PMI Titanium Dioxide Photocatalyst

Overview

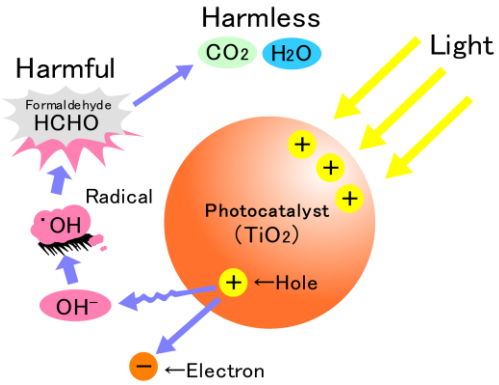
Titanium dioxide (TiO^2) is a photocatalyst which exhibits strong oxidative property when exposed to ultraviolet (UV) light. TiO^2 is able to decompose harmful organic compounds, kill bacteria and eliminate odours. TiO^2's reactivity is used in many environmentally beneficial applications including water treatment and purification, atmospheric Nox (nitrogen oxide) removal and self-cleaning building façade.

Titanium dioxide is non-toxic and therefore is used in cosmetic products (sunscreens, lipsticks, toothpaste) and in pharmaceutics (pills).

Technology

When TiO^2 absorbs UV light, electrons are promoted from the valence band to the conduction band, producing holes in the valence band. The production of pairs of negative-electrons (e-) and positive-holes (h+) is called "photo-excitation". The holes in the valence band react with water on the titanium dioxide coating, forming hydroxyl radicals.

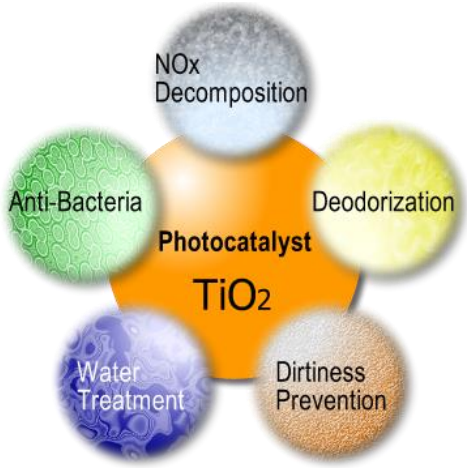
When a contaminant in the air is adsorbed onto the TiO^2, the hydroxyl radical attacks the contaminant, extracting a hydrogen atom from the contaminant. The hydroxyl radical oxidizes the contaminant, producing water, carbon dioxide and other harmless substances.



Hydroxyl radicals have much stronger oxidative power than chlorine or ozone which is used as a sterilizer.

Applications

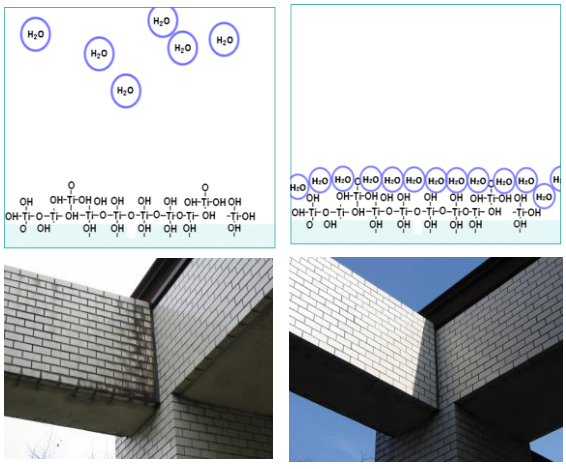
1. **Atmosphere Cleaning**
   Nox removal from the atmosphere
2. **Deodorization**
   Indoor odour and VOC removal
3. **Self-Cleaning**
   Dirt removal for exterior building facade
4. **Water Treatment**
   Water sterilization and odour removal
5. **Anti-Bacterial**
   Bacteria growth elimination



1. Self Cleaning

Hydroxyl radicals are generated on the TiO^2 film when exposed to UV light. Water is easily attracted to the hydroxyl radicals, making the TiO^2-treated surface super-hydrophilic. On the surface, water cannot exist in the shape of a drop but spreads over in the form of a uniform thin film.

The hydrophilic and oxidative nature of TiO^2, coupled with gravity, will enable dust and dirt particles to be disintegrated and swept away by the water stream, thus making the product self-cleaning.

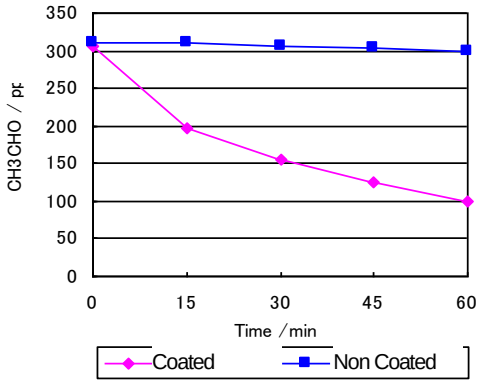


Self-Cleaning Building Façade Using TiO^2

2. Deodourization

The components of odour are usually organic chemicals. Utilizing the strong oxidation strength of hydroxyl radicals, photocatalytic oxidation can neutralize odours by changing the chemical composition of the offending organic chemicals.

The data on the right indicates the decomposition of Acetaldehyde, a major component of cigarette odour. The result shows that TiO^2-coated stainless steel plates outperformed the uncoated plates in odour removal.



3. Anti-Bacterial

TiO^2 photocatalyst generates hydroxyl radicals, excited by UV light energy. The hydroxyl radicals can oxidize the bacteria cell membrane to pierce holes through the cell. Due to osmotic pressure difference, the cell lipid will percolate out of the holes, thereby destroying the individual cell.

At the same time, the hydroxyl radicals can penetrate the cell through the holes, to destroy the bacteria DNA structure, to prevent secondary generation of the individual bacteria. This eliminates total growth of the bacteria population.

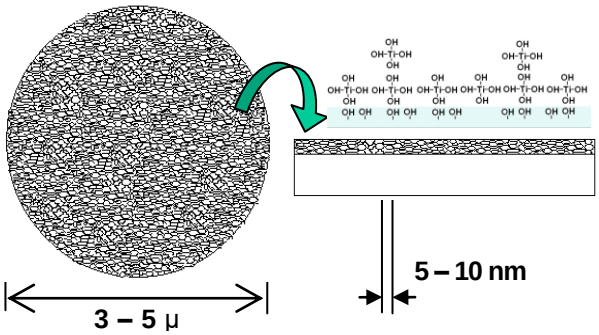
Anti-Bacteria Treatment of Indoor Surfaces

Interior Treatment for Transportation

4. Thin Film Photocatalyst Formation

The characteristic of PSO-419 TiO^2 thin film is not from the powder phase of titanium dioxide, but rather from the crystal phase of Anatase TiO^2, dispersed in the water. PSO-419 TiO^2 is sprayed as an ultra-fine water mist towards the targeted surface.

Unlike other products, PSO-419 titanium dioxide can form a strong adhesive film on surfaces without the use of binders, through the **Van der Waals** force. This force helps to form a covalent binding between the TiO^2 film and the surface with very strong adhesion and hardness. This process can be achieved because the size of our titanium dioxide crystals contained in our SOL is quite small, in the range of 5～10nm. The small size of the TiO^2 molecules enables the molecules to adhere strongly to each other and to the surface.



Patents:

US.PAT. 5,449,467	"Process for purifying water "
US.PAT. 5,562,820	"Process for purifying water drinking vessel"
EP. 0 704 187 B1	"Use of a utensil for table use or cooking use"

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