Editorial

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Biographical notes: S.K. Sundaram, a Materials Scientist, joined the Pacific Northwest National Laboratory first in 1994 as a post-doctoral fellow and then as a Senior Research Scientist in 1996. He became Chief Materials Scientist in January 2002. Overall, he has over 13 years of scientific, technical, and managerial experience. On the technical front, he has worked/been working on several aspects of advanced materials science and engineering. His major areas of interest and contributions are millimetre/THz wave materials diagnostic technologies, integrated infrared photonic materials and devices, and nanomaterials synthesis and characterisation. He is now leading a team of scientists and specialists to develop spectroscopic technology for rapidly screening and identifying environmental biomarkers on exposing live ling cells to nanoparticles. This technology has the potential of rapid screening of medical biomarkers for drug development and discovery. He has over 80 peer-reviewed publications and technical reports and made over 100 technical presentations. He has also organised/co-organised several national and international symposia on advanced topics in materials science. He is a Fellow of the American Association of Advancement of Science (AAAS) and the American Ceramic Society (ACerS). He has won several awards, including two R&D100 awards (2001 and 2006) and honours.

Tom Weber is a Senior Research Scientist in the Department of Cell Biology and Biochemistry at the Pacific Northwest National Laboratory. He received his PhD in Toxicology from Texas A&M University in 1994 and completed a postdoctoral fellowship in the area of renal toxicology at The University of Texas at Austin, funded by the National Institute of Environmental Health Sciences. He conducts basic research on the toxicity of chemical, biological and physical agents to develop a fundamental understanding of cell signaling pathways perturbed by the toxicant and associated molecular mechanisms of action. His primary research interests include the regulation of low dose radiation toxicity, wound repair and carcinogenesis. He is currently funded by the Department of Energy Low Dose Radiation Research Program to define epigenetic mechanisms of carcinogenesis operative at low dose exposures. Recent efforts also include the development of multidisciplinary teams for Systems Biology approaches with a focus on identifying protein complexes that regulate key signal transduction pathways and application of findings to transduction events operative *in vivo*. He is an *ad hoc* reviewer for *Toxicology Letters* and is a member of the editorial board for *Environmental Health Perspectives.*

Engineered nanomaterials promise great societal benefits ranging from commercial applications to medical therapeutics. It is crucial that nanomaterials are developed in a safe and responsible manner to enable maximum benefit to society. The field of nanotoxicology has emerged to guide the safe development of nanomaterials, however, nanotoxicity studies have significantly lagged behind the rapid production and marketing of these important materials.

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Engineered nanomaterials are defined as materials with at least one dimension of 100 nm or less. Early research indicates that the biological activity of nanomaterials is strongly influenced by their physicochemical properties, which are often not routinely characterised in toxicity screening studies (e.g., particle size and size distribution, agglomeration state, shape, crystal structure, chemical composition, surface area, surface chemistry, surface charge, and porosity). Further, nano-sized particles can cross cellular membranes by phagocytic and nonphagocytic mechanisms, which may facilitate their access to sites within cells and tissues not previously or routinely observed by toxicologists and other health professionals. The potential for nanomaterials to cause effects by operating at unique sites of action within cells and tissues has contributed to the uncertainty surrounding nanomaterial toxicity assessment.

The rapid proliferation of engineered nanomaterials into the market place is a significant challenge for researchers trying to define the science underlying exposure and risk. This gap between development/deployment of nanomaterials and safety assessment also poses a dilemma to regulators regarding hazard identification. Recent toxicological data demonstrate the complex relationship between toxicity and particle characteristics that includes surface coatings and have dispelled some generalised notions, e.g., *smaller particles are always more toxic*. Thus, research advancements are beginning to impact risk assessments that will be used to regulate the use of nanomaterials in consumer products, their release into the environment and human occupational exposure. In this milieu, we present a collection of eight key publications in this *Special Issue on Nanotoxicity* that covers a wide range of topics in this dynamic area of science and engineering.

1 Owen R. Moss, 'Insights into the health effects of nanoparticles: why numbers matter'

2 Christie M. Sayes and David B. Warheit, 'An in vitro investigation of the differential cytotoxic responses of human and rat lung epithelial cell lines using TiO_2 nanoparticles'

3 Priya Santhanam, James G. Wagner, Alison Elder and Robert Gelein, Janet M. Carter, Kevin E. Driscoll, Günter Oberdörster, and Jack R. Harkema, 'Effects of subchronic inhalation exposure to carbon black nanoparticles in the nasal airways of laboratory rats'

4 Barbara J. Panessa-Warren, John B. Warren, Mathew M. Maye, Daniel van der Lelie, Oleg Gang, and Stanislaus S. Wong, 'Human epithelial cell processing of carbon and gold nanoparticles'

5 Scott C. Wasdo, David S. Barber, Nancy D. Denslow, Kevin W. Powers, Maria Palazuelos, Stanley M. Stevens Jr., Brij M. Moudgil, and Stephen M. Roberts, 'Differential binding of serum proteins to nanoparticles'

6 Michael G. Tyshenko, 'Medical nanotechnology using genetic material and the need for precaution in design and risk assessments'

7 Stacey L. Harper, Jennifer A. Dahl, Bettye L.S. Maddux, Robert L. Tanguay, and James E. Hutchison, 'Proactively designing nanomaterials to enhance performance and minimise hazard'

8 Michael G. Tyshenko and Daniel Krewski, 'A risk management framework for the regulation of nanomaterials'.

Nanotechnology presents a historic opportunity, challenges us to find that fine balance between exposure, risk, and commercialisation, and also inspires us to head to uncharted territories. We hope this special issue informs, excites, and enlightens those actively engaged in this exciting endeavour.