

Leading scientific technology for environmental purification — Photocatalyst —

The science in the 21st century hopefully bring us a technology that enable us to live in harmony with the earth we live in and allow us to lead a peaceful, safe and quality life.

Under a current circumstances, the global environmental issues is the most urgent matter that needed to be taken care of, and the Photocatalyst reaction utilizing semiconductor represented by oxidized titanium is one of the most powerful and leading technology.

Photocatalytic technology is an original Japanese technology that we can be proud of. It's been more than 20 years since the technology was introduced and is applied in many ways in our daily life nowadays.

Photocatalyst is generated by optical energy

Photocatalyst is a catalyst that works with energy of light. The Photocatalyst boosts up its energy by absorbing light, and generates a chemical reaction by passing its energy to a reacting substance. Metal complexes and semi-conductors are applied as an Photocatalyst in general but the most common one is the Octahedrite made from titanium dioxide (TiO_2) as it does not dissolve with water, is durable and has a strong resistance against friction and is easy to get resource as it is plenty to find out there.

We can decompose almost all the organics, including deadly poison dioxins, into water and carbon dioxide by applying its strong oxidation power when irradiated light to a Titanium Dioxide. By utilizing Photocatalyst action, we can apply to various ways in our environmental field such as deodorizing, antibacterial and mould protection, purifying exhaust gas, pollution protection, self cleaning, and waste water management.

Titanium dioxide coated with apatite Photocatalyst

Titanium dioxide coated with apatite is

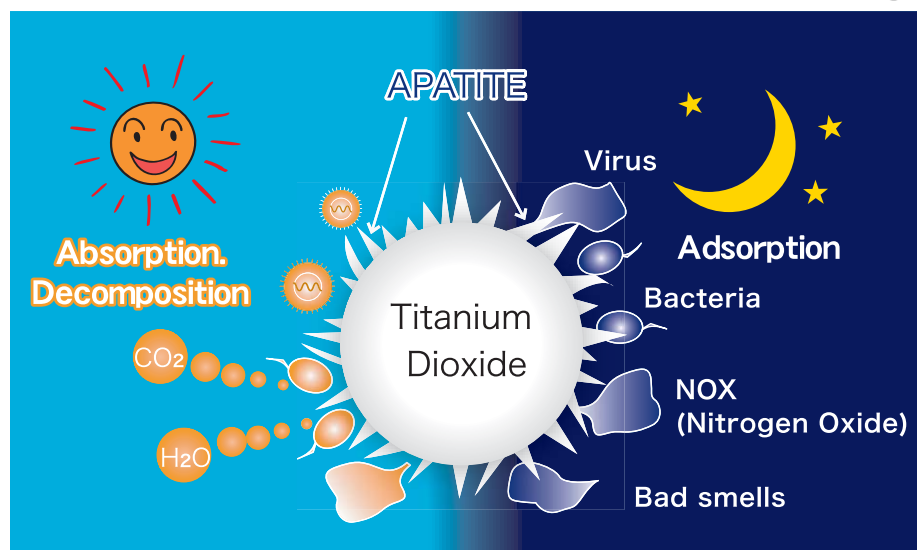


Fig.1

a substance known as a component of bone and tooth. Apatite absorbs harmful chemical substance and decomposes the adsorbed substance when contact with light activated by Photocatalyst (Fig. 1).

Titanium dioxide also decomposes textiles and resins when making a direct contact but because the apatite acts as a middle layer, it can be directly mixed with or coated on to the high molecular materials. This product can be applied to purify water and air, dirt or stain protection, bleaching and cleaning. It can also be applied to such basic organic materials as textile, resin, plastic, wood, paper.

Visible light respond Photocatalyst

Weak point of titanium dioxide is that it only functions with the ultraviolet which is contained only a few percentages in the sunlight. In order to overcome this problem we have developed a visible light respond Photocatalyst i.e. a catalyst that will react to a visible light, by applying titanium dioxide as a base together with the plasma treatment technology to let it react to the visible light as well as wavelength 300 ~ 600nm ultraviolet. This Photocatalyst can perform excellently both indoors and outdoors.

* Photocatalysts can be used in many purposes



Indoor Enviroments

Deodorize . Antibacterial . Reduce Bacteria, purifying air and water

Effective on SICK BUILDING SYNDROME **NANOBEST NA**

Improve room environment to a healthy environment

NANOBEST NA can decomposes such harmful chemical substances as formaldehyde that is said to be the cause of the sick building syndrome, into water and carbon dioxide and purifies the room environment.



Such symptoms are reported even with new automobile so called a sick car syndrome in mass media. By simply applying the NANOBEST NA onto the automobile interior such as dashboard mat will reduce the Volatilize organic compound (VOC).



▲ Offering a cleaner and safer living space by applying Photocatalyst in the various places in the room.



Photocatalyst coat for interiors

NANOBEST NA

From left

- For general interior
- Visible light reacting type
- Antibacterial silver contained

reported that "more than 70% of children's room in Beijing were sick building 汚. The survey was made on

500 children's room in Beijing that were within 1 ~ 2 years after a renovation and 361 rooms (72.2%) had more than 0.1mg of formaldehyde per square meter which was much more than the guideline given by the government and the highest was 8 times more than that of the guideline.

Formaldehyde, a harmful chemical substance may cause cancer and leukemia if inhaled for too long time.

There are 40000 new leukemia patients in China every year and half of them are children between 2 ~ 7 years of age. There is even data showing that more than 90% of children who got leukemia and treated at the children's hospital of Beijing were from those houses that were recently renovated.

Living environmental condition in Beijing
"70 % of the children's rooms is a sick building"

The survey, jointly carried out with the City of Beijing product quality / , and China interior / center, Beijing association of / center, Beijing / center discovered and

■ An indoor environmental pollution material

Origin	Polluted or contaminated subject
Plywood (closet, ceiling, wall furniture, floor and etc.)	Glue (formaldehyde), Insecticide (fenitrozon, hoxim and etc.),
Wallpaper・Paint	Preservative CCA<chrome copper arsenic compound> Plasticizer (phthalic acid ester, DOP, DBP and etc.), solvent (toluene, acetate acid ethylene and etc.), noncombustible (TCEP), glue (non reacting formaldehyde) and etc.
Floor mat Floor	Floor mattress insecticide (fenitrozon, fenzion, diazinon, naphthalene), Chlorinated resin floor plasticizer (phthalic acid ester, DOP, DBP and etc. Glue for material accumulating (formaldehyde)
Carpet	Insecticide (diazinon, fenitrozon, deet and etc.)
Under the floor Foundation	Termite insecticide (chlorphifos, hoxim, baster, trichlorfon, pridafetion, S-421 and etc.) preservative (creosote, CCA) organic solvent
Fire resistance・Heat resistance	Asbestos, glass fiber, chlorofluorocarbon

Apatite made it possible to mix with textile

Apatite covered titanium dioxide can be applied in various materials

Making it antibacterial, decomposing odors and stains on closings and sheets **NANOBEST FB**

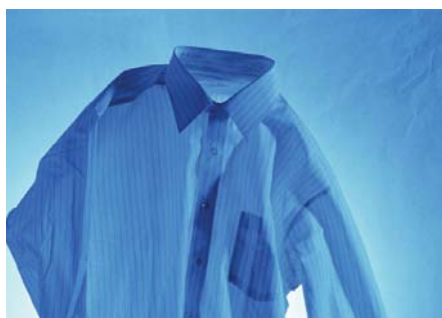


With antibacterial & deodorizing function for textiles

The traditional Photocatalyst made only with titanium dioxide had a drawback of decomposing the textile.

NANOBEST FB, covered titanium dioxide with apatite prevents titanium dioxide from having a direct contact with textile, works only to decompose odors and bacteria.

Recently, there are many Photocatalyst products being developed glossed NANOBEST FB in, such as sheets, beddings, curtain, wall cross, underwear's, socks and shirts that have antibacterial and deodorant function. These products are all made to keep its benefit even with regular washing and have its effect last longer.



▲ top left: shirts/school uniform bottom: drying the textile after dipping into Photocatalyst solution

Applied to student's uniform in Thailand

The apatite covered titanium dioxide photocatalyst is applied to the students' uniform in Thailand.

Result 100% after irradiating black light for 24 hours, 91.67% after 24 hours of visible light irradiation. These are the result of staphylococci disappearance. We have performed an inspection of the colon bacilli using unwoven cloth at the Japan Spinners Inspecting Foundation.

Underwear and lingerie applying nanobest FB

Nanobest FB (apatite covered titanium dioxide for textile) is also applied to underwear and lingerie.

Odors caused by sweat and bacterium and harmful elements such as aldehyde are absorbed by apatite and decomposed by titanium dioxide.

Namely, with this compound material, it enables mixing with textiles and absorbing matters at the same time.



Excellent function of antibacterial and deodor shoes and socks

Apatite covered titanium dioxide photocatalyst shows its abilities to activate and works its antibacterial and deodorant effect by light and heat. The shoes and socks processed with photocatalyst on the surface prevent germs and bacterial to propagate in a stuffy condition thus gives you comfort throughout the year.

Sport shoes sweat a lot which is

the cause of unpleasant odors. It will decompose the odors and bacterial by airing in the sun and keep its comfort.

These products must be produced in a suitable compounding depending on the characteristics of the textiles as well as the suitable binders in order to have the textile keep its effect i.e. photocatalyst material on the textile even after washing.

Outdoor Enviroments

Purifies air and water, self cleaning

Shows excellent effect with sunlight and rain in outdoors **NANOBEST GA**



Dirt protection for outside wall

By coating apatite titanium dioxide coat, the organics that are cause of dirtiness will be decomposed. Normally, the outside walls of buildings are cleaned once every 5 years but by applying this Photocatalyst material on the surface, you can expect to save cost to a great extent.

NANOBEST GA is made to last for a long period of time applying binder that can strongly resist under a tough outside condition. Photocatalyst works well utilizing rain and ultra violet ray to keep the wall clean and beautiful.

The product is applied on building and residential walls, monuments, and other public installations and facilities.

Purifying automobile exhaust gas

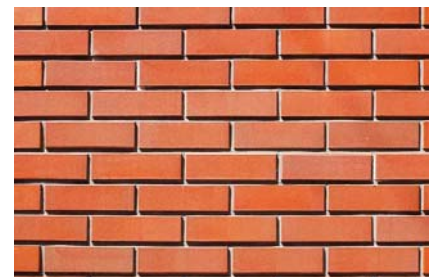
There is a experiment going on to apply a sound absorber, fixed by the side of the roads, coated with Photocatalyst to clean nitrogen oxide (NOx) and sulfur compound (Sox) which are the cause of an air pollution mixed in the exhausted gas from the automobiles. It is made by crushing oxidized ceramic



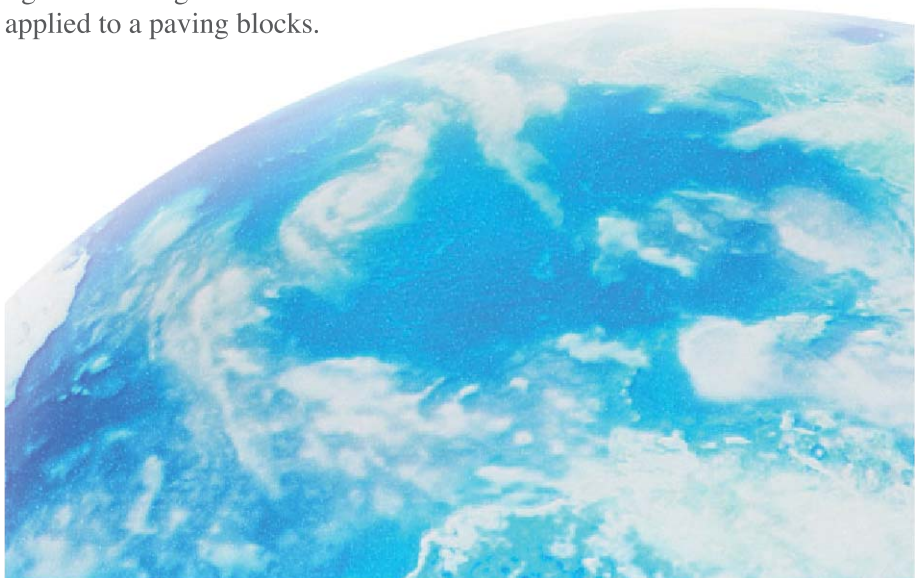
▲ Outdoor optical coating paint test. After 45 days (outside factory wall of a Japanese company / Thailand)

insulator waste and shaped into a porous sound absorber. This will oxidize NOx and SOx nearly 100% and becomes nitric acid and sulfuric acid reacting with absorbed water and get washed away with the rain.

By coating apatite coated titanium dioxide coat, it is possible to have a transparent block capable of adsorbing harmful chemical matters regardless of there is any light or no lights. It can also be applied to a paving blocks.



An outside tile baked with our available in the market Photocatalyst product. Coating (paint) for outside wall is also available.



Natural power maintains glass in clean **NANOBEST CLEAR**



▲ The whole operation is simple job but you need to give a treatment before starting.
AOT [Airport of Thailand]
Suvarnnaphumi Bangkok International Airport
Self-Cleaning

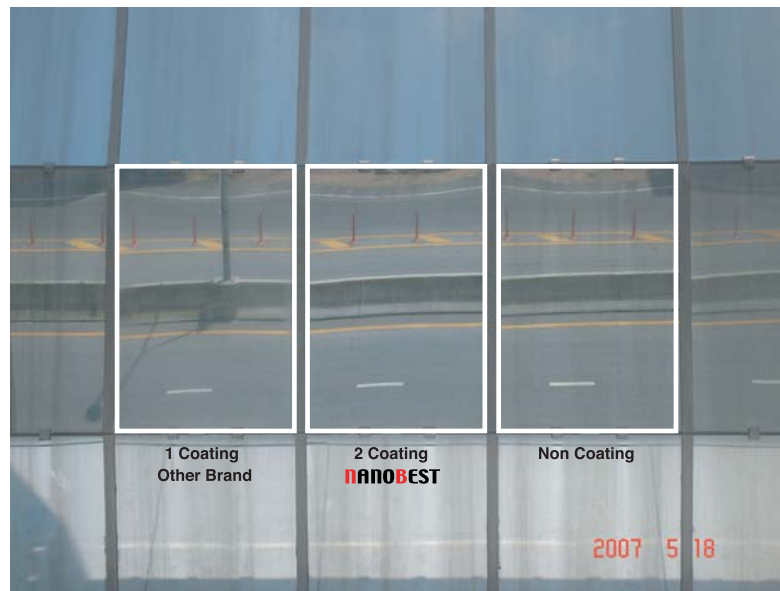
Keeping the glass clean

NANOBEST acts to make it difficult for a glass to get a dirty stain and easier to clean by its double action i.e. Photocatalyst decomposition (decomposes organics) and super water friendly Photocatalyst (to create a water friendly surface) by forming a film of Photocatalyst on the surface of a glass. By utilizing such effect, we can keep the see through beauty of the glasses for a considerable length of time.

Photocatalyst glass coating needs no pre-coating such as having an under coating. It only needs one layer of Photocatalyst coating which will make the job a lot easier. It can easily be applied on any shape and size of glasses since it is an easy spray-on type.

The glass surface that became super water friendly allows no water to form a drop but form a film of water that prevents a light to scatter (diffused reflection) which makes the gives the Photocatalyst applied glass much more clearer view than a normal glass.

It only utilizes the natural energy (solar light and water). It is also nature environment friendly technology since uses no harmful material.



▲ 10 days after the coating the center one is with the NANOBEST clear coated surface



▲ 20 days after the coating clear difference compared to the other product applied on left

Reducing various risks in the livestock industry

Contributing to produce healthier and safer meats

Highly expected to be effective to reduce bacterium in many environments **NANOBEST-01**



Photocatalyst for reducing bacterium

Effectiveness of the photocatalyst as a measure against PRRS (pig breeding, respiratory disease syndrome = cause of mass death of pigs) is expected. These viral diseases not only damage the livestock breeders by lowering their productivity but also have a risk of infecting human and some effective measures are needed to be taken urgently.

Nanobest 01 is a visible light responsive photocatalyst, specially



▲ Nanobest test in a pigsty. We've succeed to reduce the death ratio of pigs by spraying nanobest01 onto the floors, walls and ceilings of the facility. (Experimental pigsty/the Philippines)

developed to reduce bacterium and can be applied in many ways.

We have succeeded in reducing the death rate of pigs not by giving them antibiotics but by applying 1% solution of Nanobest 01 on regular the bases to the walls and floors of the pigsty in a piggyery.

Not just by keeping the pigsty clean, which have to be kept germless clean,

but also by spraying the Nanobest 01 solution in the area will protect livestock and human from creeping viral contamination. It also reduces the unpleasant smells, which is another problem that the pig farmers have.



▲ Antibacterial a pigsty on regular bases spraying nanobest 01 liquid. It is necessary to keep appropriate environment for pigs.



Also an effective measure against SARS

Photocatalyst has been proven to be highly effective as a protection against other viral contagious diseases infection such as SARS (Bird flu). We recommend poultry farmers to apply the coating solution on the outside and the inside walls of the henhouse together with shutting out other birds from entering the house. It is expected to reduce the risk of mass death of domestic feathers such as chickens.

Applying photocatalysts in wider range

New usages are expected for photocatalyst

The study of the photocatalyst came to a full-scale in the 80s'. Since then, there have been many materials being developed. The difference between the basic knowledge of and the application for the photocatalyst is not much thus the development of new material is immediately reflected to the product. The development of new material opens a new door to its new application which leads to a new product. Photocatalyst can easily and safely be used by anyone and is effective as long as there is a light. Thus regardless of the user being in the advanced country or developing country, it is applicable all over the world. It definitely is an ideal technology for those countries that are still under development. Therefore, it is not only in Japan but all over the world, that diffusion and the technology applications are expected.

Environmental purification effect of photocatalyst

Studies are being carried out to decompose and make it harmless, the matters that cause the environmental pollution by applying photocatalysts. And other studies such as purifying waste fluids from farming, applying to the water treatment system, development of harmless materials to fight against dioxins, to reduce leftover farming fertilizer, apply to manage unpleasant smell from stock farming, and to increase its effect under the visible light.

Products being developed in various areas

We are busy developing products that can contribute to our environment



▲ Inside deodorant mat. Tackles and deodars even the unpleasant tobacco smell and refresh the environment.



▲ Experimenting self cleaning on a passenger car that was coated with the titanium dioxide photocatalyst paint on the body. Can clearly see the difference between the coated surface and non-coated surface. With silica's high water friendliness, it makes it easy to get the dirt off in the rain.

and society by applying the nanobest's photocatalyst products to various materials.

Products being developed in various areas

With the conventional titanium dioxide photocatalyst decomposes the paint work of automobile body and

thus not possible to be coated with. But by coating with silica, we've succeeded in developing highly effective self cleaning coat.

And as for the interiors of the automobile, there are paints especially for that purpose as well as the deodorant mat that is for placing on the dashboard are manufactured.



▲ Spraying nanobest Na onto the interior of a passenger car. It is applicable on almost all the places inside the car. Decomposes those typical new car smell and tobacco smell and create a pleasant environment.

Photocatalyst playing an active role in various environments

New products are being developed using NANOBEST

Applying optical catalytic technology to the agricultural field. Organically grown tomato.



▲ Safe as well as high value added organically grown tomato.



▲ Placing an photocatalytic processed charcoal by the root.

Organically grown tomato

An organic farming experiment in Hokkaido, Japan. The area of the vinyl house is 100 square meter. Tomatoes harvested satisfactory without using any fertilizer from the seed planted in the soil improved with charcoals and placed with photocatalyst processed charcoals by

the root.

There are growing concerns over food safety nowadays. Applying the optical catalytic technology to the agricultural field is only a beginning, but, there are increasing interests in this area for it is highly likely that high value added crops can be grown safely and efficiently as proven with the



▲ Photocatalytic Blue Charcoal



Applying optical catalytic technology to construction material.

Measures for sick building syndrome **NANOBEST DOOR**

Room door processed with Photocatalyst

There are many names to it nowadays such as sick building syndrome, chemical material hypersensitivity, and becoming a big issue for residents feel dizziness, nauseated, headache, losing the sense of balance and respiratory organs trouble and other symptoms and deteriorating health conditions caused

by buildings.

The door on the photo is a Nanobest door as a construction material which is compressed with visible light reacting type Nanobest NAVL, an photocatalyst paint coat developed as a measure for the sick building syndromes.

Products applying photocatalyst brought into life by new idea

NANOEST



Purifying drinking water

Thin invisible film made from titanium dioxide Photocatalyst is coated inside the glass. Powerful oxidization will take place when light is irradiated and decompose harmful organic compounds into water and carbon dioxide and removes unpleasant smell such as chlorine smell. It also is effective as antibacterial and anti-mould which can be suitable for a flower vase as the water will not get easily rotten and thus keeps flower longer.



Purifying air

Purifies the air by applying the Titanium dioxide coated with apatite coat on the surface of artificial room plant.

Purifying dirty water

Since coated micro titanium dioxide aired glass ball density is 0.92g/cu. cm and floats on water, it can sufficiently decompose contaminated matters. We have succeeded to purify sea weed processed waste water to purify even purer than the sea water. This can be applied to decompose heavy oil that has leaked out from an oil tanker in case of a vessel accident.



Protects exhibits such as objects

Apply Photocatalyst coating liquid on the exhibits to protect them from dust, color fading and dust. There is an experiment to apply Photocatalyst coating liquid on ceramic objects.

Antibacterial and anti-mould for foodstuff

The affinity of apatite for mould and bacteria is so good that it attracts bacteria and moulds that are floating in the air and sterilizes them. It is effective for antibacterial and anti-mould.



Photocatalyst powder for reducing bacteria

NANOEST-01

Left : Visible light type Photocatalyst for reducing bacteria

Deodorizing and antibacterial
NANOEST Spray (1%)

Preventing from bacteria

The light not able to reach deep enough because of the high density of the harmful substance in the water is often a problem when applying for a water treatment. It is very useful to apply Titanium dioxide coated with apatite coating to prevent sliminess caused by

bacteria in the swimming pools and hot spring baths. When applying only a 33ppm of the Titanium dioxide coated with apatite powder contained bath medicine into a bathtub and irradiate ultra violet ray, it will sterilize bacillus just about in an hour.



Bacterium reducing shampoo and soap

A soap containing bacterium reducing photocatalyst powder is being produced. Being produced using natural materials and deep sea water from the ocean.



Inner sole for shoes/deodorant bag (shoe rack, garbage bin, refrigerator) / other photocatalyst products such as antibacterial masks

The products are being developed to deodorize shoe racks, garbage bins and refrigerator. Together with absorbing power of active carbon, apatite capture odors and titanium dioxide decomposes it. As well as the inner sole, it is possible to restore its function by exposing it to the sunlight on regular bases.