

Dear NanoSafe Australia members,

Welcome to the 2nd NanoSafe Australia newsletter, which will bring you up-to-date with the latest developments in the field of nanotoxicology in Australia and abroad. Much has happened since our last newsletter in August 2006 and many of us have been busy promoting our initiatives at numerous conferences and workshops. This issue includes:

- An overview of activities in Australia;
- NanoSafe Australia activities;
- International activities;
- Recent nanotoxicology research papers.

An overview of Australian activities

The NanoSafe Australia network will keep you informed of significant Australian government and industry activities in the field of nanotechnology, focusing primarily on activities concerning health, safety and the environment. Several noteworthy events occurred in the last six months.

National Nanotechnology Strategy Taskforce (NNSTF)

In our last newsletter, we noted that the Report of the NNSTF had been submitted to the Minister for the Dept of Industry, Tourism and Resources (DITR), the Hon Ian Macfarlane MP. The Report, which is entitled "[Options for a National Nanotechnology Strategy](#)" and released by the Minister in September last year, recommends the adoption of a nine-point plan, including the establishment of a dedicated federal office responsible for developing and coordinating the implementation of the National Nanotechnology Strategy. In his Media Release of 12th September 2006, Mr Macfarlane observed that the Taskforce report identifies the importance of capturing the benefits of nanotechnology while also consulting widely to measure its impact on health, safety and environmental (HSE) issues. Mr Macfarlane has circulated the Report to his Ministerial colleagues, and the Government is now considering how it will respond.

The taskforce reported that HSE issues are one of four key policy drivers and "*require immediate attention because they are urgent and have the clear potential to severely hamper the development of nanotechnology in Australia if not addressed*". The report recommends "*...that there is an immediate need to coordinate the management of, and research into, risks arising from HSE issues, and that there is a need to fund HSE research in Australia*".



This report was good news for the members of our network who are planning to begin nanotoxicology studies. The government response to the report will hopefully include funding for the development of a significant nanotoxicology program in Australia, which will be able to contribute to the global effort of this new field. If Australia is seeking to be a global player in the nanotechnology industry, it is paramount that Australia also contributes resources to addressing HSE issues.

You can look at the process of the NNSTF and what DITR is doing at their [nanotechnologies website](#).

Standards Australia NT-001 and ISO TC229 projects

The International Standards Organisation (ISO) is currently developing a Technical Report entitled "*Health and safety practices in occupational settings relevant to nanotechnologies*". Australia is both represented on the project steering group and contributing to the drafting of the report through the Standards Australia NT-001 (Nanotechnology) committee. The report aims to cover the following areas, with an expected completion date in June 2007:

- Description of nanomaterials and manufacturing methods
- Hazard identification and evaluation
- Assessing levels of exposure to nanoparticles
- Risk assessment
- Control methodologies

Australian representatives have also taken on a leadership role in the TC229 Business Planning Taskforce and membership of the Chairman's Standards Roadmap Advisory Group. This Taskforce will play a major role in determining the priorities for the TC229 project, and Australia's leadership gives the NT-001 committee a significant impact.

Our last newsletter described the contribution of the NanoSafe Australia members to the NT-001 committee, specifically WG3 “HSE aspects of Nanotechnologies”.

NHMRC Nanotechnology roundtable

The NHMRC hosted a roundtable discussion on nanotechnology in Canberra on 12th December 2006, to determine their nanotechnology funding strategy for the next triennium. The event represents the first steps by the NHMRC to make nanotechnology a priority and address the EHS issues. A number of NanoSafe Australia members were invited and participated in this event, including Paul Wright (co-ordinator, RMIT), Brian Priestly (ACHHRA, Monash) and Nicola Rogers (CECR, CSIRO).

NICNAS voluntary call for information – Results published

In order to determine the extent to which nanomaterials are impacting on the broader industrial chemicals scene, the National Industrial Chemicals Notification & Assessment Scheme (NICNAS) ran a voluntary call for information from industry last year via its Chemical Gazette and through direct contact with companies. The results have been recently published and the document can be found on the NICNAS [website](#). This document gives a concise overview of the current status of the Australian nanotechnology industry and should be useful in the development of future initiatives. Although NICNAS has not released details of the companies involved in survey, they will pass on any queries that agencies may have.



NanoSafe Australia Activities

Although our program is in its preliminary stages, we now have attracted over 10 research groups nationwide to our network. There are a number of additional groups that may join in the near future and we are also building collaborative links with both local material scientists and nanosciences institutions abroad.

Publications

Our ability to generate successful research interactions was recently demonstrated with the completion of the network’s first initiative, i.e. “*Current OHS best practices for the Australian nanotechnology industry: A NanoSafe Australia position paper*”. We received strong participation from the majority of our members who critically reviewed this manuscript. This timely document provides simple OHS guidance for the burgeoning Australian nanotechnology industry and the manuscript is under review by the *Journal of Occupational Health and Safety – Australia and New Zealand* and is expected to be published as a brochure for distribution to industry and universities. This document has generated much interest and we have written a short related article for *Hazard Alert* concerning OHS for nanotechnology companies. The document will be made available on our website once post-production is completed.

In addition, we have had a commentary concerning the significance of nanotoxicology published in the *Medical Journal of Australia* (Priestly *et al.*, 186(4): 187-188, Feb 19, 2007). This article introduces the readership to the field of nanotoxicology and is part of our mission to inform health professionals of the HSE implications of nanotechnologies.

AZoNano Podcast

In January 2007, Paul Wright participated in a podcast organised by AZoNano and NanoVic. He was asked to comment on issues concerning nanotoxicology and the presentation is now available at the [AZoNano website](#).

Citations

NanoSafe Australia has recently received some media attention and it has been interesting to note the different perspectives that may be taken by reporters on nano-safety issues. We have been quoted by:

- *The Sydney Morning Herald* October 5, 2006. “*Nanotechnology: It’s a small small world*”.
- *ABC online News in Science* December 1, 2006. “*Nanotech fears may be overblown*”.

Conferences, Workshops and Committees

3rd Australian Health & Medical Research Congress (AHMRC)

Our founding members organised and presented in an ASCEPT symposium on nanotoxicology at the 3rd AHMRC in Melbourne, in November 2006 (chaired by John Edwards, Flinders University). We also presented a poster (No. 1375) promoting the establishment of NanoSafe Australia and its research skills to address nanotechnology HSE issues. Both the poster and lectures generated a lot of interest in our activities and we received much correspondence as a result.

CSIRO – Advanced Materials workshop

Andrew Harford was invited to speak at a CSIRO Advanced Materials workshop on 14th February 2007, where he gave a presentation concerning the OHS implications of working with nanomaterials. It was an excellent chance for toxicologists and material scientists to meet and exchange ideas for future safety practices and activities.

Conference for the Australian Epidemiological Association

Some of our members participated in the conference for the Australian Epidemiological Association in September 2006. A poster titled “*Affective evaluation, trust, perceived risk and acceptability of new technology – the case of nanotechnology in Australia*” was presented at the meeting, which examined models that could explain the “affect heuristic” process that determines community perceptions of risk.

ICON Asia workshop

NanoSafe Australia was invited to participate in the ICON Asia workshop in Tokyo on 30th November – 1st December 2006. The workshop was entitled “*The Asian Workshop on International Collaboration on Nanotechnology Environmental Health & Safety*” and Andrew Harford’s participation has certainly fostered future collaborations with international nanotoxicology groups. It was a great opportunity to learn about government strategies of Asian countries, as well as the activities of ICON. Andrew’s full report of the workshop can be downloaded from the resources section of our [website](#). However, two ICON activities are particularly worthy of note here:

The first is an extensive study that was conducted by The University of California, on behalf of ICON entitled “*A review of current practices in the nanotechnology industry*”. The study surveyed a number of nanotechnology facilities and asked

questions concerning the OHS practices they employed. It is the first study of its kind and we can personally appreciate the large effort that went into the project. ICON achieved an excellent participation rate for the project, and this presentation created a lively discussion, especially concerning its value and limitations. The general conclusion was that there was a bias within the results due to the methods used in gathering data (e.g. voluntary self-reporting by administrators and management) and that there was further value that could be extracted from the results (e.g. a profile of industries that were less likely to have good practices).

Secondly, ICON has begun an EHS database (<http://icon.rice.edu/research.cfm>), which aims to be a comprehensive collection of all the research conducted in the field of nanotoxicology. The database contains abstracts and citations for research papers related to the EHS issues of nanomaterials. Some entries have links to full papers, although site registration or payment may be required to access the full content of these articles. Nevertheless, this database should be heavily used by all nanotoxicologists, and if you find that your own work is missing, please contact ICON and they will add your article.

International Conference on Nanotechnology Occupational & Environmental Health & Safety: Research to Practice

This conference was held in Cincinnati during December, 2006 and was sponsored by NIOSH and the USEPA. The aim of this conference was to advance nanotechnology OHS with respect to:

- Protection and promotion of worker safety and health in nanomanufacturing enterprises/environment and consumer public health, and
- Prevention and treatment of occupational diseases through the use of nanotechnology.

Australia was represented at the conference by Brian Gulson and his notes will be posted soon on the NanoSafe Australia [website](#).

Advisory Committee on Chemical Safety

The Advisory Committee on Chemical Safety is an expert committee advising the Australian Government Office of Chemical Safety (OCS) and NICNAS, which has carriage of the development of health-related regulation of nanomaterials and input into international regulatory program developments (e.g. OECD). NanoSafe Australia representative, Brian Priestly, is making nanotoxicological contributions to the agenda and staying in touch with national and international regulators through this forum.

International Activities

ASTM Terminology

The Committee E56 on Nanotechnology of the international standards organization, ASTM International, issued its first standard in December 2006 entitled “[Terminology for Nanotechnology](#)”. The ASTM terminology aims to standardise communication within the field of nanotechnology and will undoubtedly be expanded in the future. [E56](#) consists of 75 members, meeting biannually (May & November).

OECD Working Party on Manufactured Nanomaterials (WPMN)

In September 2006, the OECD council established a new Working Party on Manufactured Nanomaterials (WPMN), which is now a subsidiary body of the Chemicals Committee. The working party met for the first time in October 2006, where they agreed to a draft programme of work to address HSE issues of manufactured nanomaterials. Australian representatives from NICNAS are participating in this working party and have made submissions concerning developments in Australia. Further information on the development of this working group can be found on their [Safety of Manufactured Nanomaterials website](#). Documents from this website are a good source of information for those wanting to gauge the response of various countries to this issue.



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The nano-debate in the USA

Recent information from the USA indicates that their debate concerning nanotechnology EHS has become very lively. Many organisations have submitted statements to numerous public meetings that were held in the last six months to discuss the need for EHS research. It would have been very interesting to observe these meetings as various media reports have indicated that these were vigorous debates and the USA regulators have received some criticism.

The Woodrow Wilson International Center for Scholars appears to be taking a lead role in moving the nanotechnology EHS agenda forward. At a meeting of the House Science Committee (21-09-06) Andrew Maynard stated that, “*The federal government needs to invest a minimum of \$100 million over the next two years in targeted risk research in order to lay a strong, science-based foundation for safe technology*”). They also released a [report](#) authored by a former government official, which claims the FDA lacks the resources to address nanotechnology EHS issues and faces legal gaps.

The US National Nanotechnology Initiative released a [report](#) on EHS research needs in September 2006, which was followed by a public meeting held on January 4, 2007, by the National Nanotechnology Coordination Office (NNCO). Comments and recommendations made or submitted at the meeting will be used to inform “...*strategic and interim goals for filling the EHS information needs gaps for nanomaterials*”. Further information can be found at the [NNCO website](#).

Dupont and the NGO “Environmental Defense” have jointly release a draft document entitled “[Nano Risk Framework](#)”. This document aims to be a framework for the responsible development, production, use and disposal of nano-scale materials and they are looking for feedback so that they “...*can make this framework as effective, practical, and useful for as wide an audience as possible*”. This is an admirable initiative and will undoubtedly generate much discussion. It is wide-reaching and contains many familiar elements of a traditional risk assessment. However, they have also refined certain components to address some of the specific needs for nanomaterials. We encourage everyone to read this document and submit their comments by 30th March, 2007.

NIOSH have been moving ahead with their nanotoxicology projects and have recently released a new OHS guidance document entitled “*Progress toward safe nanotechnology in the workplace*” – available from their [website](#). NIOSH states that, “*This document is a report of the progress of the NIOSH Nanotechnology Research Center (NTRC) since its inception in 2004 through 2006. Using only internally redirected resources, the NTRC has begun to make contributions to all the steps in the continuum from hazard identification to risk management*”. This document is a “must-read” for all nanotechnology OHS managers and personnel handling nanomaterials in the workplace.

The Center for Biological and Environmental Nanotechnology (CBEN) at Rice University has received an additional US\$12M from the National Science Foundation, which will be used to fund studies concerning the health and environmental impacts of nanotechnologies. Much of the leading nanotoxicology research is being generated by CBEN and their activities are worth watching.

One of the most interesting stories to come out of the USA concerns the EPA's decision to begin regulating products containing nano-silver. The US government has held the position that adequate regulatory frameworks are in place for nanotechnologies and therefore agencies should "go forth and regulate" using existing legislation. The EPA has taken on this challenge and their decision represents a world-first attempt to regulate nanomaterials in consumer products. The new ruling is based on legislation that was introduced to control pesticides. Many products containing nano-silver are making claims of biocide/antibacterial properties and the EPA is viewing these products as pesticides. Consequently, they have asked companies to provide scientific evidence that the products do not pose environmental risks. However, companies are already finding loopholes in the legislation and are removing claims of antibacterial properties. It is highly likely that these issues will appear in a US federal court in the near future. This story does not appear on the EPA's website but many other internet sites have reported on this matter, including the [Washington Post](#) website.

Meanwhile, in Europe...

The UK Department for Environment, Food, and Rural Affairs (DEFRA) launched a voluntary reporting scheme for engineered nanoscale materials on 22nd September 2006. This program aims to understand the characteristics of engineered nanoscale materials while stimulating a debate on appropriate controls. Likewise, the USEPA are considering a similar scheme. Information about this scheme and other UK nanotoxicology activities can be found on the [DEFRA nanotechnologies website](#).

The French public research centre (CNRS) is also getting involved in nanotoxicology. Their ethics committee published several recommendations recently on nanotechnology [health and environmental impacts](#). They have also launched a three year project that will investigate the [safety of carbon nanotubes](#). The federal German institute of occupational health and safety (BAuA) has also published a [research strategy](#) for HSE risks of nanoparticles.

Recent Nanotoxicology Papers

- 1) Balbus JM, Florini K, Denison RA, Walsh SA. *Getting it right the first time: developing nanotechnology while protecting workers, public health, and the environment*. Ann NY Acad Sci 2006, 1076:331-42.
- 2) Balbus JM, Florini K, Denison RA, Walsh SA. *Protecting workers and the environment: An environmental NGO's perspective on nanotechnology*. J Nanopart Res 2007, 9(1):11-22.

These two papers by Environmental Defense call for two immediate initiatives: 1) a major increase in the federal investment in nanomaterial risk research; 2) rapid development and implementation of voluntary standards of care, pending development of adequate regulatory safeguards in the longer term.

- 3) Cherukuri P, Gannon CJ, Leeuw TK, Schmidt HK, Smalley RE, Curley SA, Weisman RB. *Mammalian pharmacokinetics of carbon nanotubes using intrinsic near-infrared fluorescence*. PNAS 2006, 103(50):18882-18886

This paper investigates the pharmacokinetics of SWCNTs following intravenous administration to rabbits. The results show that significant concentrations were found in the liver 24 h after exposure.

- 4) Cross SE, Innes B, Roberts MS, Tsuzuki T, Robertson TA, McCormick P. *Human skin penetration of sunscreen nanoparticles: In vitro assessment of a novel micronized zinc oxide formulation*. Skin Pharmacol Physiol 2007, 20(3):148-154.

This Australian research group have used Franz-type diffusion cells to assess the penetration of ZnO nanoparticles. They conclude that "minimal nanoparticle penetration occurs through the human epidermis".

- 5) Kandlikar M, Ramachandran G, Maynard A, Murdock B, Toscano W. *Health risk assessment for nanoparticles: A case for using expert judgment*. J Nanopart Res 2007, 9(1):137-156

This article suggests ways of dealing with the large uncertainties when conducting risk assessments for nanomaterials.

- 6) Maynard AD, Aitken RJ, Butz T, Colvin V, Donaldson K, Oberdorster G, Philbert MA, Ryan J, Seaton A, Stone V, Tinkle SS, Tran L, Walker NJ, Warheit DB. *Safe handling of nanotechnology*. Nature 2006, 444:267-9.

This short discussion paper was written by some of the world's leaders in nanotoxicology and is essential reading for all interested researchers. It lists "five grand challenges" for future nanotoxicology research.

- 7) Pulskamp K, Diabate S, Krug HF. *Carbon nanotubes show no sign of acute toxicity but induce intracellular reactive oxygen species in dependence on contaminants*. Toxicol Lett 2007, 168(1):58-74.

This paper concludes that biological effects of CNTs are due to trace metals associated with commercial nanotubes.

- 8) Rouse JG, Yang J, Ryman-Rasmussen JP, Barron AR, Monteiro-Riviere NA. *Effects of mechanical flexion on the penetration of fullerene amino acid-derivatized peptide nanoparticles through skin*. Nano Lett 2007, 7(1):155-60.

This paper demonstrates that flexed skin is more permeable to nanoparticles.

- 9) Ryman-Rasmussen JP, Riviere JE, Monteiro-Riviere NA. *Surface coatings determine cytotoxicity and irritation potential of quantum dot nanoparticles in epidermal keratinocytes*. J Invest Dermatol 2007, 127(1):143-53.

This paper demonstrates that the surface chemistry of QDs is significant in their cytotoxicity.

- 10) Teeguarden JG, Hinderliter PM, Orr G, Thrall BD, Pounds JG. *Particokinetics in vitro: Dosimetry considerations for in vitro nanoparticle toxicity assessments*. Toxicol Sci 2007, 95(2):300-12.

This paper by international collaborators of NanoSafe Australia discusses a dosimetry model that describes *in vitro* “particokinetics” and highlights the problems with using traditional metrics of dose.

- 11) Vallhov H, Qin J, Johansson SM, Ahlborg N, Muhammed MA, Scheynius A, *et al*. *The importance of an endotoxin-free environment during the production of nanoparticles used in medical applications*. Nano Lett 2006, 6(8):1682-6.

This paper demonstrates that biomolecules absorbed to the surface of nanomaterials can be the cause of observed inflammatory effects.

- 12) Warheit DB, Webb TR, Colvin VL, Reed KL, Sayes CM. *Pulmonary bioassay studies with nanoscale and fine-quartz particles in rats: toxicity is not dependent upon particle size but on surface characteristics*. Toxicol Sci 2007, 95:270-80.

This paper argues that particle size and surface area are not the most important characteristics leading to toxicity from quartz particles. Their results demonstrate that the pulmonary toxicities of alpha-quartz particles correlate better with surface activity than particle size and surface area.

- 13) Wick P, Manser P, Limbach LK, Dettlaff-Weglikowska U, Krumeich F, Roth S, *et al*. *The degree and kind of agglomeration affect carbon nanotube cytotoxicity*. Toxicol Lett 2007, 168(2):121-31.

This paper demonstrates the importance of agglomeration state in toxicity and the need for comprehensive material characterisation. They also compared CNT effects with asbestosis, which was used as a reference material.

Book

Particle Toxicology. Donaldson K and Borm P (eds), CRC Press, ISBN 978-0-8493-5092-4. 456 pp (released Jan '07).

This is a comprehensive book that reviews the accumulated knowledge concerning the toxicity of particles. It focuses somewhat on data from anthropogenic particulates such as air pollution, asbestos, silica and carbon black and is edited by two leading European researchers. It is a “must-read” for nanotoxicology researchers.



We hope you enjoyed this edition of the NanoSafe Australia newsletter. We welcome any contributions that members would like to make to future newsletters and we look forward to your participation. We would also appreciate any comments from non-members who are interested in nanotoxicology and the HSE issues of nanotechnologies.

For further information please visit our website www.rmit.edu.au/rd/nanosafe

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