

### **354d Benign Nano-Thin Film Composite Particles for Protection from Uva/Uvb - Rays**

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Composite TiO<sub>2</sub>/ZnO particles capped with an Al<sub>2</sub>O<sub>3</sub> nanolayer have been designed and synthesized for the benign protection from UVA/UVB – rays. Titania (TiO<sub>2</sub>) provides excellent protection against UVB – rays. Zinc oxide (ZnO) protects against UVA-rays very efficiently. The manufacture of composite particles via novel Atomic Layer Deposition (ALD) thin film technology allows for the synthesis of composite particles with dual effectiveness. In the first aspect of this work, ZnO was deposited on nanosized TiO<sub>2</sub> particles by ALD. In the second aspect of this work, nanolaminated films of TiO<sub>2</sub> and ZnO were prepared on the surface of submicron sized spherical silica (SiO<sub>2</sub>) particles. The large substrate SiO<sub>2</sub> provides a particle size for the "UVA/UVB sun blockers" that is large enough to prevent pore blockage in human skin. In both instances, the composite particles are capped with an alumina (Al<sub>2</sub>O<sub>3</sub>) nanolayer that allows easy dispersion of these particles in non-aqueous formulations. The Al<sub>2</sub>O<sub>3</sub> nanolayer also prevents direct contact of the active TiO<sub>2</sub>/ZnO with the skin, thus protecting the skin from potential UV-photactivated reactions. The particles have been tested for UVA/UVB transmittance and Sun Protection Factors (SPF) have been calculated.