

Photocatalyst Titanium Dioxide

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TITANEFFECT THE LIGHT CLEAN REVOLUTION

Cleantech to change our life



Technical Background

What is nano technology?

Nanotechnology refers broadly to a field of applied science and technology whose unifying theme is the control of matter on the molecular level in scales smaller than 1 micrometre, normally 1 to 100 nanometers, and the fabrication of devices within that size range.

It is a highly multidisciplinary field, drawing from fields such as applied physics, materials science, colloidal science, device physics, supramolecular chemistry, and even mechanical and electrical engineering. Much speculation exists as to what new science and technology may result from these lines of research. Nanotechnology can be seen as an extension of existing sciences into the nanoscale, or as a recasting of existing sciences using a newer, more modern term.

Two main approaches are used in nanotechnology. In the “bottom-up” approach, materials and devices are built from molecular components which assemble themselves chemically by principles of molecular recognition. In the “top-down” approach, nano-objects are constructed from larger entities without atomic-level control. The impetus for nanotechnology comes from a renewed interest in colloidal science, coupled with a new generation of analytical tools such as the atomic force microscope (AFM), and the scanning tunneling microscope (STM). Combined with refined processes such as electron beam lithography and molecular beam epitaxy, these instruments allow the deliberate manipulation of nanostructures, and led to the observation of novel phenomena.

Examples of nanotechnology in modern use are the manufacture of polymers based on molecular structure, and the design of computer chip layouts based on surface science. Despite the great promise of numerous nanotechnologies such as nano particles, quantum dots and nanotubes, real commercial applications have mainly used the advantages of colloidal nanoparticles in bulk form, such as sun-tan lotion, cosmetics, functional coatings, and stain resistant clothing.

» One nanometer (nm) is one billionth, or 10^{-9} of a meter. For comparison, typical carbon-carbon bond lengths, or the spacing between these atoms in a molecule, are in the range .12-.15 nm, and a DNA double-helix has a diameter around 2 nm. On the other hand, the smallest cellular lifeforms, the bacteria of the genus *Mycoplasma*, are around 200 nm in length. To put that scale in to context the comparative size of a nanometer to a meter is the same as that of a marble to the size of the earth.. «



PHOTOCATALYSIS

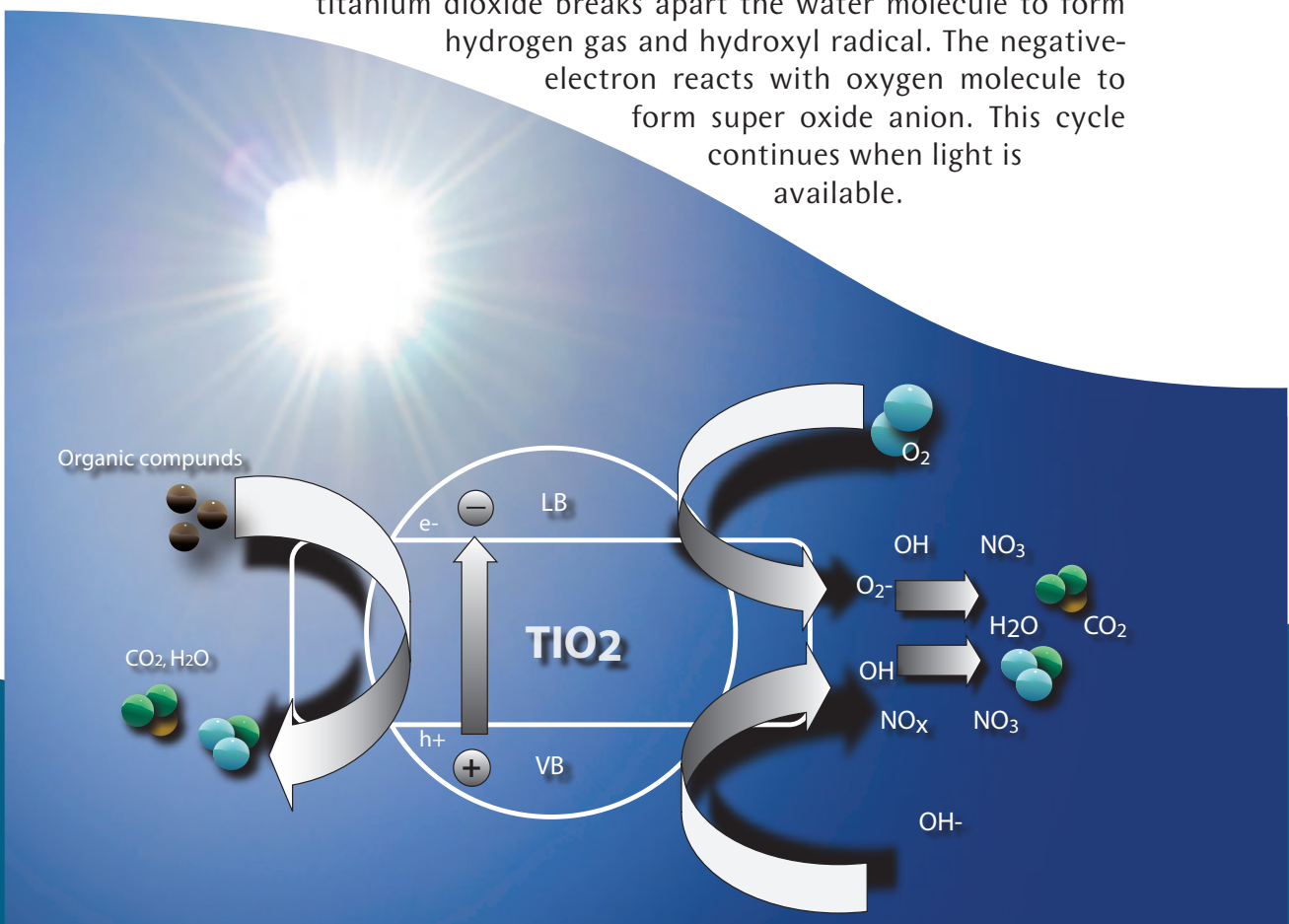
improvement of our living environment



Photocatalysis Mechanism

» Recently TiO₂ photocatalyst attract a great deal of attention. TiO₂ has sterilization, prevention of stains, deodorization, super-hydrophilicity and it is applied gradually to improvement of our living environment.. «

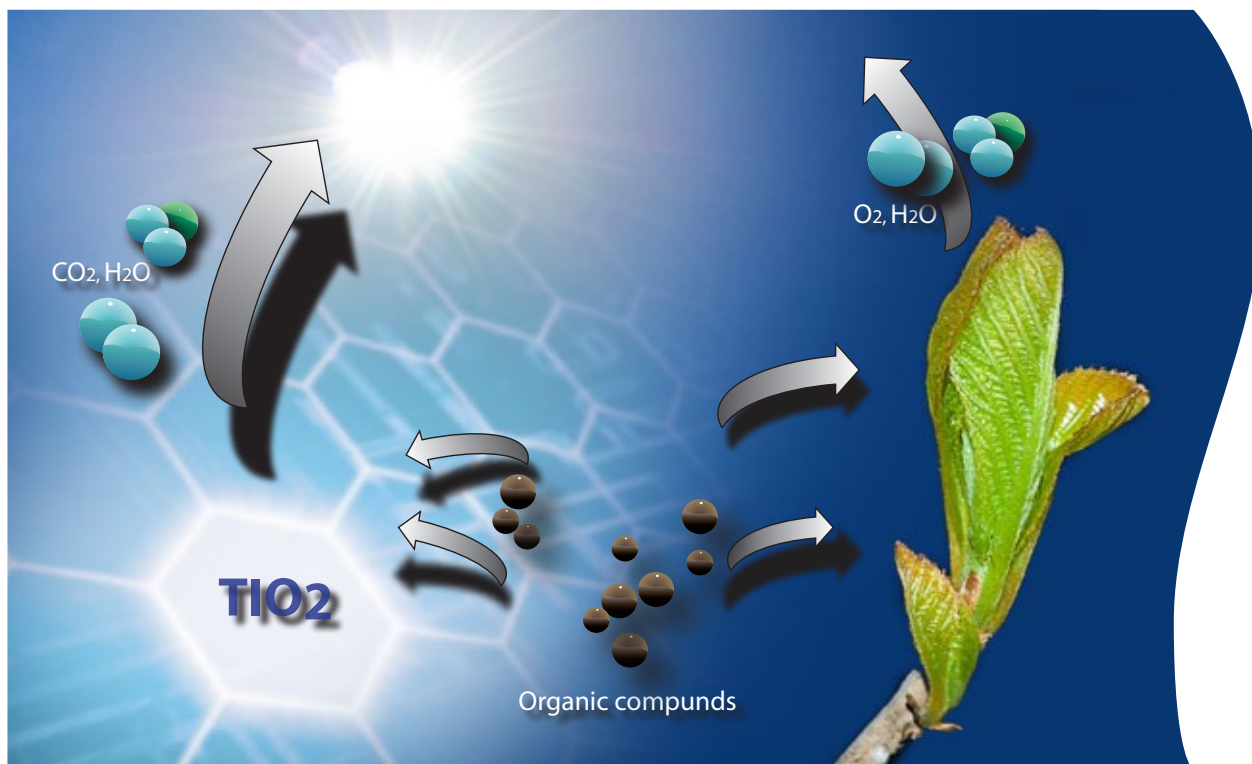
When photocatalyst titanium dioxide (TiO₂) absorbs Ultraviolet (UV) radiation from sunlight or illuminated light source (fluorescent lamps), it will produce pairs of electrons and holes. The electron of the valence band of titanium dioxide becomes excited when illuminated by light. The excess energy of this excited electron promoted the electron to the conduction band of titanium dioxide therefore creating the negative-electron (e⁻) and positive-hole (h⁺) pair. This stage is referred as the semiconductor's 'photo-excitation' state. The energy difference between the valence band and the conduction band is known as the 'Band Gap'. Wavelength of the light necessary for photo-excitation is: $1240 \text{ (Planck's constant, } h) / 3.2 \text{ eV (band gap energy)} = 388 \text{ nm}$ The positive-hole of titanium dioxide breaks apart the water molecule to form hydrogen gas and hydroxyl radical. The negative-electron reacts with oxygen molecule to form super oxide anion. This cycle continues when light is available.



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LIVING ENVIRONMENT



what's photocatalyst (photocatalysis)?



The word photocatalysis is a composite word which is composed of two parts, “photo” and “catalysis”. Catalysis is the process where a substance participates in modifying the rate of a chemical transformation of the reactants without being altered or consumed in the end. This substance is known as the catalyst which increases the rate of a reaction by reducing the activation energy. Generally speaking, photocatalysis is a reaction which uses light to activate a substance which modifies the rate of a chemical reaction without being involved itself. And the photocatalyst is the substance which can modify the rate of chemical reaction using light irradiation. Chlorophyll of plants is a typical natural photocatalyst. The difference between chlorophyll photocatalyst to man-made nano TiO_2 photocatalyst (here below mentioned as photocatalyst) is, usually chlorophyll captures sunlight to turn water and carbon dioxide into oxygen and glucose, but on the contrary photocatalyst creates strong oxidation agent and electronic holes to breakdown the organic matter to carbon dioxide and water in the presence of photocatalyst, light and water.

» »The photocatalytic process is activated on the surface of the coating thanks to the light and the oxygen. The bright energy is so transformed into environment-friendly chemical energy.« «



SELF-CLEANING

True super-hydrophilicity



Self-cleaning

The TitanEffect self-cleaning nano coat is a special nano photocatalyst coat combined by photocatalyst and nano technology. Generally, detergents reduce the surface tension of water and the contact angle will be lowered. When the surface of nano level 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 substrate. The hydrophilic nature of titanium dioxide, coupled with the gravity, will enable the dust particles to be swept away following the water stream (rain), thus making the key feature of self-cleaning and easy-cleaning.

1. Super Hydrophilicity

The TitanEffect nano coat will show the super hydrophilicity feature under light irradiation. The contact angle of the surface will be reduced to $<10^\circ$ degree, which brings 5 benefits of this feature.

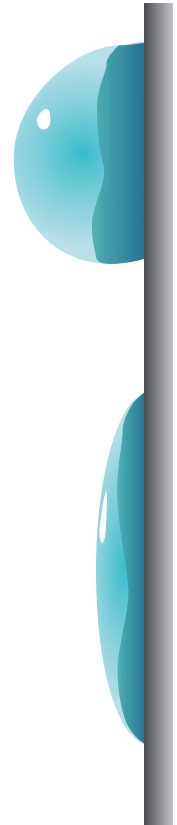
I. The water will not form a water drop on the surface when its contact angle is $<10^\circ$, it will form a completely water film. The water will be in flat condition on the surface. This will help to reduce the water stain after rain wash.

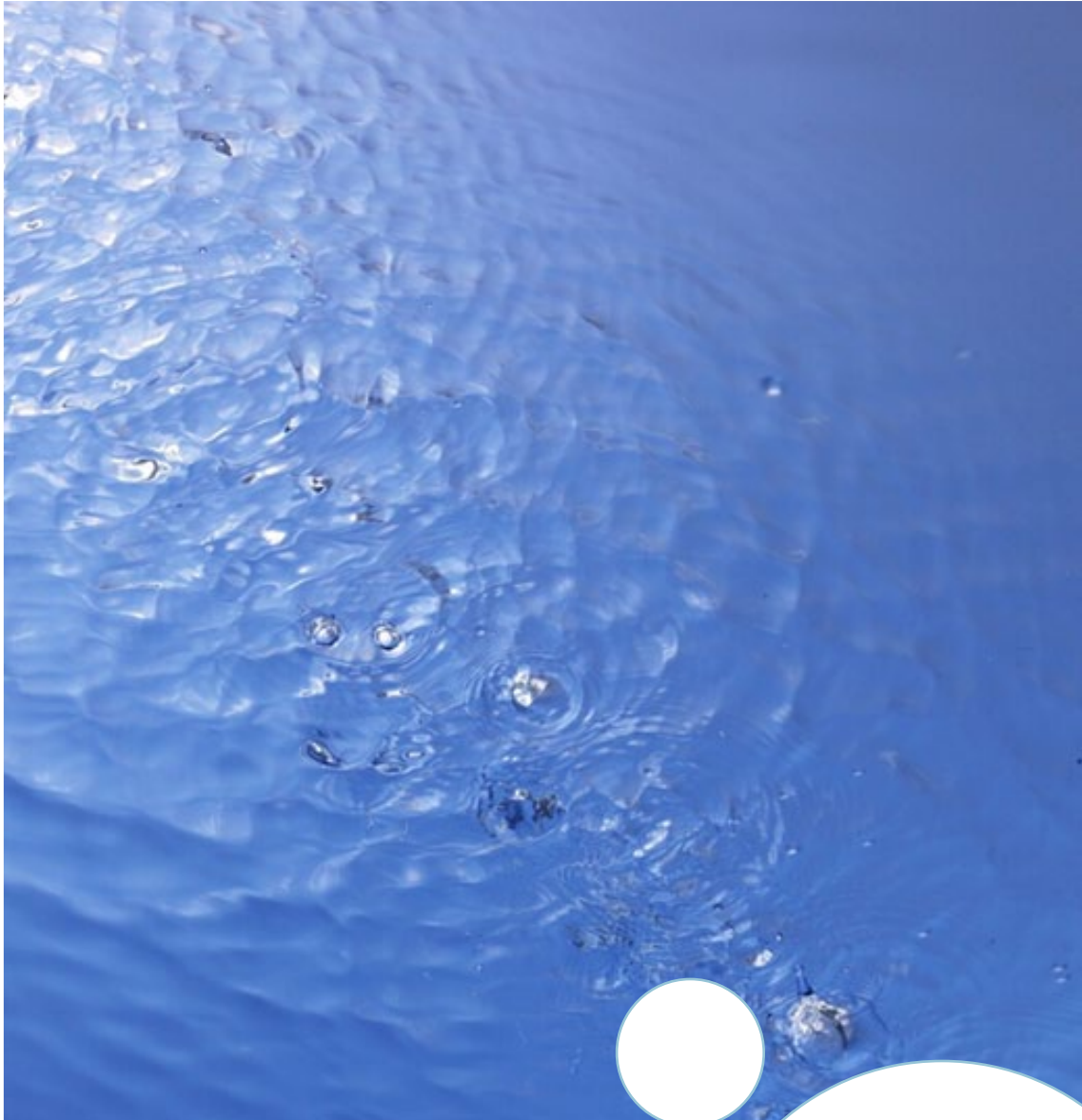
II. Generally, cleaning agent reduces the contact angle of water on surface. We call it hydrophilicity feature. TitanEffect nano coat's hydrophilicity will simulate this feature and provide better, and so that single water wash on the surface can reach the same effect to traditional washing with detergent. So after a rain wash, the surface will be renewed like after a traditional wash with cleaning agent.

III. The hydrophilic feature can keep the water on the surface and the entire surface can be covered with only need a little water. This will prompt its transpiration. So if it is coated on a building wall, the building will need less energy to cool down in summer. If it is coated on a panel in the compressor of air condition, the air condition system will show better efficiency.

IV. The dust in the air will be more difficult to absorb on a super-hydrophilic surface.

V. The hydrophilicity can make the surface with no water drop while raining, so it becomes cleaner in rain.



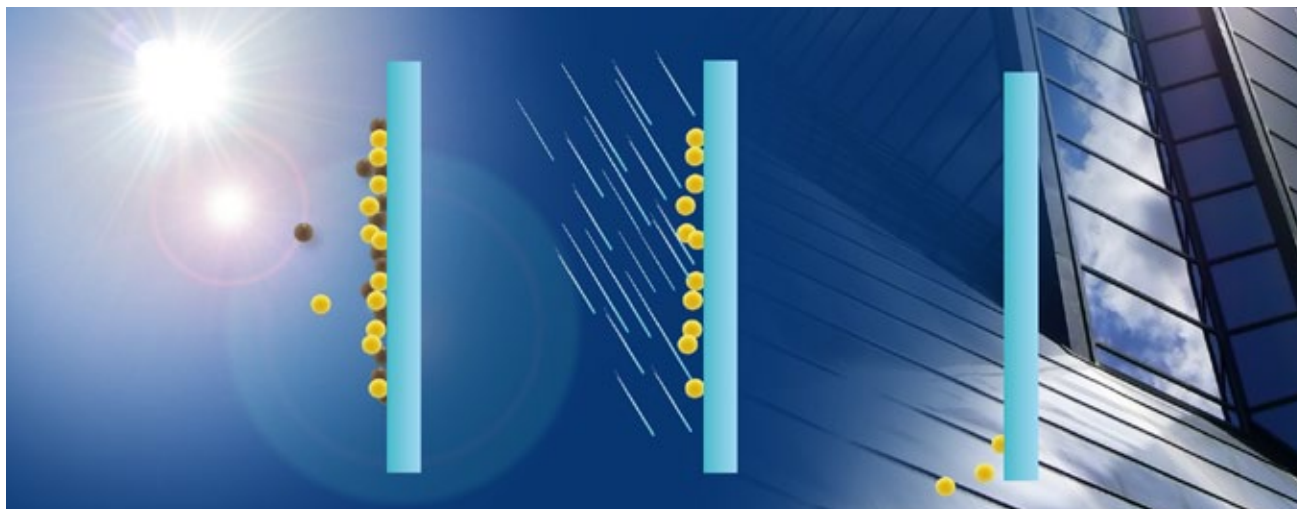


SELF-CLEANING
True Organic Decomposition



2. Organic Decomposition Feature

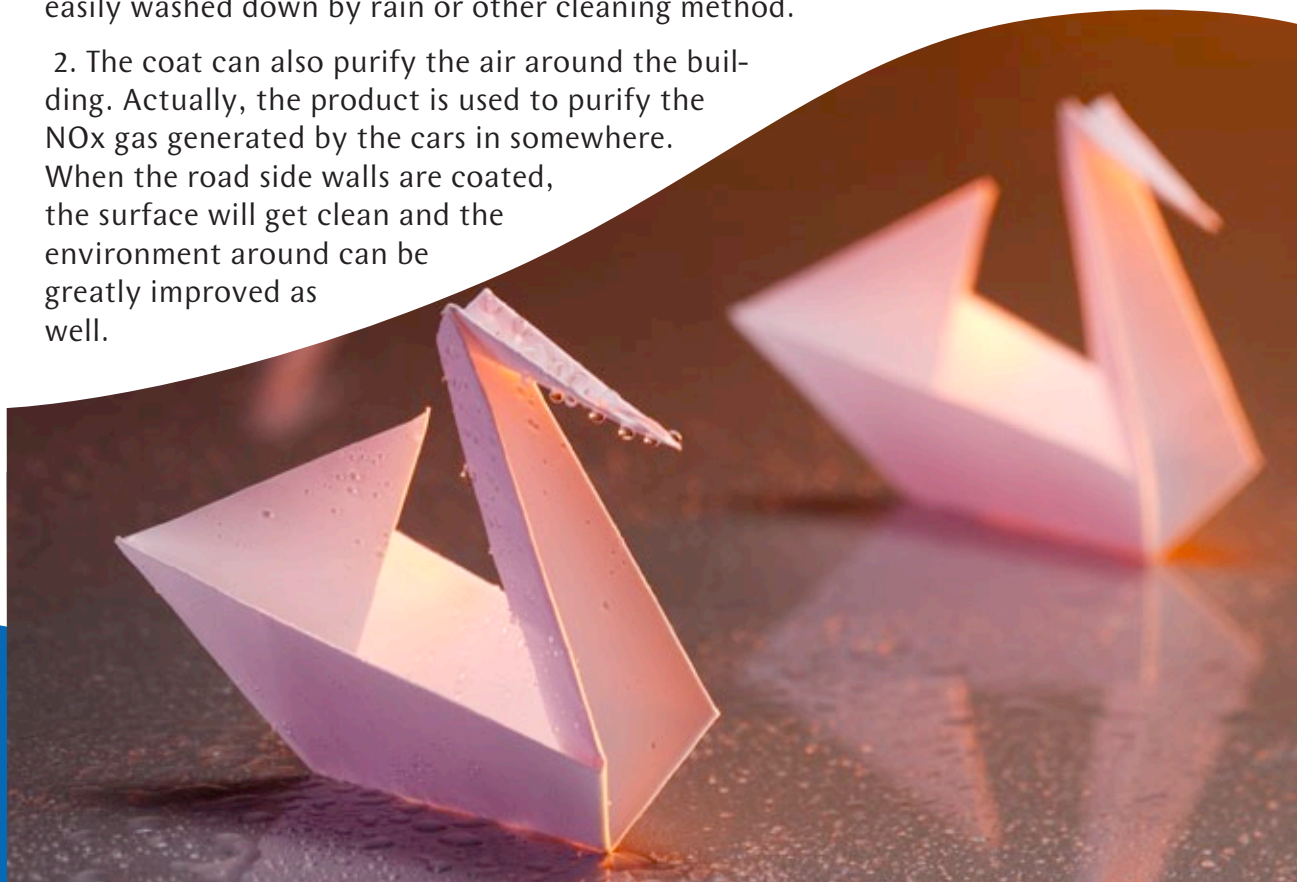
» *The super-hydrophilic feature can provide the same effect like detergent (reduce the contact angle of the surface). Self-cleaning: If there is rain, the TitanEffect nano coat provide self-cleaning feature after rain wash. The rain wash have the same effect to your traditional wash on the surface with detergent. Easy-cleaning: If there is no rain, you just need simply wash the surface using water. Your single water wash will also have the same effect to traditional wash with detergent... «*



When the coat is exposed to sunlight, it can decompose almost all the organic substance on the surface, which causes the following 2 benefits.

1. When the coat decomposes the absorbed organic pollutant on the surface like oil, it will make the surface cleaner, and after the oil is decomposed, other inorganic pollutant will be unlikely to stay on the surface, and it can be easily washed down by rain or other cleaning method.

2. The coat can also purify the air around the building. Actually, the product is used to purify the NO_x gas generated by the cars in somewhere. When the road side walls are coated, the surface will get clean and the environment around can be greatly improved as well.





**ANTI-BACTERIAL ,
ANTI-VIRAL &
ANTI-MOLD**



3. Anti-bacterial and Anti-mold

» There are 2 benefits of this feature.

1. The product can prevent mold or moss, so it will keep some marble and granite building cleaner.
2. The anti-bacterial will not only effect on the coat but also kill the bacteria in the air around, because of the air flow , the anti-bacterial feature will cause the bacterial in the besides air down.... «

Anti-bacterial

Titanium dioxide Photocatalysis is internationally recognized as one of the new sterilization materials, which can kill almost all kinds of bacteria including avian flu and SARS. It has been widely used in places of high demanding about sterilization like hospitals, institutions, schools etc. The TitanEffect Photocatalyst has strong effect on killing almost all kinds of bacteria under the irradiation of light, which can maintain very long time and thoroughly decompose bacteria, its body and the exdotoxin. Meanwhile, photocatalyst can wipe out the indoor allergen to reduce the incidence of respiratory diseases. Sterilization Mechanism of

TitanEffect Nano Coat Titanium dioxide itself has no toxicity to microbe and cell. It processes sterilization function only after the irradiation of UV light. At the present of light, the very strong oxidizing power of titanium dioxide can destroy bacteria's cell wall and membrane, and react with cell component, which inhibits bacteria's activity and ultimately results in the death and decomposition of bacteria. The sterilization of TiO₂ photocatalyst presents the following 2 different biochemical mechanisms.





**ANTI-BACTERIAL ,
ANTI-VIRAL & ANTI-MOLD**



1. TiO₂ irradiated by light directly reacts with the cells

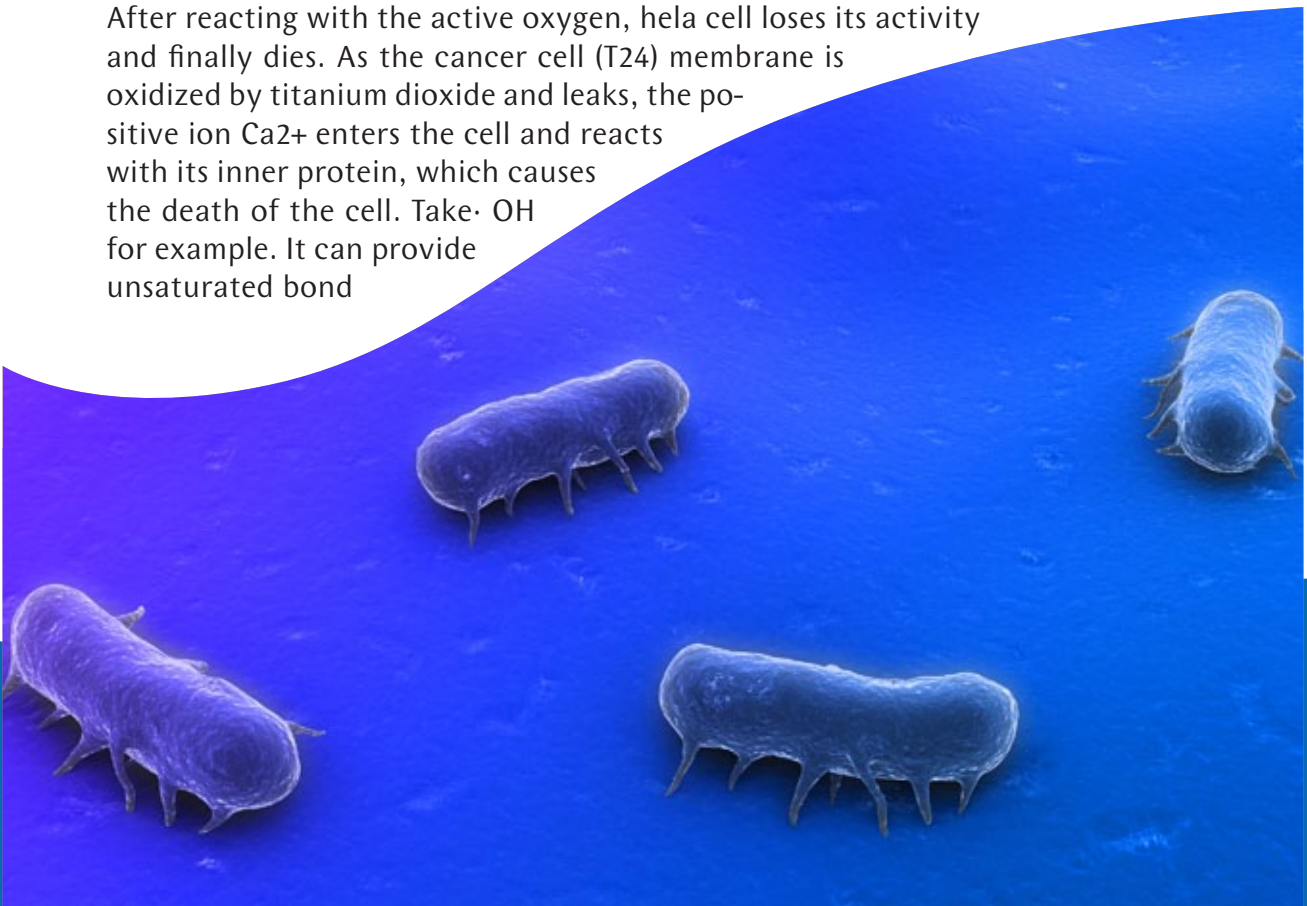
The electron-hole can directly react with cell wall, cell membrane and cell component. In the sterilizing process of microzyme and bacilli, CoA inside cell oxidized to CoA dimer loses its activity, which causes the respiration of the cell to stop and finally results in the death. During this process, the electron shift between the killed cell and TiO₂ is passed by CoA. Therefore the content of CoA decreases and CoA dimer increases.

2. Indirect sterilization reaction

That electron hole dissolves in water will generate active oxygen such as hydroxyl radical. The electronic structure of titanium dioxide is characterized by filled valence band

(VB) and empty conduction band (CB). The band gap energy is excited and an electron is promoted from the valence band (VB) to the conduction band (CB). Then an electron-hole pair is generated (electron e⁻ and hole h⁺). The positive-hole of titanium dioxide breaks the water molecule apart to form hydrogen gas and hydroxyl radical. The negative-electron reacts with oxygen molecule to form super oxide anion(O₂⁻) Super oxide anion can react with water molecule further, which generates hydroxyl radical peroxide (·OOH) and hydrogen peroxide (H₂O₂). Moreover, active hydroxyl radical can combine to form hydrogen peroxide. This cycle continues when light is available. The active hydroxyl radical, super oxide anion, peroxide hydroxyl radical and hydrogen peroxide can react with biomacromolecule such as protein enzyme and lipid, which will destroy the cell structure. They react with cell wall, membrane and its component. For example, the oxidation – reduction material is necessary in the formation of adenosine triphosphate inside the hela cell.

After reacting with the active oxygen, hela cell loses its activity and finally dies. As the cancer cell (T24) membrane is oxidized by titanium dioxide and leaks, the positive ion Ca²⁺ enters the cell and reacts with its inner protein, which causes the death of the cell. Take ·OH for example. It can provide unsaturated bond





**ANTI-BACTERIAL ,
ANTI-VIRAL & ANTI-MOLD**



The new free radical will cause chain reaction, which will lead to the qualitative change of bacterial protein and the total decomposition of lipid. The bacteria is decomposed and killed at once. Therefore, the electron hole and H_2O_2 formed on the surface of titanium dioxide can react with cell wall, membrane and its component to kill the cell. In the sol, the titanium dioxide particles absorb on the surface of animalcule cells or are swallowed by the cells. As to particles swallowed by cells, electron hole and active oxygen will react

directly with cytologic histological elements, which improves sterilization effect. The positive-hole of titanium dioxide irradiated by UV light is an extremely strong oxidation agent, the oxygen reacted is also very active. As a result, titanium dioxide can effectively kill escherichia coli, lactobacillus, bacillus subtilis, hela cell and cancer cell (T24) etc. Furthermore, it can inhibit or prevent the growth of malignant cells and even kill green algae. Due to function of strong sterilization and malignant cells preventing, titanium dioxide is supposed to be used in indoor antiseptis and sterilization, water treatment, water pollution comprehensive management and photodynamic therapy.

Actually, photocatalytic sterilization is supposed to constantly work between bacteria and titanium dioxide instead of simple surface reaction as photocatalytic degradation. As the active hydroxyl radical cannot longtime exist and cannot enter cell membrane to destroy cell structure, the sterilization effect is the result of hydroxyl radical and other active oxygen. Since H_2O_2 can enter cell wall, it not only kills the bacteria but also decomposes lipid like endotoxin released by its death. In addition, it can exist stably for a long time, so H_2O_2 can be the most important reaction medium in photocatalytic sterilization. Of course, the reaction also includes other active oxygen, and H_2O_2 is not the only reactant. The active hydroxyl radical performs strong oxidation inside the cell, which improves its sterilization effect greatly.

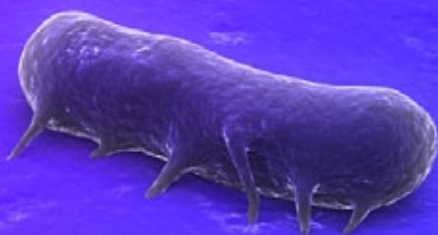
Microbe cell	Concentration Cell/L	Redox Potential /V
Microzyme	1×10^{11}	0.74
Escherichia coli	1×10^{11}	0.72
Lactobacillus	5×10^{11}	0.68
Bacillus subtilis	2×10^{11}	0.68
Samonella typhimurium	6×10^{11}	0.70

Typical Redox Potential of Microbe and cell (vs. SCE, PH=7)

Cell component	Concentration Cell/L	Redox Potential /V
Microzyme extravasate	-	0.65
CoA	3.7×10^3	0.65
Reductive coenzyme	5.0×10^3	0.40
Cysteine	2.5×10^3	0.45
Protoplasm	-	0.67
Hela cell	-	0.65

Redox potential of nano TiO_2 :+ 2.6 (vs. SCE, PH=7)





Antiseptics Comparison

The traditional antiseptics are divided into the following three ones, including organic antiseptic, inorganic antiseptic and natural antiseptic. There two kinds of inorganic- antiseptics, one is to use its strong oxidant ability to kill bacteria and fungus; the other is by means of metal ion.

It can effectively kill germ, however the antiseptics themselves like chlorine, chlorine oxide are bad for people's health. The metal ion antiseptics can't continue to decompose the germ body after killing them. Thus the germ body coats the metal ion, which will greatly affect its antibacterial efficiency. The organic antiseptics compounded by scientific chemical methods usually kill germ quickly, but the germ can adapt itself to organic antiseptics easily. Meanwhile the sterilization brings toxic substances.

	Advantages	Disadvantages	Typical products
Inorganic Antiseptic	Heat-resistant, wide range of sterilization and no need of light	The silver- antiseptics s are easy to change color, and surface coated with germ body will affect the result.	Silver-zeolite, phosphate, silver silica gel
Organic Antiseptic	Fast and wide range of sterilization, low price	ot heat-resistant, fast drug, produce toxic substances, have pollution	Phenol
Natural Antiseptic	High effect of sterilization, safety to human, no pollution	Not heat-resistant, difficult in processing the raw material	Chitosan, Sorbic Acid
Photocatalyst	Wide range of sterilization, high and everlasting effect, decomposition of germ body and endotoxin, safety, no pollution, harmless to human beings	light required *	Titanium dioxide based photocatalyst

* Notes: Through combine with nano silver technology, now some novel photocatalyst can work excellently under no-light condition.



PHOTOCATALYSIS
FOR
Environmental AIR Purification

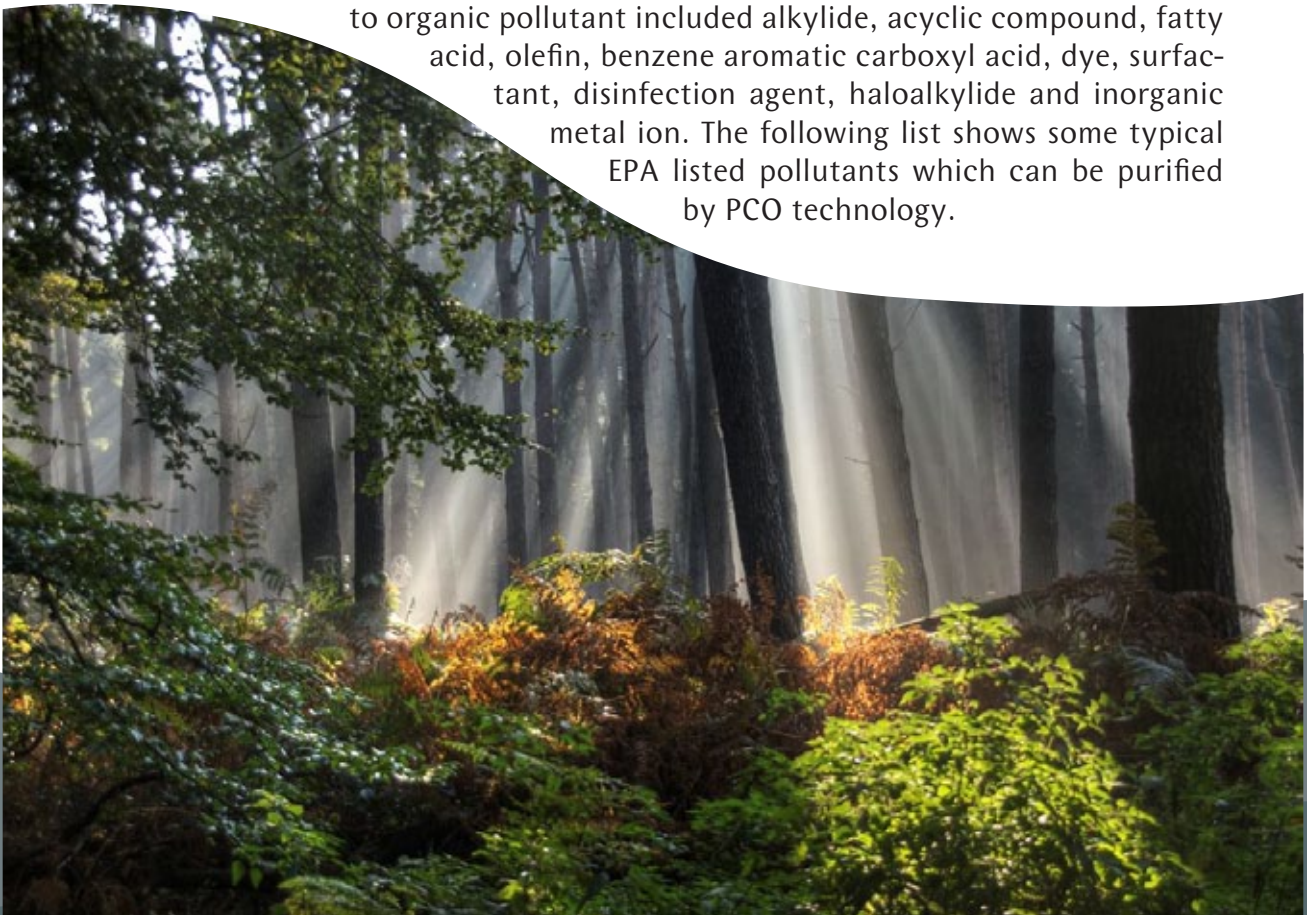


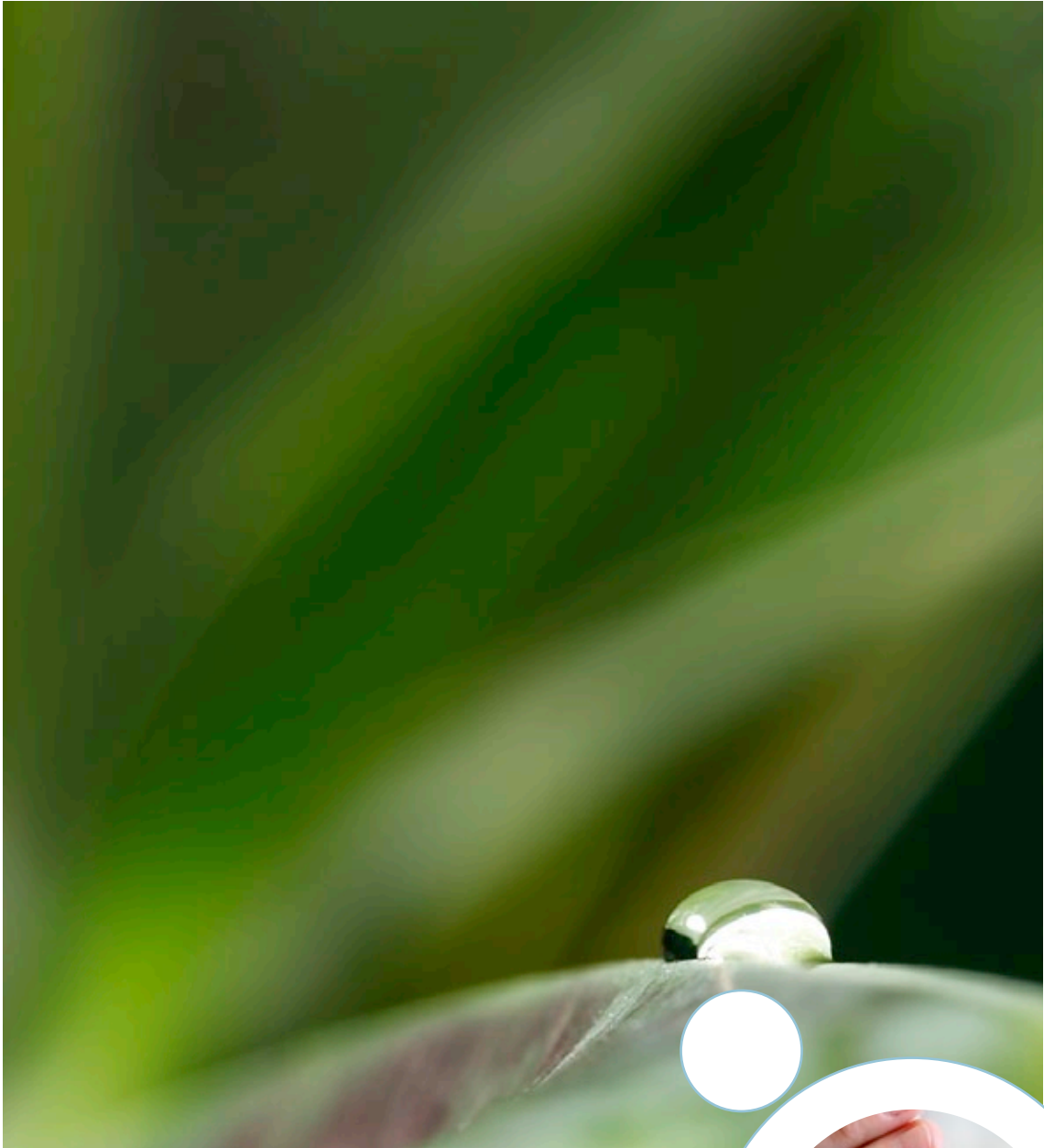
» photocatalytic technology will make life in the twenty-first century safer and more convenient. «

PCO Environmental Purification Technology

The environmental protection now becomes the global problem. More and more water, air are polluted. How to purify the environment efficient becomes a hot point of science researching. PCO (PhotoCatalytic Oxidization) technology are considered to be a potential high efficient environmental purification technology. In 1976, scientist found that the pollutant biphenyl and biphenyl oxide can be decomposed by photocatalyst in water. This discovery leads a new environmental purification researching trend. The advantage of PCO technology is its deep purification reaction ability. Even just under room temperature, PCO technology can decompose the pollutant into harmless chemicals completely and rapidly. This technology only need consume light as power, and do not require high temperature heat or other condition. Since PCO do not have re-pollution risk also, it becomes a very promising next generation environmental protection technologies.

For now, various researches show that PCO technology can be applicable to organic pollutant included alkylide, acyclic compound, fatty acid, olefin, benzene aromatic carboxyl acid, dye, surfactant, disinfection agent, haloalkylide and inorganic metal ion. The following list shows some typical EPA listed pollutants which can be purified by PCO technology.





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List of EPA priority controlled pollutant (PCO technology decomposable)

1,1,1-trichloroethane	monobutyl phthalate	cyclic ketone	ethylene dichloride
ethylidene chloride	nitrosobutylamine	o-methoxyaniline	dimethyl benzene
trichlorohydrin	ethyl perchloride	o-nitroaniline	picric acid
dcetylenedichloride	diisocyanate	PCB	pentachlorophenol
1,2-dichloropropane	n-hexane dinitrotoluene	propene	ethyl peroxide
dinitrotoluene	ene	propanamidezan	o-toluidine
1,3-butadiene	2,4-tolylene	parathion	sulfocarbamide
1,3-dichloropropene	dinitrotoluene	chloroxylenol	methylbenzene
2,2,4-trimethylpentane	acetaminofluorene	m-cresotyl	toluene diisocyanate
omal	2-aminoanthraquinone	nitrosopyrrolidine	chlorodifluoromethane
2,4,6-trinitrotoluene	chloroketol	phenyl phthalate	richloroethylene
fenclofenac	chlorophenol	butanal	triethylamine
methyltoluidine	carbitol	caprolactam	trinitrophenol
teraconic	2-methylnaphthalene	captan	rimethyl phosphate
dinitrotoluene	2-nitropropane	carbon subsulfide	chloroacetic anhydride
amino nitroge	xenol	carbon tetrachloride	chlorostyrene
aminobiphenyl	acraldehyde	oxythiamine	mtolunitril
chloraniline	propanamide	phenol	cumene
chlordimeform	acroleic	phenanthrene	cyclohexane
homohydroquinone	acrylonitrile	phenylic acid	anone
nitrotyrosine	aldrin	pesticide	dibenzofuran
accenaphthene	aminobenzene	DDVP	dichloroaniline
acetaldehyde	anthracene	chlorobenzene	d i c h l o r o d i f l u o -
acetamino	antiparasitic	clobenfurol	romethane
chlorothalonil	benzoyl	aldrine	acaricide
dimethyl sulfide	benzene	anodynnon	ethyl thiother
1,2,4-pseudocumene	hexachlorobenzene	chloroform	cyanmethine
1,2-dibromoethane	hexachlorobutadiene	chlorobutadiene	dimethylformamide
1,2-dichloroethane	acetone	propoxur	heptane
2,4-dichlorophenol	acerophenone	propionyloxy	propaldehyde
disolfoton	benzal chloride	diaminoazobenzene	tetrachlorothane
dioctylphthalate	thiacetamide	sumaresinol	stirofos
detylphthalate	ethyl bromide	chlorobenzoyl chloride	tetrahydrofuran
endosulfan	bromoform	benzoperoxide	hexachloro-cyclopenta-
epichlorohydrin	butyl acrylate	benzanthracene	diene
ethylaniline	1,4\ dihydroxybenzene	cchromene	pentachloronitroben-
ethene	indenofluorene	benzoic	zene
vinyl-ethyl alcohol	isophorone	chlorobenzaldehyde	homo-hydroquinone
fluoranthene	isopropyl ethylene	ethyl perchloride	carbonyl fluoride
fluorene	malachite	phenylog	phthalic anhydride
formaldehyde	malathion	phenylene-diamine	nitrosodiethylamine
methyl isopropyl ether	maleic acid	benzopyridine	nitrosopyrrolidine
MTBE	mancozeb	benzoquinone	nitrosodibutylamine
miecanyin	cyanuramide	chlorofos	nitrosodiisopropylam-
2,2-dichlorodiethyl	carbinol	oil of sassafras	ine
nitrobenzene	paspertin	butyl alcohol	sodium alizarinsul-
N,N-dimethylaniline	2-hexanone	mancozeb	fonate
naphthalene	abrodil	phenylacrtic acid	methylamine
naphthylamine	hexone	terephthalate	p-methoxyphenylala-
triglycylglycine	nitrosulfamide	butyl mercaptan	nine
nitrobenzene	nitrosotoluene	polyurethane	3-amino-2,5-dichlo-
nitrofen	N-nitroso-piperidine	vinylphenyl acetate	robenzoic acid
glycerin	pentane	ethylene bromiide	bromodichloromethane
butyl glycol	octane	ethylene chloride	pentachlorodiphenyl



UV Block

Today, UV irradiation degeneration is becoming a worse and worse problem to human society. Billions of dollars are lost in the UV damage cases. From acrylic paint to human skins, million kinds of surface are sensitive to UV damage. There are various UV block materials widely used in paint, cosmetic, coating, rub fields. Most of them are organic based, such as diphenylketone, but most organic based UV block agents are toxic and they will lose effect because of UV irradiation degeneration. In the movement of nano technologies, novel nano inorganic UV block agents are becoming a promising technology. There are 2 major method applying the nano TiO₂ UV block technologies, additive and coating.

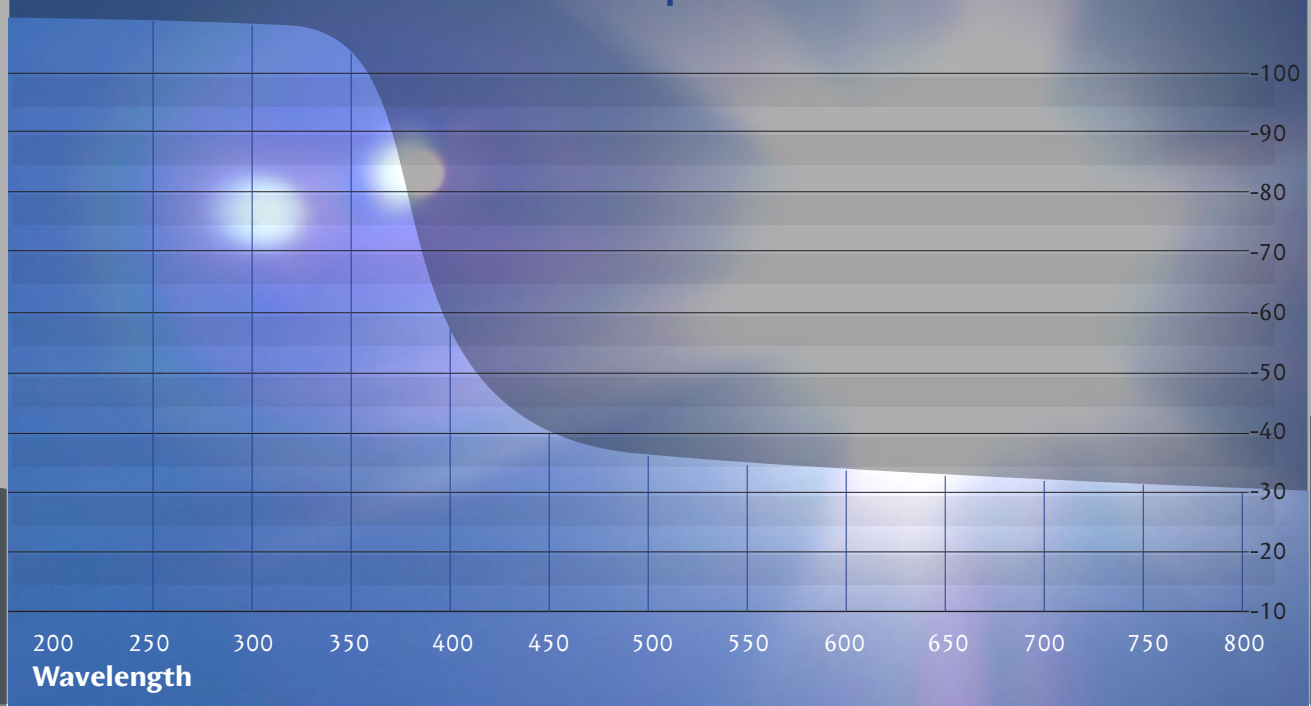
Additive:

The cosmetic, shampoo and paint industries usually apply nano TiO₂ as additive into exist system. A very low nano TiO₂ dosage will have a very excellent UV block performance, and nano TiO₂ last longer and safer to human beings.

Coating:

Coating is an innovative way to apply nano TiO₂ for UV block purpose, TitanEffect offer a series visible light transparent nano coating which applicable for various surface. Just simply coat a several hundred nano meter film on the substrate will offer a obvious anti-UV feature. The coating method can be applied in almost all the application, especially the application can't use additive. For example, outside advertisement paints are easily degenerated by UV irradiation and what cause several millions US dollar lose every year. With TitanEffect nano coat, the outside advertisement can last longer and keep the color in bright and colorful situations. Further TitanEffect nano coat can also offer the self-cleaning feature to the outside advertisement. The above multi-feature makes TitanEffect nano coating become a very promising UV block technologies.

TitanEffect UV-Vis DRS Spectrum 200-800 nm



TITAN EFFECT

HIGHLIGHTS



Next Generation Building Cleaning Solution

Objective:

Building exterior self cleaning, protection and energy saving
Road self-cleaning, protection and car exhausts purification

Solution:

The TitanEffect nano photocatalyst coat is the combination of photocatalyst and nano technology. Just simply coating the nano coat on the building exterior surface will bring diversified excellent features to the building.

Also, the product can be sprayed on road and road side to provide the self-cleaning & air purification function to the road. The TitanEffect nano coat can keep the building or road in a very new view and reduce the cleaning & environment protection cost and water consumption.

Benefits:

- Keep the building in new and clean view
- Protect the surface from dust, acid rain and air pollutant damage
- Purify the air pollutant near and on the surface (e.g. car exhausts NOx, Formaldehyde, Benzene, VOCs)
- Decompose the organic pollutant on the surface (e.g. oil, graffiti)
- Make the surface without water stain after raining
- Reduce the energy consumption for cooling the building in summer
- Restrain mildew or alga growing
- Kill the bacteria and virus on the surface and in the air near the coated building
- Absorb the UV from sun and then protect the surface from UV damage
- Restrain the dust electrostatic adsorption

» Features:

- *Super hydrophilicity*
- *Atmospheres purification*
- *Anti-bacterial and anti-mold*
- *Anti-UV protection*
- *Surface antistatic*
- *Self-cleaning*
- *Easy-cleaning.*

Example.1

Surface:

Product:

Apply Method:

Period:

Organic pollutant decomposition

Marble

Titan Effect coating

Spray

24 hours



Write "TEST 9/6" by orange pen on the marble without Titan Effect photocatalyst sol coat on 9th June.



Write "TEST 9/6" by orange pen on the marble coated by Titan Effect photocatalyst sol on 9th June.



On 10th June, the graffiti had infiltrated through the marble without Titan Effect photocatalyst sol coat.



On 10th June, the graffiti on the marble coated by Titan Effect had been decomposed.



Example. 2
Surface: Granite
Product: Titan Effect coating
Apply Method: Spray
Period: 3 months



This picture shows a granite wall which is old and dirty after years of weathering. The area divided by yellow adhesive tape is supposed to be coated with Titan Effect photocatalyst sol later.



Before photocatalyst is coated on the surface, pre-cleaning work is necessary. Wash the granite wall and clean out the deposit stain and pollutant. If possible, cleaning the surface with suitable chemical solvent is recommended. Then spray Titan Effect on the left part of the cleaned area.



After 3 months weathering, the wall coated with Titan Effect shows obvious self-cleaning function. The right part without photocatalyst becomes dirty and dark under the poor air condition of the metropolis. It will be close to the no cleaned area again after several months.

Example.3

Surface:

Product:

Apply Method:

Period:

Exterior column self-cleaning

Granolith

Titan Effect coating

Spray

102 days



Day1:

40 years' old granolithic column had been cleaned with improper strong acidic cleaning agent. The structure of granolithic covering had been destroyed; air, dust & pollutants had been retained on column base after raining as photo 1 dated 2005-7-18. Lower part of the stained column base would be cleaned & treated with Titan Effect Photocatalyst Coat.



Day1:

Lower part of column base (below the taped area) had been cleaned with cleansing agent. Dirt & stain had been removed off the stained area. Then Titan Effect was applied to the treated area of column base.



Day 36:

The untreated area- upper part of the column base was found dark & dirty while the area treated with Titan Effect, (lower part of the column) was found white & clean.



Day 102:

The untreated area became dark as a result of contamination by air & organic pollutants. Decomposition of pollutants & self-cleaning test on granolithic covering works & succeeds.

Example.4 External Limestone Cladding self-cleaning & anti-moss

Surface: Limestone
Product: Titan Effect coating
Apply Method: Spray
Period: 224 days

Before



After





SELF- CLEANING TECHNOLOGY
SUPER- HYDROPHILIC

The light clean revolution



Suggested applications of super-hydrophilic self-cleaning technology

Division	Function	Application
Materials for a road	Cleaning easiness Self Cleaning by a rainfall Anti-fogging property	Tunnel lighting, Tunnel wall, Clear soundproof wall Traffic sign, Lightning, Soundproofed wall, Guardrail, Decorative laminated panel and Reflector on a read Road mirror
Materials for a house	Cleaning easiness Self Cleaning by a rainfall Anti-fogging property Accelerated drying	Parts of a Kitchen, a Bathroom and Interior furnishings Exterior tiles, Siding boards, Window, Sash, Screen door, Gate door, Roof, Sun parlor, Handrail of a verandah Mirror of a Bathroom and a Dresser Toilet, Window, Bathroom
Materials for a tall building	Self Cleaning by a rainfall	Window, Sash, Curtain wall, Painted steel plate, Aluminum panel, Tile, Building stone, Crystallized glass, Glass film
Materials for a store	Cleaning easiness Self Cleaning by a rainfall Anti-fogging property	Showcase Signboard, Fingerpost, Show window, The exterior of a store Refrigerated showcase
Materials for agriculture	Self Cleaning by a rainfall, Preventing dewdrops forming	Plastic and Glass greenhouse
Materials for an electric and electronic instrument	Cleaning easiness Self Cleaning by a rainfall Preventing dewdrops forming	Computer display Upper glass of a solar cell, Insulator Heat exchanger of an air conditioner, High- voltage cable
Materials for vehicles	Self Cleaning by a rainfall Anti-fogging property Preventing dewdrops forming	Painting and Coating of vehicles, The out- side of windows, Headlights The inside of windows, Glass film, Helmet visor Side view mirror, Rearview mirror and Windshield of a motorcycle, Side mirror film
Materials for optical instrument	Anti-fogging property	Optical lens
Materials for medical instruments and supplies	Bio-compatibility	Contact lens, Catheter
Daily necessities and Consumer products	Cleaning easiness Self Cleaning by a rainfall Anti-fogging property	Tableware, Kitchenware Spray of anti-fouling coat Spray of anti-fogging coat, Anti-fogging film
Paint	All properties mentioned above	Paint, Coat



HIGHLIGHTS
ADVANCED
ODOR ELIMINATION SOLUTION





Objective:

Odor and bad smell control system Daily odor control coat and application Deodorizing function textile and material

Solution:

TitanEffect nano photocatalyst is a novel deodorizing technology. There are two traditional odor control methods. One is to use some more strong smell to cover the odor, such as perfume. The other is to use physical method to absorb the odor and remove it temporarily. However, the TitanEffect nano coat can effectively decompose the smelling materials and gases to produce water and carbon dioxide. Photocatalyst itself is a safe chemical substance with no extra pollution. It reacts as catalyst in the reaction so that its performance maintains longtime. As photocatalyst is effective to most odors, it can be widely used from daily life to industry processing to eliminate kinds of odor. TitanEffect manufactures varieties kinds of nano coat products, which can be applied in different environments and places especially textile, to meet the needs of daily life and industry processing.

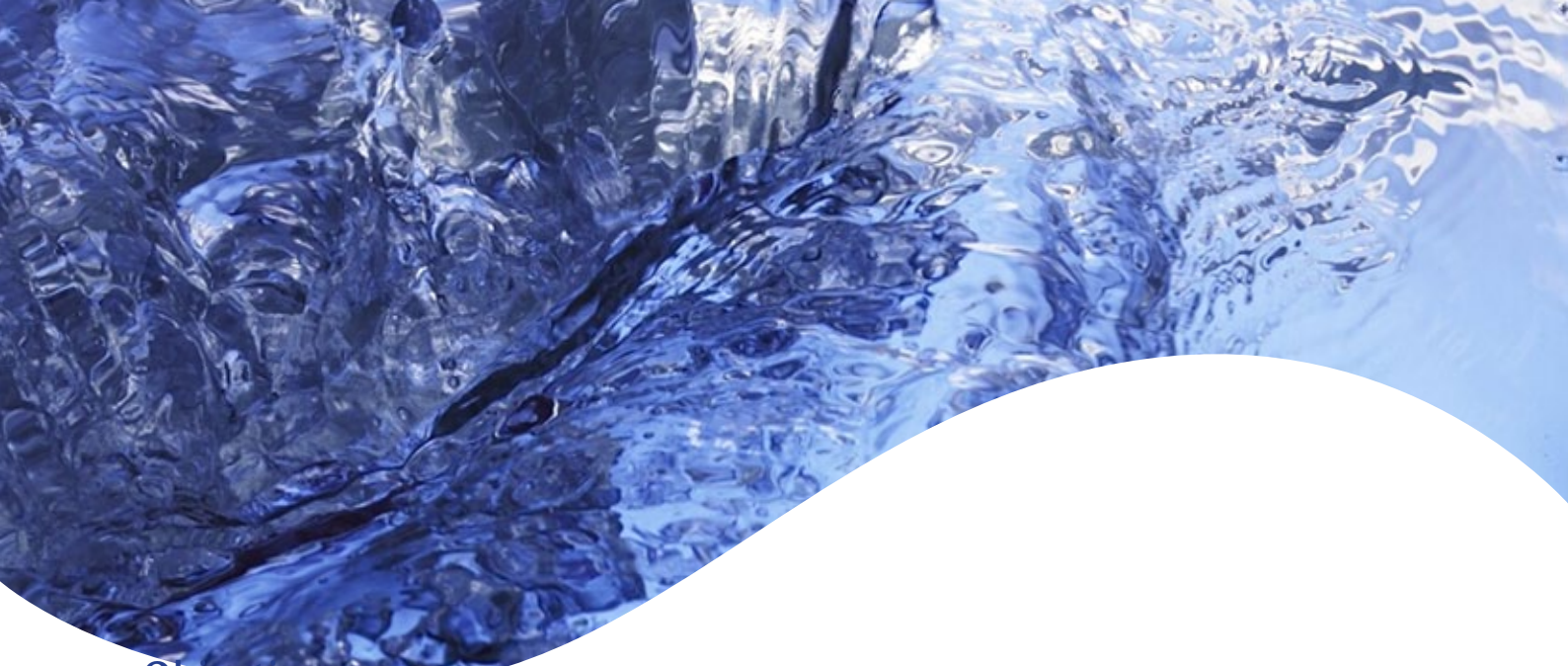
Features:

- Environmental-friendly, no extra pollution
- Easy to apply in most site and diversified surfaces
- Decompose the odor molecular, different to perfume
- Catalytic action mode, longtime performance
- Not only effect to odor, but also purify the harmful gas, keep the environment safety to human
- Anti-bacterial



HIGHLIGHTS
ADVANCED AIR PURIFICATION
SOLUTION





Objective:

Outdoor air purification (car and industry exhausts purification)
Indoor air purification (Sick-house Syndrome, VOCs)
Air purification device and filter industry

Solution:

TitanEffect nano coat is a next generation of air purification technology, which can treat air pollutions caused by more than 85% kinds of harmful gases such as car exhausts NO_x, formaldehyde, benzene, VOCs. At the presence of light, photocatalyst produces hydroxyl radicals and holes (h⁺), which react with organic materials and harmful gases to produce water and carbon dioxide. There is no extra pollution in the whole purification process. The nano photocatalyst reacts as catalyst in the chemical reaction so that its performance will maintain longtime and it will never be consumed. What's more, we have the innovative VLR (Visible Light Response) photocatalyst manufacture technology whose products are suitable for indoor use where UV light irradiation is weak.

Features:

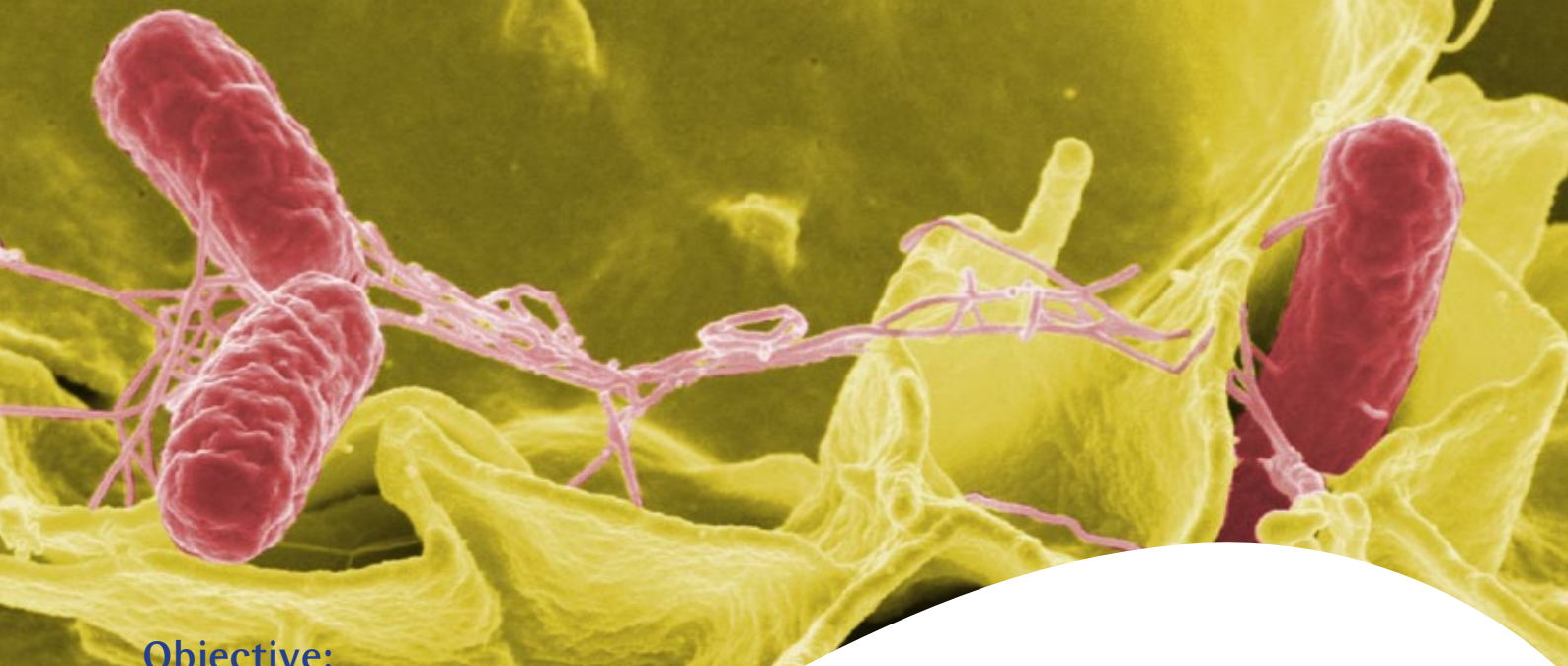
- Purify most air pollution include NO_x and VOCs
- 100% mineralize harmful gas to H₂O and CO₂
- Environmental-friendly, no extra pollution
- Organic pollutant decomposition
- Catalytic action mode, longtime performance
- Odor control
- Anti-bacterial

	HEPA1	ES Filter2	Ozone	UV3	Minus-Ion	Photocatalyst
Mold	Good	Normal	Good	Good	Normal	Excellent
Germs	Excellent	Normal	Good	Good	Normal	Excellent
Virus	Normal	Normal	Normal	Normal	Normal	Excellent
Dust Mite	Excellent	Good	Normal	Normal	Normal	Normal
Toxicant	Normal	Normal	Good	Good	Normal	Excellent
Odor	Normal	Normal	Good	Normal	Good	Excellent
Smoke	Good	Good	Good	Normal	Excellent	Good
VOCs	Normal	Normal	Good	Good	Normal	Excellent
Allergen	Good	Good	Good	Normal	Excellent	Excellent



HIGHLIGHTS
ADVANCED STERILIZATION
MATERIAL SOLUTION





Objective:

Anti-bacterial & anti-virus treatment of public places and facilities such as hospitals, schools, hotels, taxis, buses etc. Anti-bacterial and anti-virus treatment for antibacterial mask, filter, clothes, device and products Home antibacterial, deodorizing, anti-allergic, defend epidemic.

Solution:

The TitanEffect nano photocatalyst has strong effect on killing almost all kinds of bacteria and virus included SARS, H5N1 etc. This performance continues very long time. The TitanEffect coat can thoroughly decompose bacteria & virus, their body and the endotoxin, and has a stable effect on killing new variations of the bacteria. Due to the photocatalyst can complete decompose the bacteria and virus; it won't lose its effect because of the bacterial body accumulation on the surface (e.g. silver antibacterial process). Meanwhile, photocatalyst also can eliminate smoke of cigarettes and pets, and wipe out the indoor allergic agent to reduce the incidence of respiratory diseases. The nano coat can be used for antibacterial products such as mask, filter, clothes to provide convenience and comprehensive antibacterial effect for people daily life.

Features:

- Broad-spectrum sterilization, no target selection
- High performance and everlasting effect
- Decomposition of germ body and endotoxin
- Catalytic action mode, longtime performance
- Safety, no extra pollution, environment friendly and harmless to human beings

Benefits:

- Broad-spectrum sterilization feature, kill almost all kinds of bacteria and virus; meet variety anti-bacterial need.
- Provide deodorization and anti-allergen feature.
- For the anti-bacterial mask, filter and device industry.
- Long time efficiency, not need frequent reuse.
- Control and restrain outspread of mold and fungus.
- Efficiently defend epidemic disease in public places, such as hospitals, schools, hotel etc.
- For home, office and car anti-bacterial requirement, easy use & no extra pollution.
- For hospital, hotel, school anti-bacterial requirement, excellent performance & no odor release like chlorine oxide antiseptic.

Example.1 Anti-bacterial test of TitanEffect Bac Plus

Irradiating by 40w fluorescent lamps during testing

	Klesiella pneumoniae (ATCC 10031)	The Inoculums Count after 24 hour (cfu/piece)	Bactericidal rate (%)
Escherichia coli (ATCC 25922)	3.9X10 ⁴	9.0X10 ²	97.69
Staphylococcus aureus (ATCC 6538)	6.8X10 ³	1.1X10 ²	98.38
Pseudomonas aeruginosa (ATCC 9027)	2.8X10 ⁵	84	99.97
Klesiella pneumoniae (ATCC 10031)	2.7X10 ⁵	1.5X10 ³	99.44

According to GB15979-2002, tested by GUANGDONG DETECTION CENTER OF MICROBIOLOGY)

Example.3 Anti-bacterial test under dark condition of TitanEffect Bac Plus

	Bacteria concentration (cfu/ml)	Sample concentration	Test times	Contact time	Survival bacteria from sample (cfu/ml)	Survival bacteria from control sample (cfu/ml)	Killing Rate %
Escherichia coli (ATCC 25922)		Original	1	24h	<1	1.2X10 ⁸	>99.9
		Original	2	24h	<1	1.1X10 ⁸	>99.9
	1.2X10 ⁶	Original	3	24h	<1	1.1X10 ⁸	>99.9
		Original	4	24h	<1	1.4X10 ⁸	>99.9
		Original	5	24h	<1	1.0X10 ⁸	>99.9

(Test Condition: According to GB15981-1995, tested by SGS, the whole process is under no-light condition)

Example.2 Anti-bacterial test of the lamp coated by TitanEffect Bac Plus

	Results: Total Mould Count, ctu/plate [Sabbouraud Dextrose Agar (25°C, 5 days)]
Stage 1: Taken with 4 existing fluorescent lamp (normal 18W plug-in CFL) switched on. Time: 9:30 a.m.	19
Stage 2: Taken 1 hour and 30 minutes after switching existing lamp with 2 table lamp. Time: 11:00 a.m.	4
Stage 3: Taken with the same conditions 1 hour and 30 minutes after stage 2. Time: 12:30 a.m.	0

This example tests the environmental anti-bacterial performance of the lamp treated by TitanEffect nano coat. The lamps are set in a house and then test the air bacteria in the house tested by CHEMICAL LABORATORY (MALAYSIA) SDN BHD. In-house test Method based on United States Pharmacopoeia 28)

HIGHLIGHTS
NANO GREEN
TEXTILE SOLUTION





Objective:

Daily home textile treatment Industrial functional textile manufacturing process Integrated textile part treatment.

Solution:

The TitanEffect nano coat is a novel nano material for functional textile and fabric production to promote their property, widely used in textile processing and daily textile treatment. TitanEffect photocatalyst sol can effectively bind on the surface of fabric. The effect will maintain longtime after one treatment. TitanEffect photocatalyst sol can also be used in the processing of textile industry, greatly promoting anti-bacterial and deodorizing performance. In anti-allergy and anti-skin disease field, TitanEffect products also perform excellent and stable. The TitanEffect nano coat can remove odor and decompose harmful gas to produce water and carbon dioxide. As a result, our product can be applied on textile and fabric for air purification, such as curtain and fabric air filter. Meanwhile, there is no extra pollution and no harm for the coated textile. Our product is extremely easy to use, just dipping the textile in the sol or spray the sol on the surface.

Features:

- Deodorization & Air purification
- Anti-allergy
- Reduce skin disease happen
- Anti-static
- Elimination all kinds of bacteria and virus
- Bind strongly on the surface of textile
- Easy to use, home DIY ready
- Totally safe to human, no stimulation

Benefits:

- Easy for home use, provide anti-bacterial, deodorization and anti-static functions to usual textile by means of dipping
- Broad-spectrum anti-bacterial for clothing, kill the variation of bacteria and virus.
- Deodorization for clothes, e.g. remove sweat smell and other bad smell from sports suites.
- Integrated with the textile facility in the automobile can refresh the air in the automobile.
- Personal health prevention and cure on foot odor, skin diseases, women and infant diseases.
- Remove harmful and venomous substances in textile such as formaldehyde.
- Applied for air purification functional textile production.
- No harm to human body, bland to skin, safe and high performance, suitable for underwear
- Widely used in textile for anti-bacterial, including mask, curtain, sheet, underwear, shirt, T-shirt, sports garments, glove, sock, towel, blanket, quilt cover, pillow cover, washing cloth and various kinds of women and children stuffs, one-off medical textile
- Excellent anti-mold feature for wool textile product.



HIGHLIGHTS
NOVEL NANO COSMETIC
ADDITIVE SOLUTION



Objective:

UV block cosmetic Super fine whiten cosmetic Anti-bacterial & anti-allergen cosmetic Anti-grease cosmetic & shampoo

Solution:

Solution:

The high concentration TitanEffect nano photocatalyst slurry and sol product can be used as additive in cosmetic products. The cosmetic products with TitanEffect nano slurry additive can take advantage of the advanced nano photocatalytic oxidation feature to offer anti-grease function. Further TitanEffect nano photocatalyst slurry will bring a long term and broad-spectrum anti-bacterial function, it has excellent effect to skin disease, and the product combine with nano silver technology can work even in dark condition (like your foot). UV block is a basic function of nano TiO₂, now nano TiO₂ is becoming one of the most promising physical, no stimulation, high efficient and inorganic UV block additive. The nano level particles can also bring silky touch to the cosmetic products. The very fine dispersing feature also makes the additive easier to use.

Features:

Features:

- UV block
- Anti-grease
- Anti-bacterial
- Anti-allergen
- Whiten
- Super fine particle, silky touch
- Easy to disperse
- Safe to human, no stimulation
- Easy to use, home DIY ready
- Totally safe to human, no stimulation

Benefits:

- UV block cream & gel cosmetic product, which can offer whiten feature at same time
- Anti-grease shampoo for decompose & reduce the grease on grease-hypersecretion hair
- Anti-grease cream & gel cosmetic product for skin grease reducing
- Anti-bacterial function for skin care cosmetic, which have excellent effect to skin disease
- Inorganic stable structure, safety to human, longer life