Photocatalytic Degradation Mechanism of Cosmetic Materials under UV exposure

Hisao Hidaka

Faculty of Science and Technology, Meisei University

Studies on the photocatalytic mechanism for cosmetics containing TiO_2 powder is useful for the protection of human skin. The photodegradations of such cosmetic materials as surfactants, amino acids, polymers, et. al. in heterogeneous aqueous TiO2 suspensions under UV or solar exposure were examined in the present work. The anionic surfactant of DBS can be easily photooxidized in the presence of TiO₂ powder under solar exposure to mineralize into CO² gas.

The photodegradation of amino acids and nitrogen-containing surfactants gives NH_4^+ and NO_3^- ions concomitantly. The decomposition of DNA and RNA produces NH4+ and NO_3^- ions (4:1) after 5-h irradiation with a maximal formation of $H_2PO_4^-$ ion at 2 h of irradiation. Water soluble polymers of polyethylene glycols (PEG) and polyvinylalcohol (PVA) were easily photooxidized to evolve CO_2 gas. The CO_2 mineralization yield decreased with increasing the molecular weight of PEG and PVA. The photooxidation process involves the photogeneration of $\cdot OH$ and/or $\cdot OOH$ radicals at TiO_2/H_2O interfaces. These activated radicals attack the organic molecules adsorbed on or near to the TiO_2 surface to form hydroxylated intermediates or peroxides. Subsequently, they were photo- or auto-oxidized to mineralize ultimately into CO_2 via several oxidation steps such as formaldehyde and formic acid.