatically during the coming years, with the world market predicted to be in excess of one trillion dollars by 2015. Sustaining the growth necessary to achieve such a figure from current, relatively modest levels, will require considerable investment in technological and manufacturing/business related infrastructure, especially standards.

In accordance with its scope, BT/WG 166 has prepared a Strategy Paper and a draft Business Plan for the creation of a CEN/TC, even if ISO has also in the mean time set its own TC (ISO/TC 229). The full BT/WG 166 report is given in annex to BT N 7373.

CEN/BT/WG 166 recommends that:

CEN/BT establishes forthwith a new Technical Committee in the area of Nanotechnologies with the following Title, Scope and Structure:

- Title: Nanotechnologies

- Scope: Standardisation in the field of nanotechnologies, with specific tasks being classification, terminology and nomenclature, basic metrology, measurement and characterisation (including procedures for calibration), health, safety and environmental issues. Liaison with relevant national, regional and international standardisation bodies and organisations, and with other relevant bodies, organisations and groupings world-wide.

- Structure: The structure of the new TC shall be determined from time to time by the TC in order to promote its efficient working, the timely production of standards and the

optimum provision of assistance to other CEN Technical Committees working in the field of nanotechnologies, in accordance with CEN/CENELEC rules. It is recommended that the initial structure should comprise 4 Working Groups in the areas of:

WG 1: Terminology, classification and nomenclature
WG 2: Measurement and characterisation
WG 3: Health, safety and environmental issues
WG 4: Nanotechnology products and processes.

Based upon the responses to survey questionnaires, a proposed work programme for preliminary standardisation by the TC has been developed, together with a draft business plan, taking account of the recent establishment of an ISO Technical Committee for nanotechnologies - ISO TC 229.

It is recommended that BT/WG 166 should remain in existence to act as a focus for European activities in this area at least until the inaugural meeting of the CEN/TC.

---

4 DRAFT RESOLUTION:

BT

- establishes a new Technical Committee in the area of Nanotechnologies with the following Title and Scope:

  - Title: Nanotechnologies

  - Scope: Standardisation in the field of nanotechnologies, with specific tasks being classification, terminology and nomenclature, basic metrology, measurement and characterisation (including procedures for calibration), health, safety and environmental issues. Liaison will be ensured with relevant national, regional and international standardisation bodies and organisations, and with other relevant bodies, organisations and groupings world-wide.

- allocates the Secretariat of the new CEN/TC to BSI, who agrees to comply with the terms of the CEN Memorandum N°1 as approved by Resolution CA 11/1993 and the 'Rules and conditions for allocation of CEN/TC Secretariat' (see Resolution BT 66/2000);
- referring to Resolution BT 49/2003, asks the new CEN/TC to provide a Business Plan in accordance with the new format as well as a detailed programme of work by 2005-12-31 for BT approval;
- decides that BT/WG 166 will be disbanded when the first meeting of the new CEN/TC takes place.

This resolution is applicable as from: 2005-09-01

---

5 RESP: AP/JVH

Supplementary Information provided with the Survey Responses (cont.)

UNITED STATES

Currently NIOSH-funded research:

1. Generation and Characterization of Occupationally Relevant Airborne Nanoparticles.

Principal Investigator: Doug Evans, Ph.D., DART

There is mounting evidence that the toxicity of some aerosols may be closely associated with the number or surface-area of inhaled particles. Low-solubility ultrafine (typically smaller than 100 nm) and high specific surface-area particles are of particular concern. This project is part of a wider research program aimed at studying the toxicity of workplace-related aerosols within this category, including those associated with nanotechnology. Methods are being developed to generate and deliver well-characterized particles to exposure systems, enabling particle characteristics responsible for specific toxic responses to be investigated in a systematic manner. The research includes the development of off-line and on-line aerosol and particle characterization techniques, including methods to measure aerosol surface-area, and methods to characterize the composition and structure of nanometer-diameter particles.

2. Pulmonary Toxicity of Carbon Nanotube Particles.

Principal Co-Investigators: Anna Shvedova, Ph.D., HELD, and Paul Baron, Ph.D., DART

This project will evaluate mechanisms of pulmonary toxicity in response to in vitro or in vivo exposure to carbon nanotubes. Specific aims are: 1) to study mechanisms of cytotoxicity of carbon nanotubes in culture systems of bronchial epithelial cells, macrophages and alveolar type II cells; 2) to determine the effect of pharyngeal aspiration of carbon nanotubes in a mouse model - determine dose-response and time course; 3) to develop a generation system for carbon nanotube aerosols; 4) to conduct inhalation exposure to aerosolized carbon nanotube particles and monitor the pulmonary response in a mouse model.

3. Role of Carbon Nanotubes in Cardio-Pulmonary Inflammation and COPD Related Diseases.

Principal Co-Investigators: Michael Luster, Ph.D., HELD, and Petia Simeonova, Ph.D., HELD
This project will evaluate mechanisms involved in the cardio-pulmonary responses to exposure to carbon nanotubes using molecular biology procedures and transgenic animal models. Specific aims are: 1) to monitor changes in gene expression of lung tissue associated with intratracheal exposure to carbon nanotubes; 2) to determine the role of TNF-alpha in these responses using TNF-alpha receptor knockout mice; 3) to evaluate the role of carbon nanotubes in the induction of emphysema using a emphysema susceptible mouse (TSK+); 4) to characterize the cardiovascular reactions to pulmonary exposure to carbon nanotubes, using a mouse model (apo E-/-) susceptible to atherosclerosis.

4. Particle Surface Area as a Dose Metric.

Principal Investigator: Vincent Castranova, Ph.D., HELD

This project will determine whether the high inflammatory reaction of the lung to ultrafine particles compared to an equal mass of fine particles of similar composition is due to a unique toxic property of ultrafine particles or could be explained by their high surface area, i.e., is particle surface area a more appropriate metric for exposure dose than particle mass? Specific aims are: 1) expose alveolar type II epithelial cells, bronchial epithelial cells, and alveolar macrophages to ultrafine and fine crystalline silica, titanium dioxide or carbon black; determine toxicity on a particle surface area/cell surface area basis; 2) determine if titanium dioxide and carbon black exhibit similar in vitro toxicity on a particle surface area basis while silica exhibits greater toxicity; 3) determine the pulmonary response to inhalation of ultrafine vs. fine titanium dioxide on an equivalent deposited particle surface area/pulmonary epithelial cell surface area basis; 4) provide in vitro and in vivo data to EID for modeling.

5. Ultrafine Aerosols from Diesel-Powered Equipment.

Principal Investigator: Aleksander Bugarski, Ph.D., PRL

This project will identify and evaluate the nanometer and ultrafine aerosols emitted by diesel-powered equipment and formulate control technologies to reduce the exposure of workers to these particles, thereby reducing the associated occupational health risks. The physical and chemical properties of the nanometer and ultrafine diesel aerosols will be characterized through a series of engine/dynamometer tests both at the NIOSH Lake Lynn Laboratory experimental mine and at participating active metal and coal mines. The knowledge obtained, from this study, will strengthen our understanding of the health implications related to exposure to diesel particulate matter and aid in assessing the potential of various control technologies for reducing this exposure.

6. Nanoparticles: Dosimetry and Risk Assessment

Principal Investigator: Eileen Kuempel, Ph.D., EID

This project will provide a unified approach for quantitative analysis of exposure, dose, and response relationships for particles of varying size and composition, using rat and human in vitro and in vivo data, and particle surface area dose. Biomathematical and statistical models will be developed to estimate internal dose and disease risk in workers exposed to nanoparticles, and to provide a scientific basis for developing improved occupational health recommendations to reduce the risk of lung diseases in workers. As part of this project, research contracts have been awarded to Bahman Asgharian, Ph.D., CIIT Centers for Health Research, and Lang Tran, Institute of Occupational Medicine (IOM) (pending).

7. An Ultrafine Particle Intervention Study in Automotive Production Plants

Principal Investigator: Keith Crouch, Ph.D., DART

Evaluate the generation and control of ultrafine particles (in terms of mass, surface area and number) at several automotive manufacturing plants. Relate the ultrafine exposures to respiratory and other symptoms and objective measures of pulmonary inflammation while providing control recommendations linked to cost-benefit analysis.

8. Filter Efficiency of Typical Respirator Filters for Nanoscale Particles

Project Officer: Appavoo Rengasamy, Ph.D., NPPTL
Research contract with: David Pui, Ph.D., University of Minnesota

Manufactured nanoparticles may exist as separate particles of only a few nanometers in size. Respirator theory predicts that as particle size decreases from 300 nm, diffusion becomes increasingly effective in capturing the particles on the filter filters. However, a recent study suggests that as particles reach sizes of a few nanometers, capture efficiency begins to decline. The goals of this project are to determine (1) if single fiber filtration theory is valid for engineered nanoparticles, (2) the possible boundaries of the most penetrating particle size range, and (3) the filtration boundaries of nanosized particles in the diffusional capture mechanism range. The findings from this study will enable extending single fiber theory beyond the traditionally described particle range. These findings will also allow NIOSH to make recommendations regarding the effectiveness of respirator filter media for engineered nanoparticles based on experimental data.

9. Nanoparticles in the Workplace

Principal Investigator: Mark Hoover, Ph.D., DRDS

The objective of this project is to provide NIOSH and the occupational safety and health community with a better understanding of the nature and extent of current and emerging occupational exposures to nanoparticles and to foster development of a comprehensive and scientifically sound occupational health protection strategy for emerging nanotechnologies.

10. Web-Based Nano-Information Library Implementation

Principal Investigator: Arthur Miller, Ph.D., SPL

The primary objective of this project is to implement the web-based programming for the Nano-Information-Library (NIL) that is being developed to support the Nanoparticles in the Workplace project. This work will provide NIOSH and the occupational safety and health community with access to knowledge as to the variety and extent of nanomaterials being produced world wide, along with information concerning their physical and chemical properties, processes of origin, and possible health effects.

NIOSH Funding Decision Pending:

1. Systemic Microvascular Dysfunction: Effects of Ultrafine vs. Fine Particles

Principal Investigator: Vincent Castranova, Ph.D.

Nanotechnology is one of the fastest growing emerging technologies in the US and across the world. Defined as the manipulation of matter at near-atomic scales to produce new materials, structures and devices with unique properties, nanotechnology has potential applications for integrated sensors, semiconductors, medical imaging, drug delivery systems, structural materials, sunscreens, cosmetics, and coatings The NIOSH Nanotechnology Research Center identifies elucidation of cardiovascular effects of airborne nanoparticles as a critical issue. This study will compare the effects of inhalation exposure to fine vs. ultrafine TiO2 and monitor pulmonary effects as well as alterations in systemic microvascular function. The role of oxidant stress at the microvessels will be explored. Data will be

disseminated by presentation at scientific meeting, publications in journals, summaries in the NIOSH e-News and Nanotech Web page, and meeting with partners.

2. Evaluation of the Pulmonary Deposition and Translocation of Nanomaterials

Principal Investigator: Robert Mercer, Ph.D.

Recent years have seen an exponential growth in the development and production of nanomaterials. These materials have unique physical, chemical and electrical properties due to specially forged arrangements of atoms on a nanometer scale that do not occur in natural systems. Because of the unique properties and small size of nanoparticles, issues have been raised as to their potential adverse effects on the lung upon inhalation and whether they can translocate to systemic sites. This project will identify where in the lungs inhaled nanomaterials might deposit, the health risks that might arise from nanomaterial deposition, and to what extent the nanomaterials might translocate to other organs of the body after depositing in the lungs. Results of this study will address critical issues identified by the NIOSH Nanotechnology Research Center and assist in hazard identification and risk assessment.

3. Dermal Effects of Nanoparticles

Principal Investigator: Anna Shvedova, Ph.D.

Nanoparticles are new materials of emerging technological importance in different industries. Because dermal exposure is likely in a number of occupational settings, it is very important to assess whether nanoparticles could cause adverse effects to skin. The hypothesis is that nanoparticles are toxic to the skin and the toxicity is dependent on their penetration to skin, induction of oxidative stress, and content of transition metals. Because inflammation provides a redox environment in which transition metals can fully realize their pro-oxidant potential, a combination of inflammatory response with metal oxide particles, or iron-containing SWCNT will synergistically enhance damage to cells and tissue. Results obtained from these studies provide critical knowledge about mechanisms of dermal toxicity of nanoscale materials and will be used by regulatory agencies (OSHA and EPA) and industry to address strategies for assurance of healthy work practices and safe environments.

4. Pulmonary Effects of Exposure to Various Nanoparticles

Principal Investigator: Dale Porter, Ph.D.

The purpose of this project is to evaluate several different types of nanoparticles for toxicity in both the conducting airways and alveolar region of the lung, and to understand their mechanisms of toxicity by comparing the effects of pulmonary exposure to fine vs. ultrafine metal oxide particles. The data obtained will contribute to the development of a toxicological database necessary for hazard identification; will contribute to the NIOSH Nanotechnology and Health and Safety Research Program; and will provide data to NIOSH, OSHA, and EPA for nanoparticle exposure risk assessment and prevention.

Extramural NIOSH-funded projects:

1. Assessment Methods for Nanoparticles in the Workplace

Principal Investigator: O'Shaughnessy, Patrick, University of Iowa

Our primary objectives are (A) to provide the scientific community and practicing industrial hygienists with verified instruments and methods for accurately accessing airborne levels of nanoparticles, and (B) to assess the efficacy of respirator use for controlling nanoparticle exposures. We will satisfy these objectives through a combination of laboratory and field-based studies centered on the following specific aims:

1. Identify and evaluate methods to measure airborne nanoparticle concentrations.
2. Characterize nanoparticles using a complementary suite of techniques to assess their surface and bulk physical and chemical properties.
3. Determine the collection efficiency of commonly-used respirator filters when challenged with nanoparticles.

Our research approach will involve both laboratory and field work. Manufactured nanomaterials covering a range of the types available will be obtained from several sources. We will then systematically compare measurements obtained from a variety of sampling instruments, including a novel passive aerosol monitor, relative to measurements made by transmission electron microscopy (TEM) under controlled laboratory conditions. Field tests will involve the use of the instruments analyzed in the lab to quantify and characterize nanoparticle concentrations in workplaces that manufacture and/or use nanoparticles. This work will also provide the opportunity to refine an aerosol mapping technique we have developed to visualize the temporal and spatial variability of aerosol concentrations in a workplace. Laboratory testing will be conducted to determine the collection efficiency of respirator filters when challenged with a variety of nanoparticle types. We will also analyze the surface properties and chemical composition of a number of nanoparticle types in order to determine whether these qualities can aid in establishing the cause of differences in instrument performance and filtration efficiency when challenged with different nanoparticles as well as to aid in the recognition of unknown nanoparticles encountered in a workplace or in the ambient environment.

This work is an essential first step needed to accurately identify the hazards associated with a new workplace health threat. The expected results from these studies will include a greater understanding of the strengths and limitations of instruments capable of evaluating nanoparticle exposure levels. Our assessment of physical and chemical features of nanoparticles will aid in identifying nanoparticle qualities that affect instrument performance and filtration efficiency. Moreover this work will result in guidance on the use of respirators to protect against nanoparticle inhalation in the workplace.

2. Monitoring and Characterizing Airborne Carbon Nanotube Particles

Principal investigator: Xiong, Judy, New York University School of Medicine

Carbon nanotubes (CNT) are dominant among the array of nanomaterials due to their unique chemical and physical properties. Promising applications in many areas are expected to lead to industrial scale production in the near future. CNTs could become airborne during manufacturing and handling and result in inhalation and dermal exposure of workers to particles of unknown toxicity. However, there is very limited knowledge regarding potential exposure levels for workers exposed to this new type of material. Also, there is no adequate method for quantitative and qualitative monitoring of airborne CNTs due to their complexity. The proposed research will develop a comprehensive, yet practical, method for sampling, quantification and characterization of CNT particles in air, which will be capable of classifying sampled particles into three categories: tubes, ropes (bundles of single-walled CNTs bounded by Van der Waals attraction force), and non-tubular particles (soot, metal catalysts, and dust, etc.), and measuring the number concentrations and size distributions for each type, and the shape characters (diameter, length, aspect ratio and curvature) of CNTs. The method will utilize available instrumentation to build an air monitoring system that is capable of sampling and sizing airborne CNT particles in a wide size range by using a 10-stage

Micro-orifice uniform Deposit Impactor (MOUDI) and an Integrated Diffusion Battery previously developed in this laboratory. The samples of each size fraction will be collected onto Silicon-chip substrates and analyzed using Atomic Force Microscopy (AFM). Newly developed software, SIMAGIS® Nanotube Solutions, will be utilized for AFM image analysis and data processing, which can automatically count nanotubes, nanoropes and particles; and measure the shape characters. Other commercially available nanoparticle sampling instruments, such as an Electrostatic Aerosol Sampler and a Nano-MOUDI will also be tested in this work. Successful completion of this project will produce a validated method for sampling airborne CNTs in workplaces; and a practical method using AFM image analysis technology for classifying sampled CNT particles by type, and quantifying and characterizing each type separately. These methods are needed for determination of potential health risks that may result from worker exposure to the various types: CNTs, nanoropes, and non-tubular nanoparticles. The results will also provide a foundation for field and personal sampling devices for CNTs.

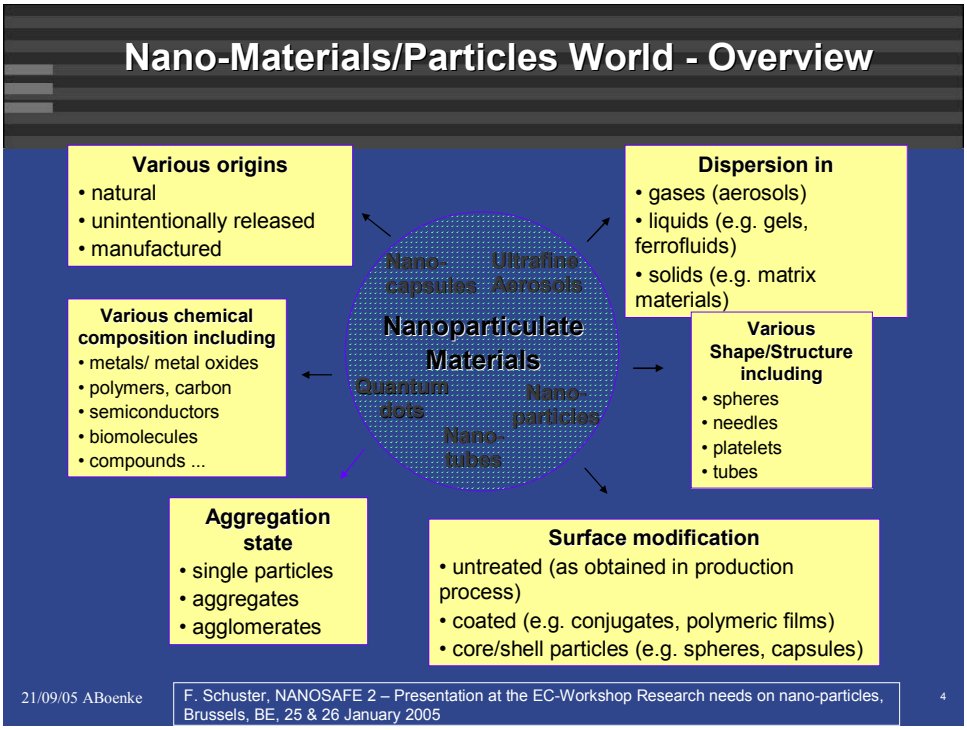
3. Lung Oxidative Stress/Inflammation by Carbon Nanotubes

Principal Investigator: Kagan, Valerian, University of Pittsburgh

Single Walled Carbon NanoTubes (SWCNT) are new materials of emerging technological importance. Their manufacturing requires iron resulting in its high content in SWCNT. Because iron is a catalyst of oxidative stress, iron-containing SWCNT are likely more toxic than iron free SWCNT. Our central hypothesis is that SWCNT are toxic to the lung and the toxicity is dependent on their content of iron. The major toxicity mechanisms include inflammatory response synergistically enhanced by oxidative stress exacerbated by iron. SWCNT toxic effects are further augmented by microbially-induced inflammation. The apoptotic/necrotic target cell death ratio dependent on the WCNT iron is also a regulator of SWCNT toxicity via production of anti-/pro-inflammatory cytokines, respectively. Specific Aim 1 is to establish the extent to which SWCNT alone are pro-inflammatory to lung cells and tissue and characterize the role of iron in these effects using genetically manipulated cells and animals as well as antioxidant interventions. Specific Aim 2 is to determine the potential for SWCNT and microbial stimuli to synergistically interact to promote macrophage activation, oxidative stress, and lung inflammation. Specific Aim 3 is to reveal the extent to which SWCNT are effective in inducing apoptosis and whether apoptotic cells exert their macrophage-dependent anti-inflammatory potential during in vitro and in vivo SWCNT exposure. The project involves a team of interdisciplinary investigators with unique expertise in redox chemistry/biochemistry (V. Kagan), cell and molecular biology of inflammation (L. Ortiz) and its interactions with microbial agents (J. Fabisiak), pulmonary toxicology of (nano)particles (V, Castranova, A. Shvedova). Based on our results, mechanism-based interventions, such as specific antioxidants, new means to control iron content (using non-toxic chelators) as well as biotechnological approaches (phosphatidylserine liposomes and/or apoptotic cells down-regulating inflammatory response) may be developed to decrease toxicity of (iron-containing) SWCNT.

Supplementary Information provided with the Survey Responses (cont.)

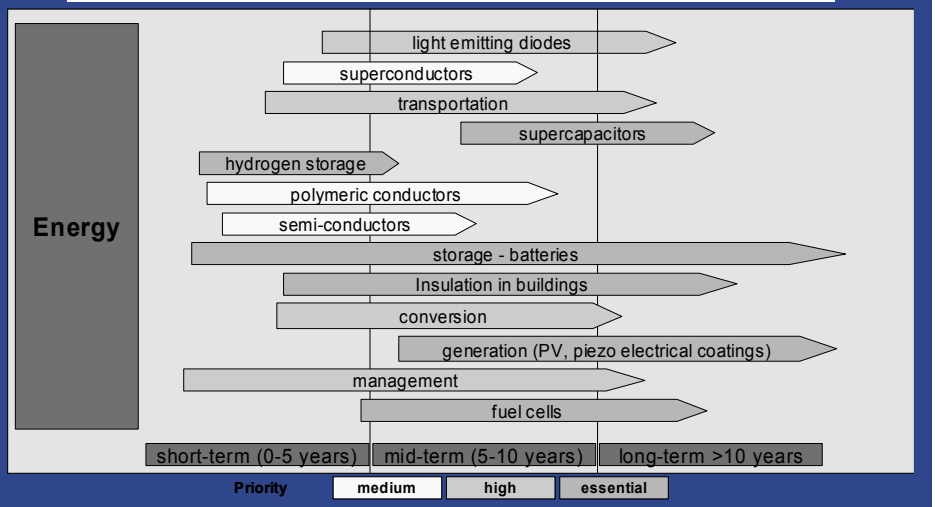
EC



Use of Nano-Materials/Particles

(Materials Technology – Draft Strategic Research Agenda (SRA) within the Technology Platform Sustainable Chemistry (SusChem), draft 17th June 2005)

Nano-Materials/Particles Application Fields Linked to Energy

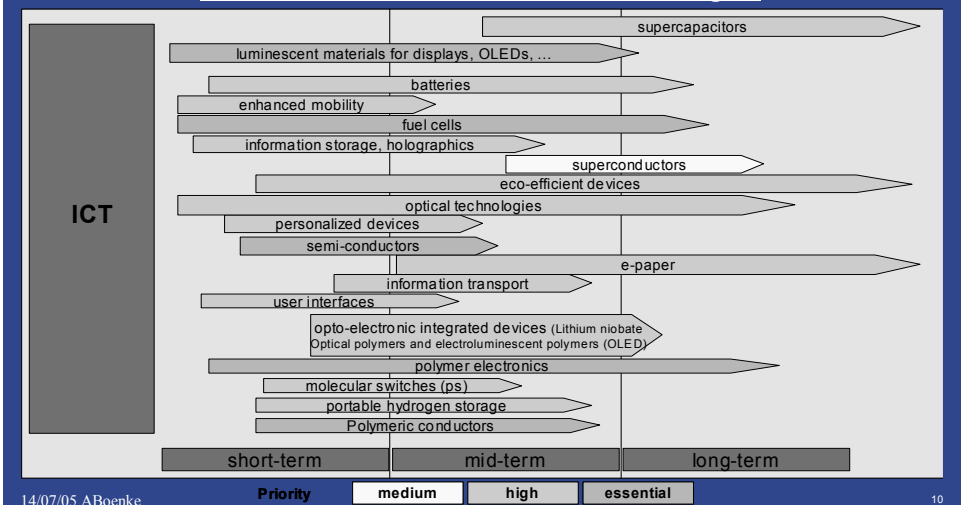


14/07/05 ABoenke 9

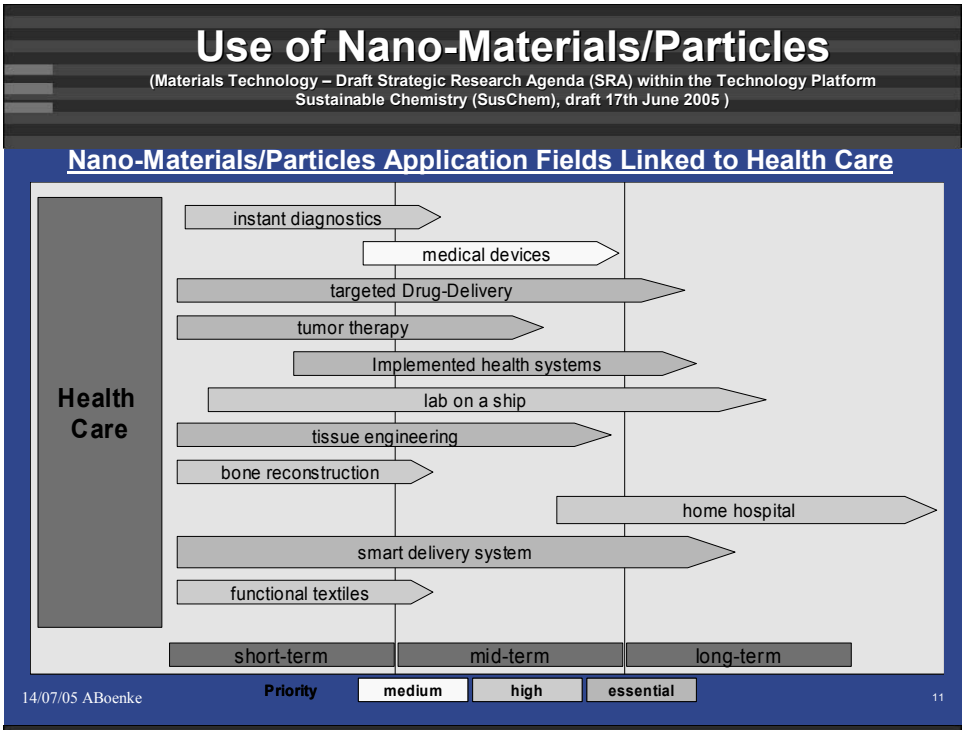
Use of Nano-Materials/Particles

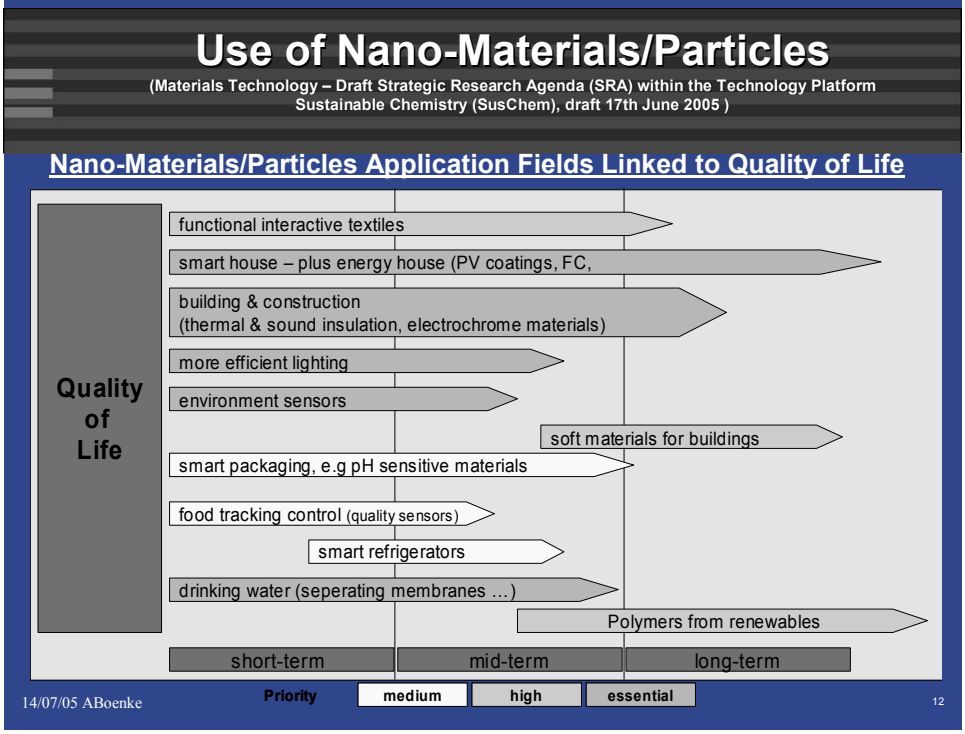
(Materials Technology – Draft Strategic Research Agenda (SRA) within the Technology Platform Sustainable Chemistry (SusChem), draft 17th June 2005)

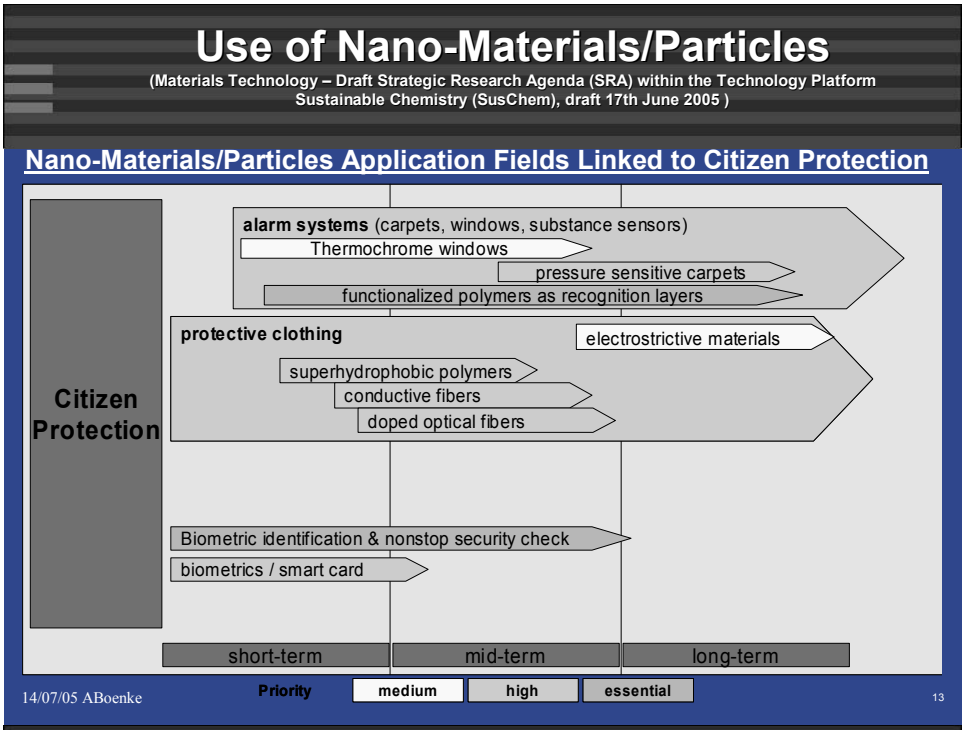
Nano-Materials/Patricles Application Fields Linked to Information & Communication Technologies

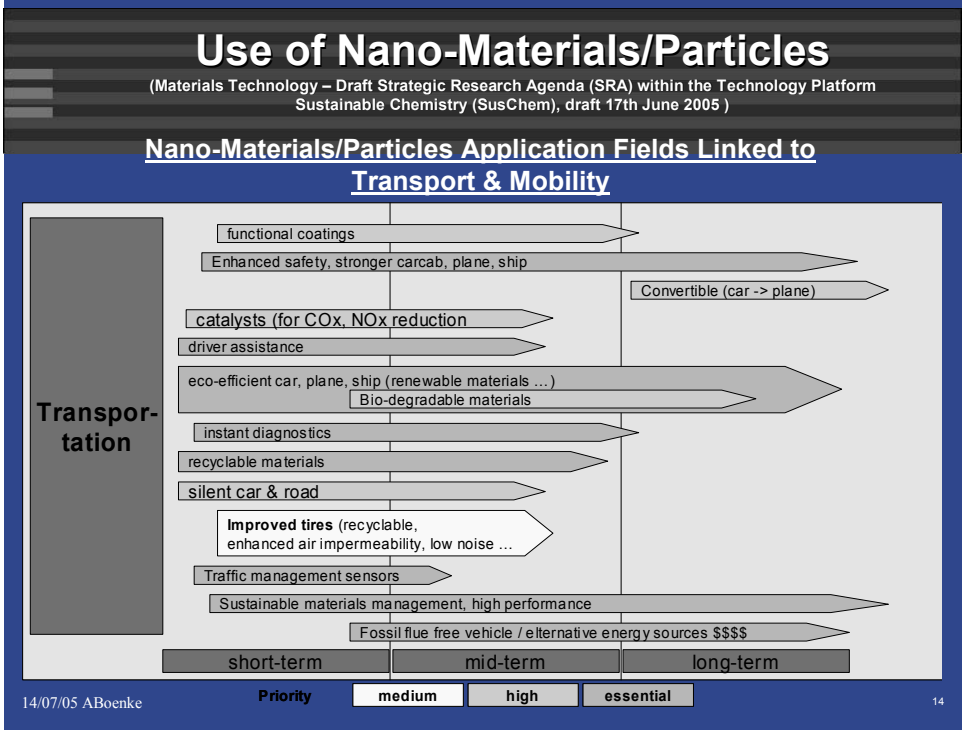


14/07/05 ABoenke 10


Use of Nano-Materials/Particles
(Materials Technology – Draft Strategic Research Agenda (SRA) within the Technology Platform Sustainable Chemistry (SusChem), draft 17th June 2005)
Nano-Materials/Particles Application Fields Linked to Health Care
Health Care
instant diagnostics
medical devices
targeted Drug-Delivery
tumor therapy
Implemented health systems
lab on a ship
tissue engineering
bone reconstruction
home hospital
smart delivery system
functional textiles
short-term
mid-term
long-term
14/07/05 ABoenke
Priority
medium
high
essential
11


Use of Nano-Materials/Particles
(Materials Technology – Draft Strategic Research Agenda (SRA) within the Technology Platform Sustainable Chemistry (SusChem), draft 17th June 2005)
Nano-Materials/Particles Application Fields Linked to Quality of Life
Quality of Life
functional interactive textiles
smart house – plus energy house (PV coatings, FC,
building & construction
(thermal & sound insulation, electrochrome materials)
more efficient lighting
environment sensors
soft materials for buildings
smart packaging, e.g pH sensitive materials
food tracking control (quality sensors)
smart refrigerators
drinking water (seperating membranes …)
Polymers from renewables
short-term
mid-term
long-term
14/07/05 ABoenke
Priority
medium
high
essential
12


Use of Nano-Materials/Particles
(Materials Technology – Draft Strategic Research Agenda (SRA) within the Technology Platform Sustainable Chemistry (SusChem), draft 17th June 2005)
Nano-Materials/Particles Application Fields Linked to Citizen Protection
Citizen Protection
alarm systems (carpets, windows, substance sensors)
Thermochrome windows
pressure sensitive carpets
functionalized polymers as recognition layers
protective clothing
electrostrictive materials
superhydrophobic polymers
conductive fibers
doped optical fibers
Biometric identification & nonstop security check
biometrics / smart card
short-term
mid-term
long-term
14/07/05 ABoenke
Priority
medium
high
essential
13


Use of Nano-Materials/Particles
(Materials Technology – Draft Strategic Research Agenda (SRA) within the Technology Platform Sustainable Chemistry (SusChem), draft 17th June 2005)
Nano-Materials/Particles Application Fields Linked to Transport & Mobility
Transpor-tation
functional coatings
Enhanced safety, stronger carcab, plane, ship
Convertible (car -> plane)
catalysts (for COx, NOx reduction
driver assistance
eco-efficient car, plane, ship (renewable materials ...)
Bio-degradable materials
instant diagnostics
recyclable materials
silent car & road
Improved tires (recyclable, enhanced air impermeability, low noise ...
Traffic management sensors
Sustainable materials management, high performance
Fossil flue free vehicle / elternative energy sources $$$$
short-term
mid-term
long-term
14/07/05 ABoenke
Priority
medium
high
essential
14

ANNEX V. List of Participants

PARTICIPANTS LIST FOR OECD WORKSHOP ON THE SAFETY OF MANUFACTURED NANOMATERIALS
LISTE DES PARTICIPANTS POUR ATELIER DE L'OECD SUR LA SECURITÉ DES NANOMATERIAUX MANUFACTURER

7 December 2005 - 9 December 2005

Australia / Australie

Deborah WILLCOCKS	*Team Leader, Rapid Risk Assessment* *NICNAS*

Canada / Canada

Andrew ATKINSON	*Head, New Chemicals Notification* *New Substances Division* *Environment Canada*
Michelle LEE	*Evaluation Specialist* *New Substances Division* *Environment Canada*
Bernard MADÉ	*A/Director New Substances Branch* *Environment Canada*
Dr. Chris METCALFE	*Professor* *Environmental & Resource Studies Program* *Trent University*
Anne-Marie PELLETIER	*Chief, New Chemicals Evaluation Division* *New Substance Branch* *Environment Canada*
Shaunalea SAVARD	*Acting Director* *New Substances Assessment and Control* *Health Canada*
Shaunalea SAVARD	*Head, New Chemical Substances 3 Section* *New Substances Assessment and Control Bureau* *Health Canada*
Gordon STRINGER	*Head, New Substances Notification Section* *New Substances Branch* *Environment Canada*
Hans YU	*Health Products and Food Branch* *Health Canada*

Denmark / Danemark

Poul Bo LARSEN	*Chief Adviser* *Chemicals/ Chemical Assessment* *Danish Environmental Protection Agency*

Janeck SCOTT-FORDSMAND — *Dept. Terrestrial Ecology*
National Environmental Research Institute

France / France

Philippe CHEMIN — *Adjoint au sous-directeur*
Direction de la Prévention des Pollutions et des risques / Sous-direction des produits et déchets
Ministère de l'Ecologie et du Développement Durable

Germany / Allemagne

Wolfgang DUBBERT — *Federal Environmental Agency (Umweltbundesamt)*

Italy / Italie

Antonietta GATTI — *Expert*
Department of Biomaterials
University of Modena and Reggio Emilia

Japan / Japon

Hajime KAWASAKI — *Team Leader, Health Hazard Assessment Team*
Research Center for Chemical Risk Management (CRM)
National Institute of Advanced Industrial Science and Technology (AIST)

Shigeki MIYACHI — *Staff*
Chemicals Assessment Center
Chemicals Evaluation and Research Institute

Kunihiko YAMAZAKI — *Research Coordinator*
Research Center for Environmental Risk
National Institute for Environmental Studies

Seishiro HIRANO — *Chief of Biomarker & Health Indicator Section*
Environmental Health Sciences Division
National Institute for Environmental Studies

Akihiko HIROSE — *Senior Researcher*
Division of Risk Assessment
National Institute of Health Sciences

Kiyohiro KUBOTA — *Assistant Chief*
Chemicals Evaluation and Research Institute, Japan

Tetsuya KUSAKABE — *Specialist for Hygiene*
Office of Chemical Safety, Evaluation and Licensing Division
Ministry of Health, Labour and Welfare

Junko NAKANISHI — *Director*
Research Center for Chemical Risk Mnagement (CRM)
National Institute of Advanced Industrial Science and Technology (AIST)

Masamichi OBATA
Project Coordinator
Bio & Medical Technology Development Department
New Energy and Industrial Technology Development Organization,Chemicals Management Technology Group

Hideo SHINDO
Chief Representative, Washington, DC Office
New Energy and Industrial Technology Development Organization (NEDO)

Yuho SHISHIYAMA
Director, Chemical Management Policy Division
Ministry of Economy, Trade and Industry (METI)

Kazunori SUZUKI
Director
Chemicals Management Technology Group, Biotechnology and Medical Technology Development Dept.
New Energy and Industrial Technology Development Organization (NEDO)

Korea / Corée

Jung-il LEE
vice-president
Korea Nano Technology Research Society

Sang-Hwan SONG
Researcher
Environmental Risk Assessment Division
National Institute of Environmental Research for South Korea

Netherlands / Pays-Bas

Pim FENGER
Coordinator international research and science policy
Ministry of Education, Culture and Science

Jolanda SCHAVEMAKER
trainee
Royal Netherlands Embassy

New Zealand / Nouvelle-Zélande

Fleur FRANCOIS
Senior Adviser
Ministry for the Environment

Brian YOUNG
Science & Technology Counsellor
New Zealand Embassy

Poland / Pologne

Jan STETKIEWICZ
Expert of the Polish Ministry of Health
Department of Pathomorphology
Nofer Institute of Occupational Medicine

Sweden / Suède

Agneta FALK-FILIPSSON	*Ph. D, Toxicologist* *Swedish Chemicals Inspectorate*

Switzerland / Suisse

Stefan DURRER	*Department of Worker Safety* *State Secretariat for Economic Affairs*
Christof STUDER	*Senior Scientific Officer* *Substances, Soil and Biotechnology Division* *Swiss Agency for the Environment, Forest and Landscape*
Steffen WENGERT	*Swiss agency for Public Health*

United Kingdom / Royaume-Uni

Clare BROWN	*DEFRA*
Peter HATTO	*Director of Research* *IonBond Ltd*
Michael ROSE	*Nanotechnologies Policy* *Department for Environment, Food and Rural Affairs*
Elizabeth SURKOVIC	*Branch Head* *Chemicals and GM Policy* *DEFRA*

United States / Etats-Unis

James ALWOOD	*Associate Branch Chief, Existing Chemicals Branch* *Environment Protection Agency*
Charles AUER	*Director* *Office of Pollution Prevention and Toxics* *US Environmental Protection Agency*
Lawrence BACHORIK	*Senior Advisor for International Policy and Communications* *Office of International Programs* *US Food and Drug Administration*
Keith BELTON	*OMB*
Stanley BROWN	*FDA/CDRH/OSEL/DSFM, HFZ-170*
John BUCHER	*NIEHS*
Richard CANADY	*OSTP*
Altaf CARIM	*DOE*

Hongda CHEN	*Cooperative State Research, Education and Extension Service* *USDA*
Flora CHOW	*Senior Scientist, New Chemicals Notice Management Branch* *Chemical Control Division* *US Environmental Protection Agency*
Jeremiah DUNCAN	*Chemical Control Division* *EPA*
Deborah ELCOCK	*Arsonne National Laboratory*
Piotr GRODZINSKI	*NCI*
Susan HAZEN	*Acting Assistant Administrator* *7101M* *US Environmental Protection Agency*
David P KELLY	*Assistant Director for International Policy* *Office of International Programs* *US Food and Drug Administration*
Carl MAZZA	*Air Toxics Coordinator, Office of Air & Radiation - EPA (ANR-445)*
Celia MERZBACHER	*Assistant Director for Tech. R & D* *OSTP*
Jeff MORRIS	*US EPA*
David R. MOUNT	*US EPA Office of Research and Development*
Vladimir MURASHOV	*NIOSH*
Christopher ROTHFUSS	*Office of Space and Advanced Technology* *U.S. Department of State*
Nakissa SADRIEH	*FDA*
John SARGENT	*Commerce*
Nora SAVAGE	*Environment Protection Agency*
Christine SAYES	*Research Scientist* *Center for Biological and Environmental Nanotechnology* *Rice University*
Phil SAYRE	*Associate Director* *Office of Pollution Prevention & Toxics* *US Environmental Protection Agency*
Loretta SCHUMAN	*OSHA*
David SHEETS	*US Army*
Clayton TEAGUE	*Director* *National Nanotechnology Coordination Office*

Sally TINKLE	*NIEHS*
Tracy WILLIAMSON	*Office of Pollution Prevention and* *US EPA (7406)*
Jim WILLIS	*Director, Chemical Control Division* *US EPA*

EC / CE

Eva HELLSTEN	*DG Environment* *European Commission*
Arianna BASSAN	*Institute for Health and Consumer Protection* *Joint Research Centre*
Achim BOENKE	*Principal Administrator* *Directorate General for Entreprise and Industry* *European Commission*
Alessandro DAMIANI	*Head of Science, Technology and Education* *European Commission, Washington Delegation*
Philippe MARTIN	*Principal Administrator* *Directorate General Health and Consumer Protection* *European Commission*
Hermann STAMM	*Joint Research Center (JRC)*

Argentina / Argentine

Alejandro WOLOSIUK	*Dept. of Materials Science and Engineering* *University of Illinois*

China / Chine

Yuliang ZHAO	*The Chinese Academy of Sciences*

India / Inde

Praveer ASTHANA	*Adviser / Scientist-G* *Department of Science and Technology* *Ministry of Science and Technology*

Business and Industry Advisory Committee (BIAC) / Comité consultatif économique et industriel (BIAC)

Terry MEDLEY	*Global Director, DuPont Corporate Regulatory Affairs.* *DuPont Environmental and Sustainable Growth Center*
Tina BAHADORI	*Senior Scientist/Senior Director* *Long Range Research Initiative* *American Chemistry Council*
Craig BOREIKO	*Manager, Environment and Health* *International Lead Zinc Research Organization*

John CARBERRY	*Central Research and Development* *DuPont, US*
Raymond DAVID	*Eastman Kodak Company*
Valérie FROMENT-LOUIA	*Toxicologist* *Dpt Toxicology and Environment* *ARKEMA*
William GULLEDGE	*CHEMSTAR Managing Director* *American Chemistry Council*
Mark HERWIG	*Manager, Chemical Management Programs* *Corporate Environmental Programs* *General Electric Company*
Alix HEYWOOD	*Manager - Biotechnology, Healthcare, Emerging Markets* *US Council for International Business*
Sree JASTI	*Product Regulatory Center of Excellence* *BASF*
Richard JOHNSON	*Senior Partner* *Arnold & Porter*
Hans-Jürgen KLOCKNER	*Head of Unit Science and Research* *Verband der Chemischen Industrie e.V.*
Kenneth MCELRATH	*Vice President, Product Development* *Carbon Nanotechnologies Incorporated*
Hideki MURAYAMA	*Vice President / General Manager* *Research & Development Center* *Frontier Carbon Corporation*
Sean MURDOCK	*Executive Director* *NanoBusiness Alliance*
Mark NELSON	*Vice President, Scientific & Regulatory Policy* *Grocery Manufacturers Association*
Markus PRIDÖHL	*Degussa* *Advanced Nanomaterials*
Michèle REFREGIER	*Health Advisor and Medical Officer* *Luzenac Europe*
George RICKS	*Sr. Industrial Hygiene Chemist* *Albemarle Corporation*
Steven RUSSELL	*Assistant General Counsel* *American Chemistry Council*
Franz SAYKOWSKI	*Managing HSE Administrator* *Bayer AG*
Paul SLATER	*Counsel, Corporate Environmental programs* *General Electric Company*
David WARHEIT	*DuPont Haskell Laboratory*

Hans Juergen WIEGAND	*Degussa AG*

Environmental NGO / Environmental NGO

Brent BLACKWELDER	*President* *Friends of the Earth*
Richard DENISON	*Senior Scientist* *Environmental Defense* *NGO*
Julie FITZPATRICK	*Staff Scientist* *Risk Science Institute* *International Life Sciences Institute*
Ken GEISER	*Professor of Work Environment - Co-Director, Lowell Centre for Sustainable Production* *University of Massachussettes Lowell*
Tracy HESTER	*Partner* *Houston Office* *Bracewell & Guiliani, LLP*
Stephen OLIN	*Acting Executive Director* *ILSI Risk Science Institute*
David REJESKI	*Director, Foresight and Governance Project* *Woodrow Wilson Center*
Karluss THOMAS	*Sr. Scientific Program Manager* *ILSI Health and Environmental Sciences Institute*

OECD / OCDE

Maria del Mar GONZALEZ	*ENVIRONMENT DIRECTORATE* *OECD*
Peter KEARNS	*ENVIRONMENT DIRECTORATE* *OECD*

Other / Autre

Lynn BERGESON	*Bergeson & Campbell*
Rebecca KLAPER	*Shaw Assistant Scientist, Ecology and Genomics* *Great Lakes WATER Institute* *University of Wisconsin-Milwaukee*