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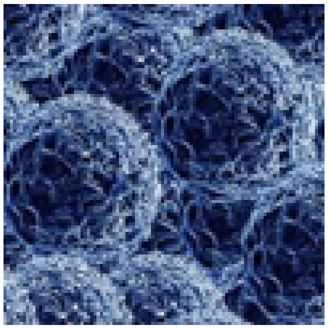
Is it Safe?

University of Dayton, Ohio (url: http://www.udayton.edu/index.php)



Is it Safe?

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A University of Dayton biologist and materials engineer are taking a two-pronged approach to understanding the harmful effects of microscopic particles increasingly found in common products such as socks, sunscreen, cosmetics, surgical scalpels, tires and lithium batteries.

The National Institutes of Health recently awarded a three-year grant of $350,000 to assistant biology professor Yiling Hong and Khalid Lafdi, Wright Brothers Institute Endowed Chair in Nanomaterials, for research on the toxicity of manufactured nanoparticles on stem cells.

Most research on nanoparticle toxicity has focused primarily on one aspect, such as how the particles are made or how cells react to nanoparticles, Lafdi said. By combining their individual expertise in the complex chemistry of manufacturing nanoparticles and the biological responses of cells and DNA, Lafdi and Hong hope to identify precisely what makes a nanoparticle more or less toxic and how to make them safer.

"Nanotechnology has enormous potential for biomedical applications; however, we face a major challenge in understanding how nanoparticles affect our bodies and overall health," said Hong. "This research is providing a critical first step in evaluating the safety and medical implications of nanoparticles."

Nanoparticles have unique properties that cause some to have toxic characteristics not present in larger forms of the same materials, such as silver or zinc oxide, Hong said. In previously published studies, Hong and her colleagues have demonstrated that carbon nanotube and nanosilver particles can cause DNA damage to and sometimes the death of mouse embryonic stem cells.

Human embryonic stem cells will not be used in the study. Hong's lab will use mouse embryonic stem cells, induced human pluripotent stem cells and human mesenchymal stem cells.

"Stem cells are especially sensitive and are a unique model to study the effect of nanoparticles on cells and DNA," Hong said. "Understanding how nanoparticles affect stem cell differentiation and self-renewal will greatly enhance consumer confidence and provide guidance for health managers when using these materials."

Hong's lab plans to investigate three nanoparticle types most common in commercially available products:

- Carbon, used in car wax, fuel lines, cosmetics
- Silver, used in antimicrobial wound dressings, odor-reducing socks
- Zinc oxide, used in sunscreens.

Lafdi is a leader in the field of carbon materials and inventor of Nano Adaptive Hybrid Fabric (NAHF-X), a tailored nanomaterial capable of being produced in quantities large enough to be viable for large-scale commercial use.

He will focus on nanomaterials processing and their surface chemistry. The surface chemistry of nanoparticles and their interaction to their future host environment are critical, Lafdi said. He plans to alter surface chemistry using various techniques to enhance the safe use of nanoparticles in terms of compatibility, targeting and cellular uptake.

"Nanoparticles can be beneficial, but they can also be harmful," Lafdi said. "The good news is they can be fine tuned. If we can understand how the chemistry of the nanoparticle interacts with the biological environment, we should be able to develop a mathematical model that reduces toxicity and makes them safe."

Hong and her colleagues have published articles showing the toxic effects of nanoparticles at the cellular and molecular levels in *Toxicology in Vitro* (August 2011), *Toxicology and Applied Pharmacology* (September 2008), and *Nano Letters* (August 2007).

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