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Effectiveness in UV absorption of hierarchical nano ZnO-microTiO₂ composites with photodegradation inhibition

Nowadays, sunscreens are formulated by using TiO₂ and ZnO nanoparticles because they are efficient inorganic UV filters. In fact micro-sized TiO₂ and ZnO have been increasingly replaced by TiO₂ and ZnO nanoparticles in order to solve the cosmetic drawback of the white opaque sunscreens apart from the higher yield that nanoparticles suppose. Also the aggregation state of the particles in sunscreens is related to the solar protection factor (SPF) of the final emulsion. In this sense, dispersed nanoparticles into sunscreens increase the SPF value, but it means a possible leading to their incorporation into the stratum corneum, the outer layer of the skin. Moreover, when TiO₂ is irradiated produces free radicals which are implicated in a number of potential health issues such as skin aging because of the formation of reactive oxygen species (ROS). In this work, composites combining TiO₂ microparticles and ZnO nanoparticles have been achieved by using several synthesis and dispersion methods. It has been demonstrated by the incorporation of the different composites into sunscreens that the presence of nanoparticles anchored over TiO₂ microparticles allows increasing the efficiency of nanoparticles but decreases the possible health problems by their absorption as nanoparticles. The aim of these new composites is to gain the advantages of inorganic nanoparticles avoiding their potential drawbacks. Hence, the combination of both oxides provokes higher SPF value and lower photodegradation, in comparison with TiO₂ microparticles. Moreover, the disposition of ZnO and TiO₂ particles means a positive synergy by the recombination of photo induced electrons holes, which decreases the formation of free radicals.

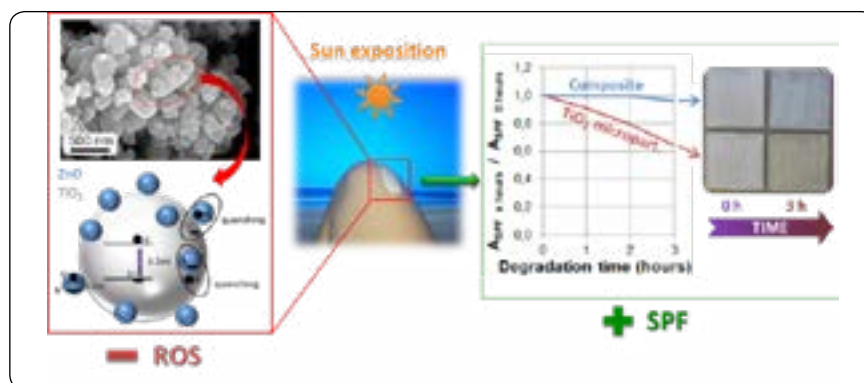


Figure 1: TiO₂ and ZnO semiconductor oxides with high absorption in the UV-range; nevertheless in this study it was observed the quenching of free radicals by recombination of electronic carriers. The hierarchical composite presents a higher UV-absorption than the pure TiO₂ counterpart. The functional stability study on standard sunscreen reveals a 50% high UV-absorption over time for the hierarchical composite without organic photodegradation of the formulation

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Recent Publications

1. De Lucas-Gil E, Reinoso J J, et al, (2017) Exploring New Mechanisms for Effective Antimicrobial Materials: Electric Contact-Killing Based on Multiple Schottky Barriers. *Applied Materials and Interfaces* 9(31):26219-26225.
2. Álvarez-Docio C M, Reinoso J J, et al, (2017) 2D particles forming a nanostructured shell: A step forward cool NIR reflectivity for CoAl₂O₄ pigments. *Dyes and Pigments* 137:1-11.
3. Bessa M J, Costa C, Reinoso J J, et al, (2017) Moving into advanced nanomaterials. Toxicity of rutile TiO₂ nanoparticles immobilized in nanokaolin nanocomposites on HepG2 cell line. *Toxicology and Applied Pharmacology* 316:114-122.
4. Reinoso J J, Álvarez-Docio C M, et al, (2017) Hierarchical nano ZnO-micro TiO₂ composites: High UV protection yield lowering photodegradation in sunscreens. *Ceramics International* (in press).
5. Reinoso J J, Leret P, Álvarez-Docio C M, et al, (2016) Enhancement of UV absorption behavior in ZnO-TiO₂ composites. *Boletín de la Sociedad Española de Cerámica y Vidrio* 55(2):55-62.

Biography

Julian J. Reinoso has her expertise in dispersion of nanoparticles, in developing of nanoparticulated microparticles and in obtaining nano and micro hierarchical composites. His studies are centered in the valuation of the developed particles and composites in comparison with microparticles or nanoparticles of similar composition in several fields. Hence, he achieved new effects in ceramics materials thanks to the dispersion and protection of oxides and metallic particles into ceramic glazes; he demonstrated the increase of the yield of UV filters when are correctly dispersed at the same time that the photodegradation is lowered; and he is studying the heating process by applying microwaves energy in particles with different dispersion grade. His expertise joined to other scientist in materials field gave rise to a spin off (AD-Particles) about the dispersion of nanoparticles and the achieving of hierarchical composites for industrial applications

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