

What is Nanotechnology?

Nanotechnology involves the manipulation of materials and the creation of structures and systems that exist at the scale of atoms and molecules. One nanometer (nm) is one thousandth of a micrometer (μm), one millionth of a millimeter (mm) and one billionth of a meter (m). If you were to imagine that a nanometer is represented by a person, a red blood cell would be more than 4 miles long! The properties of nanoscale materials (measuring $<100\text{nm}$) differ significantly from larger scales. Nanomaterials introduce new and often heightened risks of toxicity that remain poorly understood.

Nanoparticles are already being used (unlabelled) in hundreds of consumer products including sunscreens and cosmetics

Our research demonstrates that nanoparticles have entered just about every personal care product on the market, including deodorant, soap, toothpaste, shampoo, hair conditioner, sunscreen, anti-wrinkle cream, moisturizer, foundation, face powder, lipstick, blush, eye shadow, nail polish, perfume and after-shave lotion. Nano-scale titanium dioxide and zinc is widely used in sunscreens. While we don't know how widespread the use of nanoparticles is in sunscreens on the U.S. market – in Australia estimates in 2006 showed that 70% of titanium dioxide sunscreens and 30% of zinc sunscreens sold in Australia contain 'manufactured' nanoparticles.ⁱ Major cosmetics manufacturers including Revlon, L'Oreal, Lancôme, Avon and The Body Shop also use nanoparticles.

Nanoparticles in sunscreens and cosmetics could cause skin damage

Scientific studies have shown that nanoparticles of titanium dioxide and zinc oxide commonly used in sunscreens and cosmetics can produce free radicals,ⁱⁱ damage DNAⁱⁱⁱ and cause cell toxicity,^{iv} especially when exposed to UV light.^v The concern is that rather than offering us sun protection, nanoparticles used in sunscreens and cosmetics could actually result in serious skin damage.

A world first study shows next generation harm from nanoparticles

A recent 2009 study by Japanese researchers shows the transfer of nanoparticles of titanium dioxide from pregnant mice to their offspring, with related brain damage, nerve system damage and reduced sperm production in male offspring.^{vi} This is concerning because titanium dioxide is one of the most widely used nanoparticles, found in cosmetics, sunscreens, food packaging, paints, wall coatings, dirt repellent coatings for windows, car coatings, etc.

No-one knows whether nanoparticles in sunscreen will penetrate intact skin, but it seems likely they could be taken up by damaged or sun burnt skin

Government agencies worldwide are currently researching whether or not nanoparticles in sunscreens can penetrate intact healthy skin. However scientific studies have shown that nanoparticles not used in sunscreen can penetrate skin,^{vii} especially if skin is flexed^{viii} (as during exercise), or exposed to penetration enhancers^{ix} (as are found in many cosmetics). Damaged skin can take up particles 70 times bigger than a nanoparticle,^x suggesting that skin penetration by nanoparticles is likely in people with eczema or acne. Recent research has shown that skin penetration is also more likely in sunburnt skin.^{xi} We don't know if nanoparticles would more likely penetrate thinner skin – e.g. in elderly people or babies.

“Fullerenes” used in cosmetics pose particularly concerning toxic risks and we do know that they penetrate intact skin

Fullerenes – hollow soccer ball shaped particles made of carbon atoms - are extremely small (0.7nm diameter) so they have very high bioavailability (access to cells etc). Early studies have shown that fullerenes can penetrate intact skin, especially if skin is flexed^{xii} or exposed to penetration enhancers.^{xiii} Preliminary research suggests that in some forms of fullerenes pose very serious toxicity risks. Carbon fullerenes (buckyballs) have been found to cause brain damage in fish,^{xiv} kill water fleas and have bactericidal properties^{xv}. Even low levels of exposure to water soluble fullerenes have been shown to be toxic to human liver carcinoma cells and dermal fibroblasts in test tube studies.^{xvi} Fullerene-based amino acid nanoparticles have been found to decrease the viability of human epidermal cells and to initiate a pro-inflammatory response.^{xvii} Perhaps of most concern, even forms of ‘pristine’ fullerenes that are non-toxic in dark conditions can be highly toxic when exposed to UV light.^{xviii}

Cosmetics in which fullerenes are found that are sold in the United States include:

Circuit Addict: <http://www.circuitskin.com/inc/pdetail?v=1&pid=51>

Circuit White Out: <http://www.circuitskin.com/inc/pdetail?v=1&pid=46>

Circuit O.M.G. Serum: <http://www.circuitskin.com/inc/pdetail?v=1&pid=2270>

However with no regulation or labeling in place – it's impossible to determine the full extent of fullerenes use in cosmetics products.

Senior scientists have called for nanoparticles to face new safety testing – what are governments doing?

The United Kingdom’s Royal Society, the world’s oldest scientific institution, has recommended that given the evidence of serious nanotoxicity risks, nanoparticles should be treated as new chemicals^{xx} and subject to new safety assessments before being allowed in consumer products.^{xx} Yet, none of the nano-cosmetics on the market are subject to approval by the US Food and Drug Administration (FDA) before being put on the shelves.^{xxi} While agencies in the U.S. have hesitantly acknowledged the dangers posed by manufactured nanoparticles, the European Union has taken action to protect the public. New rules passed in Europe on March 2009 will require nanoparticles in cosmetics to be labeled on the ingredients list; the regulation will also require increased safety testing for cosmetics containing nanoparticles.^{xxii}

[For more information on nanotechnologies and cosmetics, please refer to two reports by Friends of the Earth U.S. and Australia: “Nanomaterials, Sunscreens and Cosmetics: Small ingredients, Big Risks” and “Nanotechnology and Sunscreens: A Consumer Guide for Avoiding Nano-sunscreens.” These reports can be downloaded at: www.foe.org]

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