Nanoparticles: Misconceptions clarified -
Interview with Dr. Gerhard Nohynek, Scientific Director, Worldwide,Safety Evaluation at L'Oréal

Nanopartikel: Vorurteile korrigieren

For a long time there has not been any international agreement on the definition of nanotechnology products or nanoparticles. Is there an internationally recognised definition of nanotechnology now?

This is indeed a key question. There are too many definitions. "Nanoscale" means a dimension between 1 and 100 nm – although there is no evidence that substances having this dimension are more dangerous than others. Even the definitions of different EU Scientific Committees are not identical. In addition, sunscreen-grade nanoparticles tend to agglomerate and thereby form much larger particles in sunscreen formulations. Some definitions proposed that man-made nanomaterials have one or more dimensions in the nano-range.

But which natural, biological or man-made material does not have at least one dimension at the nano-range? Your desk or our lap top, inside and outside, are man-made and have some nano-features. Our own body and our cells are man-made by definition and have plenty of nano-features: cell function, enzymes, metabolism, DNA replication, they all take place on a nano-level. Life would not exist without nano-features or nano-events that take place billions of times every microsecond in our own organism. So, what's so scary about nano?

But let's come back to man-made materials. Just think about carbon nanotubes (CNT) that started yet another nano-scare in 2005/2006. CNT are fibres that have an incredible strength, they conduct electricity, maybe one of the key materials of future technologies. Yet, CNT were branded as the new asbestos and nano was immediately associated by the media with asbestos-like cancer health risks. Indeed, CNT are small, insoluble fibres, and their inhalation produces typical fibre toxicity, similar to that of asbestos or other insoluble, small fibres. Yet, the external appearance of CNT is not nano: CNT fibres are built like straws: they are several micrometers long with a diameter in the micrometer range. Their only nano-aspect is the thickness of the tube's carbon walls, indeed in the nano-range, i.e. < 100 nm. So, carbon nanotubes are small fibres that only have a single nano-aspect, i.e. their wall thickness. Are CNT genuine nano-materials? Yes, in a single aspect they are, but generally they are small, insoluble fibres that display the long-known and well-researched toxicity typical for such materials.

Anything new here? Maybe, it is only much hype and no nano-related facts. By the way, carbon nanotubes are not used in personal care products.

Is there any natural or non-cosmetic exposure of humans to nanomaterials?

Of course, there is plenty. For example, carbon nanotubes were found in 700 m depth in the ice core of Greenland, they are about 10000 years old and probably generated by forest fires. Carbon nanotubes and nanoparticles are also found in polluted city air. Human food contains plenty of natural nanomaterials, mainly clays from soil residues that adhere to fruit and vegetables. Here we should consider that the principal human inhalation exposure to nanoparticles (inhalation is probably the exposure pathway of highest concern) happens in our homes and kitchens – as well as churches. Burning candles, burning natural gas, cooking, baking and frying generate substantial concentrations of nanoparticles, up to 10 higher concentration than those found in polluted city air. Toasters are known to emit carbon nanoparticles and carbon nanotubes; so you might start your day with inhalation exposure to nanoparticles. But we should not be over duly worried: their air concentrations are relatively low.

Given that most of the studies investigating indoor air pollution titled their test materials ultra-fine particles and not nanoparticles, (although both terms address the same particle size) their presence in our homes and the subsequent human inhalation exposure largely escaped the attention of nanotoxicologists and EU Committees. Overall, wherever there is fire and heat, there is an emission of nanoparticles.

Nihil novum sub sole, said the Romans (Nothing new under the sun). Perhaps "nano" is just a new label for a traditional human exposure that is as long as human history and the invention of fire. Yet, today there are more than *2* million new cases of UV-induced skin cancers per year in the US and the EU. Skin cancer has become the most frequent cancer in Western industrialised societies. Melanoma, a UV-induced and deadly cancer, has developed epidemical proportions, about 60,000 new melanoma cases per year in the US alone.

What are organisations have so far reviewed the safety of titanium dioxide and zinc oxide nanoparticles?

The Australian Health authorities (TGA) performed a very thorough review of the safety of ZnO and TiO2 nanoparticles used in sunscreens and concluded that they pose no health risk. This is not surprising: Australia is the world leader in skin cancer rates, and the Healthy Authorities attempt to protect the population against skin cancer, which has reached epidemic proportions, but not only in Australia, but also in the EU and US. The US FDA decided to review each type of nanoparticle individually – sunscreens are treated as drugs in the USA – and recently approved a TiO2 nanoparticle material as safe for sunscreens. Japan approved ZnO and TiO2 nanoparticles as safe for sunscreens. In the EU, a consortium of manufacturers of ZnO / TiO2 nanoparticles as well as major sunscreen producers submitted large safety dossiers on both materials. These dossiers are currently under review by an EU expert group (EU SCCS / EU SCENHIR).

Are there any equally efficient alternatives?

Sunscreens using nanoparticles on their own are not highly efficient UV filters. When using conventional, organic UV filters alone, the achievable SPF (sun protection factor) is maximally in the range of 20 to 30. However, some organic UV filters may become skin irritants at higher concentrations which limit their use. In contrast, the mixture of organic filters and nanoparticle-based filters results in synergy and made possible the creation of modern, high-SPF UV filters. Sunscreens with high SPF values (>30) and good skin tolerance may only be achieved when organic UV filters and TiO2 or ZnO nanoparticles are used in combination. Inclusion of nanoparticle-based filters in sunscreens also permits to reduce the concentration of organic UV filters resulting in improved skin tolerance. At present, there is no equivalent alternative to the combination of organic and nanoparticles-based UV filters.

TiO_2

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