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Anthropogenic nanoparticles in the environment

Omowunmi A. Sadik

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Nanoparticles are ubiquitous in the environment. They may originate from natural and anthropogenic sources. Natural nanoparticles are those that are produced in nature, and they include ocean spray, forest fire, dust storms, volcanic ash and biological particles such as bacteria and fungi. Humans have long been exposed to other naturally occurring nanoparticles resulting from combustion, and the human body is well adapted to protect itself from these potentially harmful intruders. Anthropogenic nanoparticles are man-made and may result in incidental exposure. These man-made nanoparticles fall into two categories: the first category has no predetermined size and may exhibit undefined chemistry. Examples are combustion particulates, diesel exhaust, welding fumes and coal fly ash. The second category of anthropogenic nanoparticles, also known as engineered nanoparticles (ENPs), exhibit specific size ranging from 1–100 nm. They are pure materials with controlled surfaces. Examples include fullerenes, carbon nanotubes, dendrimers, quantum dots, TiO_2, gold and silver nanoparticles.

The number of ENPs currently on the market is large, and is expected to increase with advances in synthetic and technological developments. The use of ENPs in consumer products may also lead to a rise in the level of anthropogenic nanoparticles in the environment. Depending on their composition, size and morphology, some ENPs may be virtually non-toxic, especially if they are contained in coatings, microelectronics, and other nanoengineered materials. However, some free, un-contained ENPs are capable of entering the body system to exhibit a biological activity that is detrimental to the body due to their associated nanostructure.

There are a number of unresolved questions for the free, un-contained nanoparticles: How do we distinguish between anthropogenic, incidental and naturally occurring sources? How are they generated? In which waste streams are they discarded? How are they transformed in the environment? Where do they end up in the environment? How do they find their way into the human body system and the potential human food sources? What effects do they have on humans? These are the many questions that are still unanswered despite the amount of research conducted to date.

The articles contained in this first issue of ESPI have tried to address some of these questions in an attempt to move the frontier of this science a little further forward, and to improve our understanding of nano-particulates in general. Philip Demokritou and his co-workers

Center for Advanced Sensors & Environmental Systems, State University of New York at Binghamton, Binghamton, NY, USA

Wunmi Sadik is Professor of Chemistry & Director, Center for Advanced Sensors & Environmental Systems at State University of New York at Binghamton (SUNY-Binghamton). She received her PhD in Chemistry from the University of Wollongong in Australia and did her postdoctoral research at the US Environmental Protection Agency (US-EPA). Her research areas include interfacial molecular recognition processes, chemical and biosensors and their application to solving problems in biological systems, energy and the environment. Dr Sadik has authored over 130 research papers and 9 patents/patent applications. She has given 120 keynote and plenary lectures, and several invited lectures at national and international conferences and has contributed 150 conference lectures and posters. Dr Sadik chaired the first Gordon Research Conference on Environmental Nanotechnology in 2011 and the first annual conference of the sustainable nanotechnology organization in 2012 of which she is a co-founder.

have examined the physicochemical and toxicological characteristics of welding fumes generated from real time welding processes (DOI: 10.1039/C2EM30505D). They have assessed the toxicological properties of these particles with respect to the size of the particles using the Harvard compact cascade impactor. The results of their investigation have confirmed the hypothesis that smaller particles generate more reactive oxygen species, and that these should be evaluated carefully for risk assessment. Antonia Praetorius *et al.* have discussed the challenges of exposure assessment of ENPs due to the novelty of their properties and their wide-ranging characteristics (DOI: 10.1039/C2EM30677H). The authors have proposed the use of exposure modeling as a method for addressing the complexity, as well as encouraging improved communication and collaboration between modelers and experimental scientists. Mehmet Ates and co-workers have presented a comparative evaluation of the impact of Zn and ZnO nanoparticles on brine shrimp (*Artemia salina*) larvae (DOI: 10.1039/C2EM30540B). They have found that the suspensions of the nanoparticles did not exhibit any significant acute toxicity within 24 hours. Mortalities increased remarkably in 96 hours and escalated with increasing concentration of nanoparticle suspension to 42% for Zn NPs (40–60 nm) (LC_{50} 100 mg L^{-1}) and to about 34% for ZnO NPs (10–30 nm) (LC_{50} > 100 mg L^{-1}). The suspensions of Zn NPs were found to be more toxic to *Artemia* than those of ZnO NPs under comparable regimes. These and many other interesting articles in this issue provide a survey of the field and the directions for future advances.

