

What are photocatalytic coatings and their potential applications?

Photocatalytic coatings are the surface films that are able to cause redox reactions in the material in contact under the influence of radiation. This is basically a heterogeneous form of catalysis. The energy is supplied to the reaction system in the form of light (UV / Visible) instead of heat as done in the conventional reactions. Since the ambient light is available in abundance, there is no cost of energy.

A photocatalyst works by absorbing a photon from the incident radiation and generating an active pair of a hole (+ve charge) and an electron (-ve charge). These, in turn, react with water and oxygen to produce a hydroxyl radical (OH*) and a superoxide anion (O₂⁻) respectively. These two species possess very high oxidation and reduction potential respectively. They react with the material on the surface of the film (adsorbate) bringing about its decomposition. The surface film has to be designed to satisfy the following requirements:

- Surface area of the film should be very high: Hence nanostructured surfaces are desirable.
- Catalyst surface should be accessible to the reactants: Hence the film-former used should not cover the active surface of the catalyst particles.
- Surface should be hydrophilic: Some degree of hydrophilicity is essential as most of the photocatalytic reactions progress via adsorbed water (and oxygen).
- Surface should be exposed to the source of radiation: Hence the adsorbate should not block out the light before it reaches the catalyst surface.

Titanium dioxide is the principal photocatalytic material that has been investigated intensively over the last two decades. Several physical and chemical modifications of titanium dioxide have been tried out so as to obtain maximum efficiency for the intended end use. The films impregnated with titanium dioxide have been found potentially useful in the following applications:

1. Waste water treatment: Reduction of COD
2. Air purification: Reduction of NO_x, SO_x and formaldehyde
3. Deodorization: Removal of malodorous fumes and gases

4. Disinfection: Killing of bacteria
5. Water splitting: Generation of hydrogen and oxygen from water which can be used as clean fuel
6. Stain removal: Decomposition of coloring matter
7. Self cleaning surfaces: Alter the wettability of the surfaces

Photocatalytic specialty grades of titanium oxide are commercially available from Degussa, Sachtleben, Ishihara Sangyo and Tayca.
