

[www. greenmillennium.com](http://www.greenmillennium.com)



Photocatalyst, the new generation of environmental purification

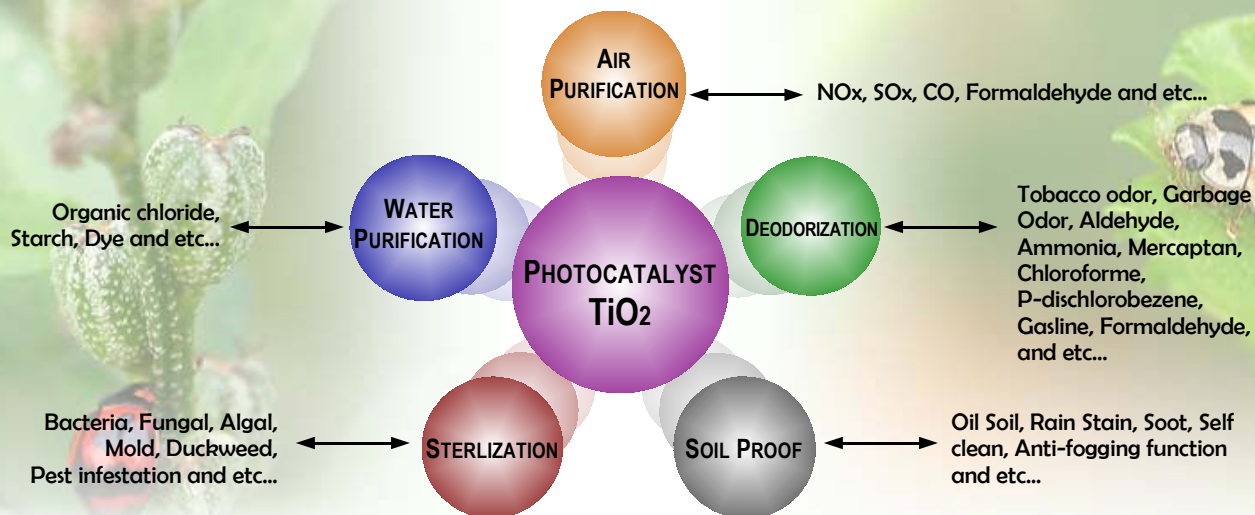
Technology

the new generation of environmental purification photocatalyst

ROBUST SCIENCE & NANO TECHNOLOGY FOR SAFE AND HEALTHY ENVIRONMENT

Titanium Dioxide is a substance characterized by its high refractive index. It is used in a variety of ways, primarily as a white pigment, because it is chemically stable and possesses a high degree of whiteness. In addition it is harmless to humans.

It has been found that Titanium Dioxide can also be used as a photocatalyst to decrease and eliminate toxic organic materials. This is accomplished through the utilization of its oxidative capability. By utilizing clean resources such as ultraviolet ray from sunlight and artificial light, water and oxygen. Titanium Dioxide is known to have high deodorizing, anti-soiling and sterilization properties. The use and applications for these properties makes the photocatalyst an ideal environmental protection product and are being recommended, expanded day by day.

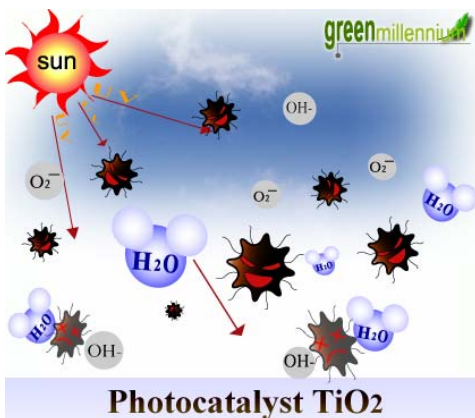


Photocatalyst

MECHANISM

$\text{Toxic VOC} + \text{Light} + \text{Water} + \text{TiO}_2 = \text{Non-Toxic Inorganic Gas} + \text{TiO}_2$

A **PROMISING** approach for remediating volatile organic compounds or VOCs is to employ photocatalyst that oxidize these compounds. It is a substance that facilitates chemical reactions by photo-irradiation without becoming transformed.



When photocatalyst is exposed to light in the presence of water vapor, two highly reactive substances are formed: hydroxyl radicals [OH·] and a superoxide anion [O₂⁻¹]. It allows the oxidation of airborne VOCs convert into carbon dioxide and water at room temperature with UV or near-UV light source. It does not need a special energy and use only clean energy in ordinary life.

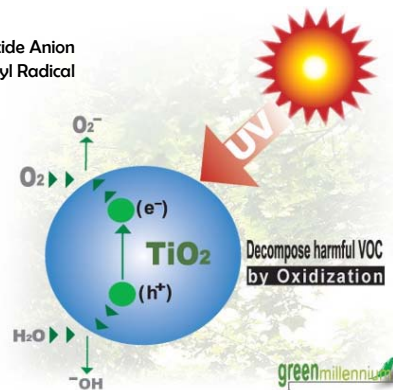
Titanium Dioxide

ENVIRONMENTAL FRIENDLY

Strong Oxidation Power

TITANIUM DIOXIDE, also known as titania, is the naturally occurring oxide of titanium, chemical formula TiO₂. Approved by the food testing laboratory of the United States Food and Drug Administration (FDA), Titanium Dioxide is chemically stable and considered an environmental friendly safe substance.

- * O₂⁻ – Superoxide Anion
- * ·OH – Hydroxyl Radical



It is commonly used in paint, printing ink, plastics, paper, synthetic fibers, electronic components, food, cosmetics and etc. Many studies have been published on the use of titanium dioxide as a photocatalyst for the decomposition of organic compounds. After illuminated by light, titanium dioxide produces hydroxyl radicals, which react with the organic matters in the air to form non-toxic inorganic matters.

Photocatalyst

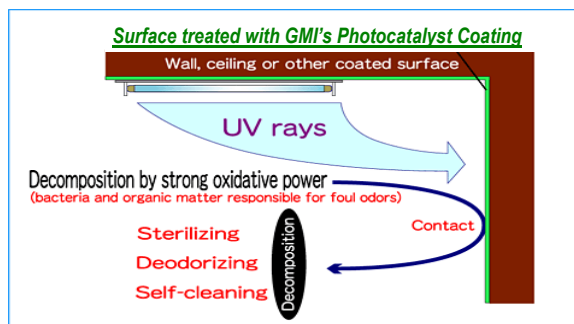
a better and safer tomorrow

Purification System

DEODORIZATION, STERILIZATION,

Antibacterial, Anti-Fungal, Anti-Algal, Anti-Mold.

DEODORIZATION — On the deodorizing application, the hydroxyl radicals accelerate the breakdown of any Volatile Organic Compounds or VOCs by destroying the molecular bonds. This will help combine the organic gases to form a single molecule that is not harmful to humans thus enhance the air cleaning efficiency.



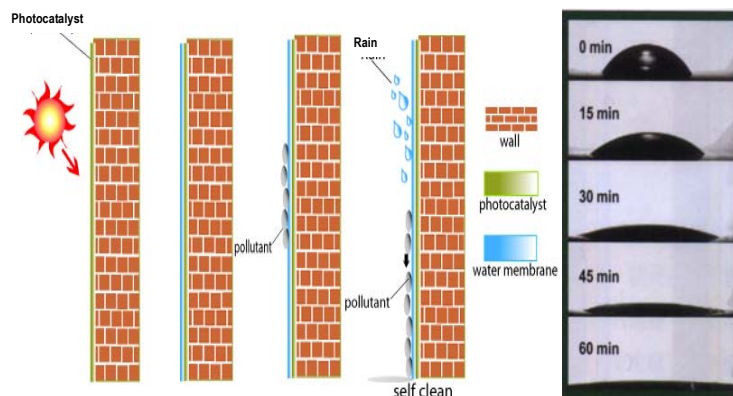
STERILIZATION — Titanium dioxide has strong oxidation affects to single-celled organism that includes all bacteria and fungus. The very strong oxidizing power of Titanium Dioxide can destroy bacteria's cell membrane, causing leakage of the cytoplasm, which inhibits bacteria's activity and ultimately results in the death and decomposition of bacteria. Generally speaking, disinfections by titanium dioxide is three times stronger than chlorination, and 1.5 times stronger than ozonation.

Soil Proof

SUPER-HYDROPHILIC PROPERTY

Self-Cleaning, Anti-soiling, Anti-Fogging

SELF-CLEAN / SOIL PROOF— when the surface of photocatalytic film is exposed to light, the contact angle of the photocatalyst surface with water is reduced gradually. After enough exposure to light, the surface reaches super-hydrophilicity. In other words, it does not repel water at all, so water cannot exist in the shape of a drop, but spreads flatly on the surface of the substrate.



The hydrophilic nature of titanium dioxide, coupled with the gravity, will enable the dust particles to be swept away following the water stream, thus making the product self-cleaning.

Applications

HYGIENIC COATING APPLICATION,

Safer and Better Environment.

DEODORIZATION

- Car Interior ● Commercial Building ● Residential House
- Hospital ● Casino ● Pet Shop ● Restaurant
- Public Restroom ● Hotel, Motel, Apartment and etc...

AIR PURIFICATION

- Living Space ● Urban City ● Residential House
- Commercial Building ● School ● Factories ● Hospital
- Senior Center and etc...

SOIL PROOF

- Road Structure ● Building Exterior Wall ● Glass Window ● Aircraft, Automobile Body
- Boats and Ships ● Bridge ● Public Facility ● Grave Stone ● Skylight Roof
- Steel Towers ● Mirror and etc...

STERILIZATION

- Hospital ● Medical Equipment ● Aquarium ● Bathroom
- Ceramic Tile ● Ceramic Table Ware ● Restaurant
- Commercial Fish Cultivating Tank ● Food Processing Factory
- Furniture ● Senior Center, ● Public Facility and etc...

WATER TREATMENT

- Bath Tub System ● Commercial Building Water Tank
- Commercial Water Sewage Treatment ● Fountain
- Residential Water Tank ● Artificial Pond
- Swimming Pool ● Spa and etc...

Photocatalyst

a better and safer tomorrow

Lab Results

TEST PROCEDURE — BACTERIA DECOMPOSITION TEST

1. Pipette 0.2mg of bacteria suspension on a test porcelain tile and a resin plate (50mm×50mm size)
2. The test substrates are covered with a piece of polyethylene film.
3. Light of 500 LUX exposes the test glass for 24 hours. The test needs to be conducted in an environment where temperature is a constant 35°C.
4. Count the number of survived bacteria
5. In order to convert the number of bacteria in 1 ml, use SCDLP culture medium and measure the number on the test materials by a pour-plate culture way.

BACTERIA TEST RESULT ON COATED TILE WITH TiO₂

Type of Bacteria	Titanium Dioxide	Immediately after illumination (number/ml)	24 hours later (Group 1)	24 hours later (Group 2)	Average
E. coli	TPX-85	3.5×10^5	< 10	< 10	< 10
	None	3.5×10^5	5.0×10^6	6.1×10^6	5.6×10^6
ST. aureus	TPX-85	3.5×10^5	< 10	< 10	< 10
	None	3.5×10^5	6.1×10^4	6.7×10^4	6.4×10^4

Tested by Kyoto Microorganism Research Center

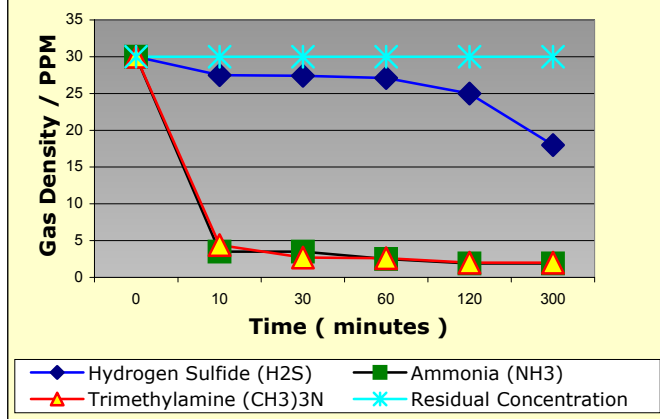
BACTERIA DECOMPOSITION TEST RESULT ON PHOTOCATALYST RESIN

Type of Bacteria	Titanium Dioxide	Immediately after illumination (number/ml)	24 Hours later (number/ml)	% Killed
E. coli	Coated	1.1×10^6	< 10	99.90%
	None	1.1×10^6	1.8×10^7	-
MRSA	Coated	4.4×10^5	< 10	99.90%
	None	4.4×10^5	9.9×10^5	-
P. aeruginosa	Coated	2.2×10^5	< 10	99.90%
	None	2.2×10^5	2.6×10^6	-

Tested by food inspection center of Osaka hygienic food association

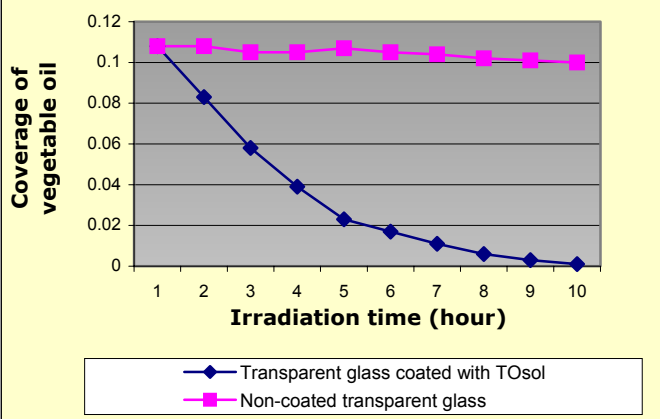
Odor Test Results

Measurement; Far Infrared Rays Application Research



Decomposition Test of Vegetable Oil

Tested by Saga Ceramics Research Laboratory

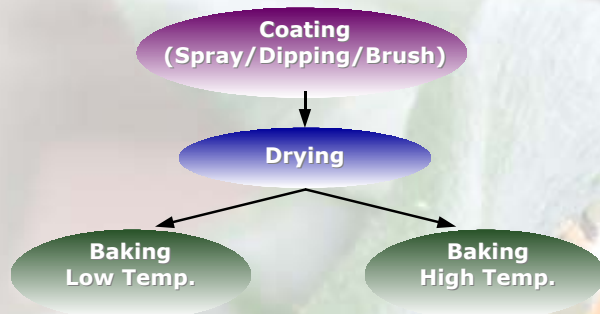


SITPA mark is issued by Technical Consultation Committee of Photocatalyst Product in Japan. Technical Committee of Photocatalyst Product has technical guide lines to examine various photocatalyst products. It is required to pass several severe tests to obtain the SITPA mark. Our photocatalyst solution product has obtained the SITPA mark on December 11th in 2001.



Products

Our photocatalyst TiO₂ coatings are neutral aqueous solution and it comes with pure inorganic compounds. It emits no smell and contains none toxic substance. It can be applied using following methods.



Japanese Patent #: 2875993
United States Patent #: 6602918

▶ TRANSPORTATION INDUSTRY

▶ ENVIRONMENTAL INDUSTRY

▶ MEDICAL INDUSTRY

▶ CONSTRUCTION INDUSTRY

▶ FOOD INDUSTRY

▶ MANUFACTURER INDUSTRY

▶ OTHER INDUSTRY

PRODUCT LINEUP

Product Name	Application Function
PTA sol	PTA forms a hard film equivalent to 3H -5H but does not show photocatalytic property at room temperature. It is used for making a pre-coat layer to protect the surface of organic substrate. After high-heat treatment, PTA exhibits photocatalytic properties therefore make it the ideal product to integrate with any product requires heating production process.
TPX sol	TPX shows photocatalytic property and forms a hard film gradually when dried at room temperature. It is applied when the high-heat treatment cannot be conducted. TPX can be used on both organic and inorganic substrate surface.
TO sol	TO shows high photocatalytic property but does not form a hard film when dried at room temperature. It is suitable for inorganic substrates that are porous or uneven.

PRODUCT SPECIFICATIONS

CLASSIFICATION - Product Name -	Peroxititanium Acid Solution	Mixed Solution of PTA and TO sol	Peroxo-modified Antanse Sol
	PTA sol	TPX sol	TO sol
Heat treatment necessity to modify	Needed	None	None
Heating Temperature to form photocatalys	250 to 600C	Room temperature to 600C	Room temperature to 600C
Adhesive state at room temperature	Strongest	Strong	Weak
Appearance	Light yellow color	Yellowish suspended solution	Milky White
Hydrogen ion concentration (PH)	6.0 to 7.0	7.0 to 8.0	7.0 to 8.5
Average Particle Size	Approximately 10nm	Approximately 10nm	Approximately 10nm
Stability	Can be stored long term at a cool, dark place	Can be stored long term at a cool, dark place	Can be stored long term at a cool, dark place

Note: Each selection of photocatalyst coating solution and application usage amount are subjected to the different surfaces, substrates, materials, and the environmental conditions.

the nature...
the photocatalyst...
green millennium

"Research indicates that people spend approximately 80 ~ 90 percent of their time indoors , where they are exposed to polluted indoor air that may cause irritation of the eyes, nose, and throat, headaches, dizziness, fatigue, and even lung cancer or other malignancies..."

Green Millennium's Environmental-Improvement Cycle



Educate — Understanding the cause and consequence of air quality problem.

Evaluate — Screening and identifying the source of air quality problem.

Improve — Pollutant source removal or modification.

Green Millennium's photocatalyst product can be integrated with applied materials and implemented with existing air-quality resolution system. Here are some of the benefits of integrating Green Millennium's photocatalyst:

- Environmental Friendly
- Easy to maintain
- Efficient and low energy consumption
- Real destruction of pollutants
- Adapted for large range of pollutants
- Using clean and readily-available energy

To find out more, please contact Green Millennium Inc. or our authorized service provider:

greenmillennium
Photo-catalyst
Green Millennium Inc.
A Manufacturer Representative Company

 **GREEN TITAN INC.**
A Service Branch Division of Green Millennium Inc.
An Authorized Application Services Provider

20539 E. Walnut Dr. Suite B
Diamond Bar, CA 91789
Tel: 909-598-0185
Fax: 626-737-6511

URL: www.Greentitan.com