

Understanding and Predicting the Toxicity of Manufactured Nanomaterials

Supporting/Contributing Agency: U.S. EPA

To understand and ultimately predict the potential complex interplay between man-made nanomaterials and the health of living organisms, experimental and computer modeling research led by Drs. Bonzongo and Kopelevich at the University of Florida unravels some of the previously unknown effects of nanomaterials. When contact between hydrophobic carbon-based nanomaterials and living organisms is facilitated by use of organic solvents or surfactants, nanomaterials easily penetrate the cell membrane, and their residence time within the membrane would vary with both size and shape of the particles. Also, while the spherical fullerenes (or C60) tend to induce toxicity through both chemical reaction with cell membrane components and membrane physical rupture, the accumulation of the tubular carbon nanotubes (CNTs) within cell membranes seems to primarily increase pressure within the membrane, resulting in dysfunctions of membrane proteins and toxicity.

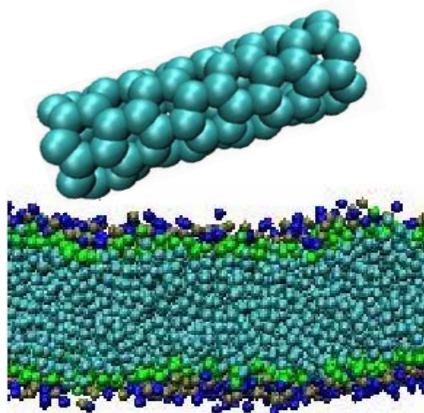


Figure. Molecular model of a cell membrane and a carbon nanotube.

With regard to the environmental fate, the suspension of carbon and metal-based nanomaterials such as nano-silver (*nAg*) and nano-copper (*nCu*) in natural river waters shows that solution chemistry affects not only the degree of particle dispersion/suspension but also the biological response of aquatic organisms exposed to such suspensions, suggesting that data obtained from experimental methods that use distilled water as solvent and drastic methods such as ultrasonification to produce nanomaterial suspensions for toxicity tests may not be representative of what could occur in natural systems.

Finally, pollutants adsorbed onto nanomaterials used in remediation processes could become bioavailable and hazardous under specific environmental conditions. Some of the above findings are found in the publications listed below.

References/Publications

- Griffitt, R.J., J. Luo, J. Gao, J.C. Bonzongo, and D. Barber. 2008. *Envir. Toxicology and Chemistry* 27(9):1972
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- Kopelevich, D.I., J.C. Bonzongo, et al. 2008. Potential toxicity of fullerenes and molecular modeling of their transport across lipid membranes. In V.H. Grassian, ed., *Nanoscience and nanotechnology: Environmental and health impacts*. Hoboken, NJ: John Wiley & Sons, Inc.