Spectroscopic monitoring of the aging of sunscreens with TiO_2 UV filters

DANIELLE SLOMBERG[1,2], ARMAND MASION[1,2,3], FABIO ZIARELLI[4], RICCARDO CATALANO[1,2], STÉPHANE VIEL[4], JEROME LABILLE[1,2,]

[1] CEREGE CNRS, Europole Arbois BP 80, 13545 Aix en Provence, France
[2] SERENADE, Europole Arbois BP 80, 13545 Aix en Provence, France
[3] SFMC, 4 Place Jussieu, 75005 Paris
[4] ICR, Aix Marseille Université, 13397 Marseille, France

There is an increasing variety of nano-enabled consumer products on the market. Besides food, personal care products are a particularly sensitive category since they come in direct contact with the skin and mucosas, and might even be (accidentally) ingested (e.g. toothpaste). In an effort to make these products benign for both humans and the environment, the strategy aims to address safety issues from the very beginning following the "safe(r) by design" approach. Here we show the implementation of this approach applied to the design of sunscreens. These products contain nano-sized TiO_2 as mineral UV filters. Since, besides being an efficient UV filter, TiO_2 is also a photocatalyst, it is necessary to protect the skin against these harmful effects. This is achieved by applying one or multiple shells around the TiO_2 core with the purpose of blocking photocatalysis and facilitating dispersion of the nanocomposite in the lotion. These nanomaterials need to be safe for human use and benign when released into the environment. Several formulations of the TiO_2 based sunscreens were artificially aged so as to determine and quantifiy the alteration. To counteract photocatalytic effects, SiO_2 and AlOOH shells were selected to coat the TiO_2 core. These shells behaved very differently: whereas dissolution/degradation of the Al based shell was slow and limited, the SiO_2 shell was far more sensitive to aging and most of the coating was eliminated from the nanocomposite. Spectroscopic data suggest dissolution as the main mechanism.