

Greener Sunscreen

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PERSPECTIVES

Sunscreen is a global product produced and applied in large quantities. Even small reductions in material utilization make an environmental difference. In sunscreen, physical filters often consist of titanium dioxide (TiO₂). Replacing the bulk form of TiO₂ with its nanoform can induce such a material reduction. However, TiO₂ nanoparticles exist in the main crystal structures anatase and rutile. Concern has risen that anatase and rutile possess inherent adverse properties. It is crucial to select the least harmful structure to reduce the impact on human and environment.

APPROACH

The use of TiO₂ in products for surface treatment has revealed a side effect of TiO₂ acting as a self-cleaning agent. UV exposure induces the ability of TiO₂ to degrade organic material as algae on window glass. These properties have caused concern about the impact of sunscreen particles on humans and thereby accelerated toxicology studies on nano-TiO₂. In attempt to clarify the toxicological properties of anatase and rutile, *umuC* genotoxicity tests on *Salmonella typhimurium* are performed. The *umuC* test is a relevant tool as the test proceed in three important phases; exposure, growth and inhibition. To simulate environmental conditions for sunscreen utilization, the *umuC* test is combined with UV exposure, which to date is an unpublished technique.

CONSEQUENCES

The *umuC* tests assessed anatase as more genotoxic than rutile. A mixture with high fractions of anatase and low fractions of rutile approximated the toxicity of pure anatase. Tests with coated crystal structures indicated the same trend but with reduced toxicity. The effect became more significant when combined with UV. In fact, the combination of UV and nano-TiO₂ was capable of severe inhibition in growth of biomass even for exposure in 30 seconds only. Low concentrations of nano-TiO₂ appeared more genotoxic.

Replacement of bulk TiO₂ in sunscreen with nano-TiO₂ is a necessary action to reduce material consumption. However, the nano-crystal structure anatase TiO₂ is more toxic than the structure rutile. Especially exposure with UV enhances the effects and sunscreen is established to protect against UV sunlight; an unavoidable combination. Thus, for physical filters in sunscreens, rutile should substitute anatase to diminish adverse effects on humans and the environment without compromise on protection efficiency. The study verifies science on human toxicology must not be disregarded as a sustainable and necessary technology.