

D i a n u m

D i a n u m



Environmental purification catalysts Dianum

Environmental purification catalysts Dianum



dianums.com

Seller: Dianum Co., Ltd.
3-2-4 Meieki, Nakamura-ku, Nagoya City,
Aichi Prefecture, Japan
TEL: +81-52-414-7737 FAX: +81-52-414-7738
info@dianums.com

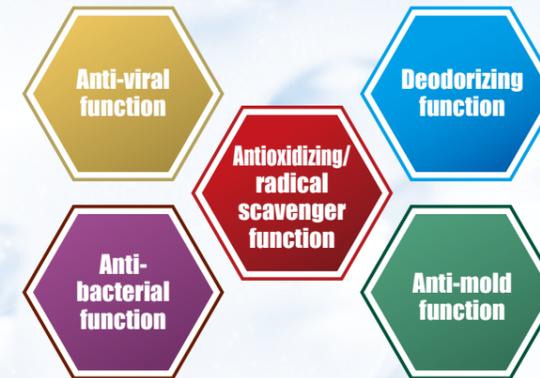
Inquiries



Environmental purification catalysts and nanodiamond evolution



Evolved catalyst functions are being applied and proven in a range of scenarios.



Simply applying Dianum products in toilets, guest rooms, vehicles, hospitals, and a diversity of other public spaces and facilities has long-lasting, continuous sanitation effects! These products are being used for treating aircraft of major airlines, Chubu Centrair International Airport, Nagoya Medical Center, and JR Tokyo Station.*

*The above includes performance data for the Nano Revolutionary Carbon series.

Do you have any of the following problems or concerns regarding odors or sanitation?

Public facilities/transportation industry

- Cannot remove bad odors from toilets ■ Many complaints from customers
- Concerns about hygiene and health issues, such as influenza/norovirus infection and food poisoning
- Critical reviews are being posted on the Internet ■ Low ratings from evaluation/certification organizations

Healthcare/nursing care industry

- Concern about hospital-acquired infection and viral infection
- Many complaints or requests regarding toilets
- Due to the physical condition of patients and hospital users, it is unavoidable that toilets are soiled
- Cleaning the hospital and facilities is a huge task

Hotel/inn industry

- Cannot remove the smell of cigarettes, body odor, perfume.
- Many complaints or requests from guests to change rooms due to odors.
- The time and effort required to clean guest rooms has increased, and the rooms are not ready by check-in time.
- In the worst-case scenario, there are vacancies, which decreases revenue.
- Concern about sanitary conditions in the kitchen, baths, etc.
- Critical reviews are being posted on the Internet.

Other industries

- Construction/renovation/real estate industries: Odors cannot be removed, increasing the cost of restoring rental properties to their original condition; difficulty finding new tenants.
- Pet industry: Animal odors cannot be removed from pet shops, clothing, or vehicles.
- Used car sales industry: odors cannot be removed from vehicles, causing prices to be lowered and deals to be lost.
- Restaurant industry: Decrease in customers due to odors in toilets and the restaurant property.

Dianum products have been proven to be effective in all those places where it has been impossible to remove odor regardless of how intensively the area has been cleaned or deodorized, as well as places where the spread of infectious diseases or sanitary conditions are of concern.

Actual case examples where Dianum products are being used

Chubu Centrair International Airport

Now ranked as the world's second cleanest airport!

Everyone at Chubu Centrair International Airport is working together to improve customer satisfaction. Because toilet odors and hygienic environments have a tremendous impact on customer satisfaction, Dianum deodorizing and anti-bacterial products were applied. As a result, Skytrax has ranked Chubu Centrair International Airport No. 1 in the regional airport category for four consecutive years and as No. 2 in the world in the clean airport category.



Tokyo Metro

Continuing results can be felt after a one-and-a-half-year trial period!

Subway users were complaining about the bad odors filling station toilets, which could not be completely removed by cleaning. Toilets with especially bad odors were selected and Dianum products were applied as a demonstration, and after a one-and-a-half-year verification period, it has been decided to use these products in all Tokyo Metro station toilets. Nowadays, the toilets smell so fresh that users are more sensitive to concourse odors!



Hospital

Amazement at air so fresh and clean, you can take deep breathing!

After many years of use, hospital toilets had absorbed smells and reeked of foul odors. There were complaints about the women's toilets in particular due to the long sojourn times. After Dianum deodorizing and anti-bacterial treatment, the smell was reduced to zero. They seemed so clean that you could not only take huge breathfuls of air, but also rub your cheek against the tiles. The transformation was so enormous, hospital staff were amazed.



World Heritage Site

Unrecognizably comfortable and easy to clean!

The toilets for sightseeing bus visitors at the Tomioka Silk Mill, a World Heritage Site—in the men's toilets especially, there were problems with respect to odor and hygiene due to urine splattering around the urinals. After Dianum deodorizing and anti-bacterial treatment, the toilets became unrecognizably clean, ensuring the reputation of this World Heritage Site is not dirtied and making daily cleaning and maintenance far easier.





A new future for public healthcare that enables long-lasting continuation of functions, in any environment, created by nanodiamond technology

New Public Healthcare

Taking anti-viral, anti-bacterial, deodorizing, anti-mold, and antioxidizing functions to the highest level...

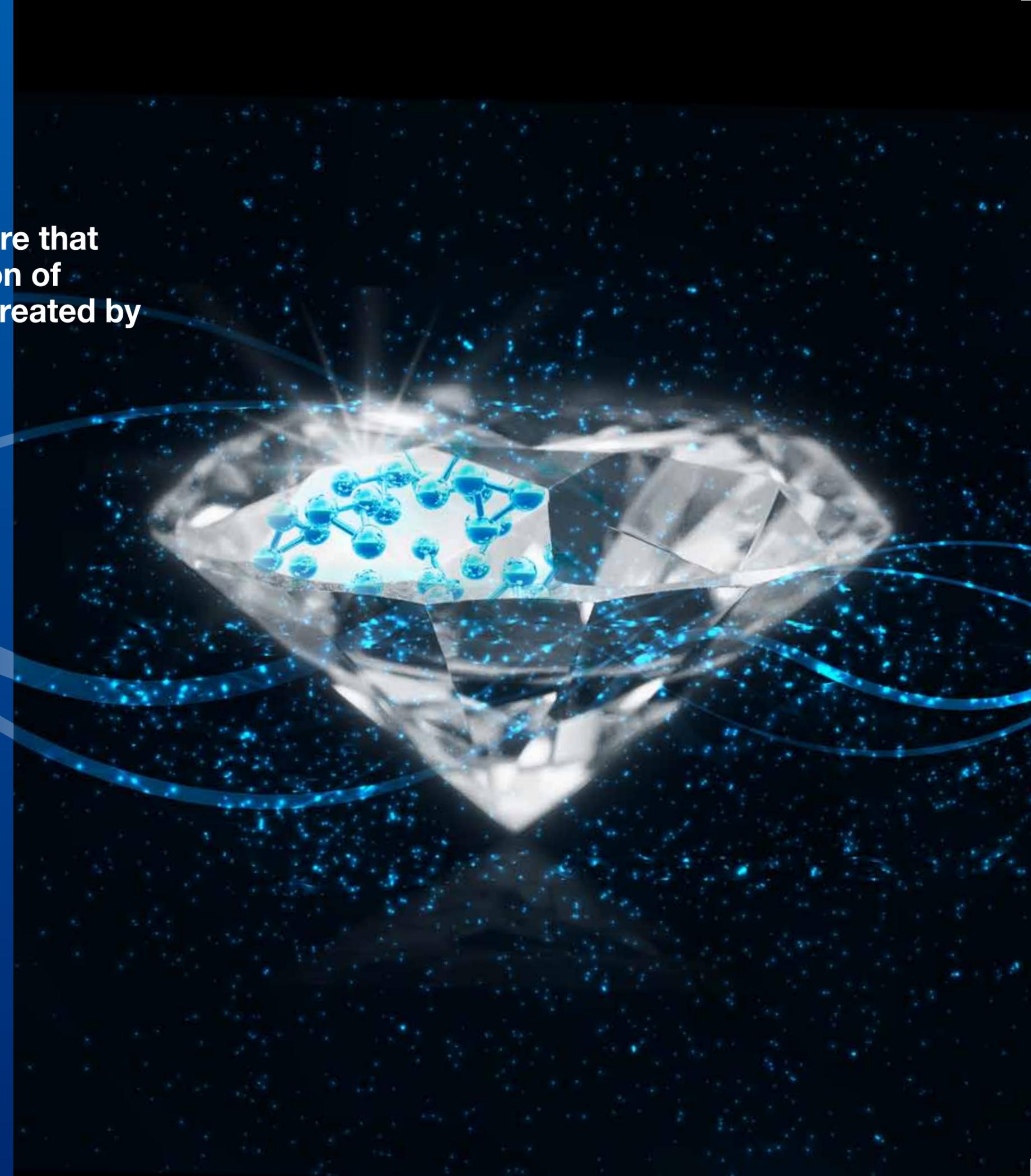
Anti-viral function

Anti-bacterial function

Deodorizing function

Anti-mold function

Antioxidizing/radical scavenger function



Case study in aviation industry



Case examples of Dianum product use and effects in the aviation industry

Dianum products are currently being used by an airline company group in all 1,000 or more restrooms on 250 aircraft.

Path to the introduction of nanodiamond catalysts



Safety, comfort, peace of mind

Comfort functions can be added in treated locations

Bad-smelling substances and germs (bacteria, viruses, fungi) that come in contact with or are absorbed by treated surfaces are broken down through oxidation-reduction.



Functions continue for long period of time without being affected by the environment

Anti-viral, anti-bacterial, deodorizing, anti-mold, and antioxidizing functions can continue for long periods of time without being affected by the environment due to the use of nanodiamonds (UDD catalysts) with surfactant properties, which are manufactured in a special production method.

High safety and abundant testing results

Precisely because these products are used on passenger aircraft—enclosed spaces that can rise to an altitude of 10,000 m—nothing is more important than safety. This product clears the Dianum Group's strict standards with regard to restroom anti-bacterial/deodorizing treatment and is the only such product to receive accreditation. It is compliant with JIS Z2801 (Japanese Industrial Standard) and ISO 22196 (International Organization for Standardization) standards for anti-bacterial function, and has also received quality accreditation from the Society of International Sustaining Growth for Antimicrobial Articles (SIAA mark).



This product is accredited by SIAA (Society of International Sustaining Growth for Antimicrobial Articles) standards, which were formulated based on anti-bacterial function and safety guidelines issued by the former Ministry of International Trade and Industry (now the Ministry of Economy, Trade and Industry). Its safety, as well as its anti-viral, anti-bacterial, deodorizing, and anti-mold functions have been verified through experiments performed by various testing organizations. There is also a wealth of published academic papers and literature related to UDD.

Taking an attitude of hospitality/raising customer satisfaction

Increasing peace of mind with anti-viral/anti-bacterial functions

When viruses and bacteria that have penetrated from outside come in contact with treated surfaces, they are inactivated and decrease in number.

Decreasing the number of complaints about bad odors

Bad odors are reduced, enabling people to wash their hands in comfort. Thus, the number of complaints about bad odors decreases.

Enables companies to advertise their corporate stance

Publicizing your company's stance regarding sanitation measures distinguishes the organization from others and increases customer satisfaction.

[Examples of anti-bacterial/deodorizing applications]



Coating treatment with a solution formulated specially for aircraft, applied with a spray gun



Treatment is complete



SIAA marks are attached to treated areas

Various examples of introduction

Case examples of Dianum product use in various environments

Hospital



- Anti-infection measures
- Sanitation measures
- Deodorizing measures
- Reduced cleaning and maintenance



New construction works at St. Mary's Hospital International Medical Center



New construction works at St. Mary's Healthcare Center



Toilet odor countermeasures at the Nagoya Medical Center



New construction works at Asahikawa Keisenkai Hospital

Welfare facility for the elderly



- Anti-infection measures
- Sanitation measures
- Deodorizing measures
- Reduced cleaning and maintenance



New construction works at Philos Minato



New construction works at Famine Omori-Minami



Repair works at Dainiseifuen



Nursing home in Gifu

Railway station toilets



- Deodorizing function
- Anti-bacterial function
- Anti-viral function
- Reduced cleaning and maintenance



Tokyo Metro subway station



JR Tokyo Station



JR Hokkaido



Nagoya Station

Infrastructure (tunnels/bridges)



- Protection against staining
- Reduced cleaning and maintenance
- Protection against graffiti



Visual guidance coating in the National Route 421 Ishigure Tunnel



Visual guidance coating in the San-en Nanshin Expressway Kawaji Tunnel



Graffiti prevention coating on retaining wall on National Route 23



Graffiti prevention coating on bridge piers on the Shima Ohashi Toll Road

Anti-mold Testing



Outdoor verification of function sustainability over long periods of time

Anti-mold function verification that can be observed visually



After 7 years



After 7 years (ceiling)



After 11 years



After 11 years (ceiling)

Other Case Examples



Diamond catalyst-treated suit



Applying a special surface coating on the Fuji Speedway course



Anti-bacterial/easy cleaning treatment in toilets at the Tomioka Silk Mill (sightseeing facility)



Anti-bacterial/easy cleaning and maintenance treatment at stone sauna facilities



Odor prevention/easy maintenance treatment at a garbage collection point

What is an environmental purification catalyst (nanodiamonds)?



The catalyst reacts on hazardous substances etc. with its high activity of oxidation-reduction reactions and antioxidative reaction and decomposes, eliminates and inactivates such hazardous substance.

Six features of Dianum

- ① New environmental purification catalyst based on advanced nanotechnology
- ② One coating or spray of the product ensures the 5 effects are long lasting.
- ③ Demonstrates the product effects even indoors, in dark or cold places.
- ④ Our unique technology allows the catalyst to adhere tightly to resin and metal surfaces
- ⑤ Our unique application and cleaning knowhow developed for deodorizing and antibacterial activity of toilet.
- ⑥ Expanded product types with enhanced anti-viral activity and with added fragrance.

Working principle of Dianum Series

Patent application statement

The special nano-sized diamond, a primary material constituting Dianum, is made up of diamond particles having a size of 4 to 6 nanometers, produced by explosion of a special explosive in an oxygen-free atmosphere under high pressure, and is chemically stable.

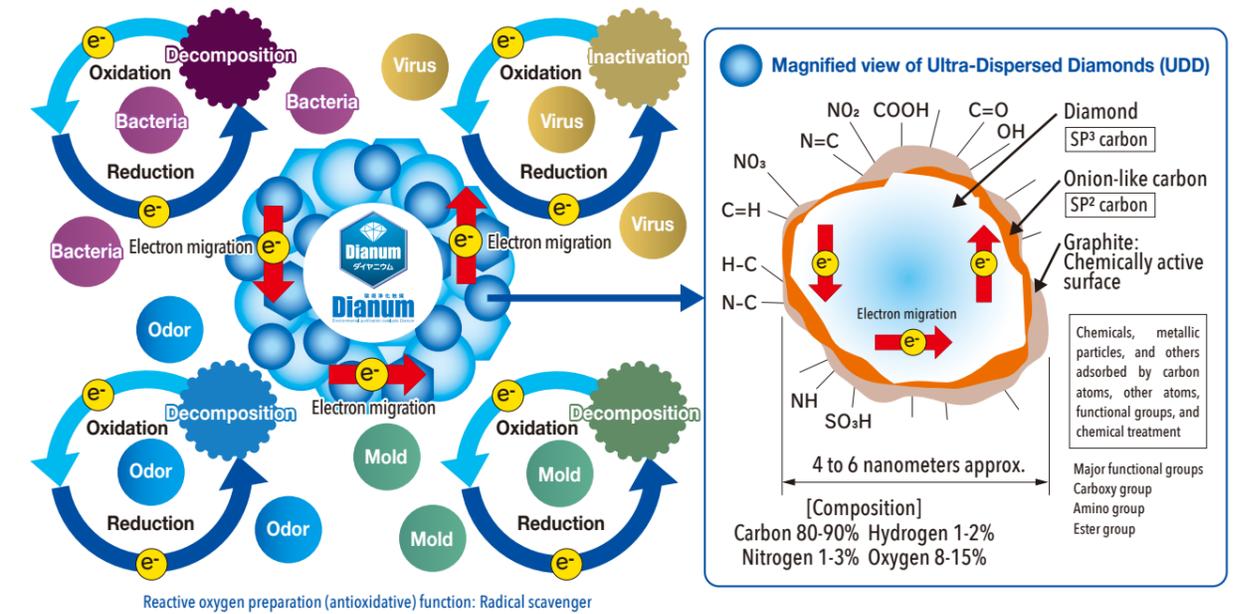
To the surface of the nanodiamonds, various types of functional groups such as the carboxyl group, the amino group, and the ester group adhere and high surface activity is realized.

The surface configuration of the nanodiamonds consists of sp² carbon and sp³ carbon having a different electrical potential, which induces the transfer of electrical charge and causes an oxidation-reduction reaction of the substances in contact with the nanodiamonds, and such reaction decomposes viruses, bacteria, molds, and various types of odor components.

With just the simple application of this coating, the technology provides a long lasting and consistent effectiveness that ensures chemical stability while being unaffected by light rays and temperature.

While the photocatalyst using titanium oxide requires light rays or UV rays with high intensity, Dianum does not require light rays or UV rays, which allows for a wide range of applications of Dianum as it can be used in indoor spaces and other dark spaces.

How the catalyst functions



The remarkable functions of Dianum (=NRC)

The synergistic effect of the highly active oxidation-reduction reaction and the antioxidant action of the UDD catalyst (reactive oxygen reduction: Radical scavenging function) with the introduction of different metal atoms produces the ion-exchange function, an advanced high functional catalyst (secondary ion effect), which acts on various unwanted substances and decomposes, removes, and inactivates them. The specially produced NRC (carbon-based organic-inorganic compound: special nanocarbon material) is chemically stable and provides a consistent and long lasting effect unaffected by light rays and temperature just by the simple application of the coating.

Comparison of functions between Dianum and competing products using a catalyst

		UDD catalyst		Air catalyst	Photocatalyst
		Dianum	Diamond Magic		
Primary component		Nanodiamonds	Nanodiamonds	Titanium phosphate or potassium-40	Titanium dioxide
Deodorizing function	UV rays	Not required	Not required	Not required	Required
	Reaction temperature	Not affected by temperature	Not affected by temperature	Unknown	6°C or above
Anti-bacterial function	UV rays	Not required	Not required	Not required	Required
	Reaction temperature	Not affected by temperature	Not affected by temperature	Unknown	6°C or above
Anti-mold function	UV rays	Not required	Not required	Not required	Required
	Reaction temperature	Not affected by temperature	Not affected by temperature	Unknown	6°C or above
Anti-viral function	UV rays	Not required	×	Unknown	Required
	Reaction temperature	Not affected by temperature			6°C or above
Antioxidative activity (Prevention of deterioration)		○ Reduces active oxygen (Radical scavenger activity)	○ Reduces active oxygen (Radical scavenger activity)	Unknown *2	× Generates active oxygen (Radical reaction)
Decomposition of dirt and oils (Decomposition of organic matter)		×	×	×	○ High intensity UV rays are required*
Mechanism		Ion exchange function (oxidation-reduction reactions) *1	Charge transfer function (oxidation-reduction reactions) *1	Not yet known *2	Photoexcitation function (Radical reaction) *3

*1: Decomposes with the transfer of electrons. *2: No scientific report is published. *3: Decomposes with the energy of UV rays.

Application areas

Application areas of environmental purification catalyst

Our products provide important functions in a variety of application areas towards a comfortable living environment



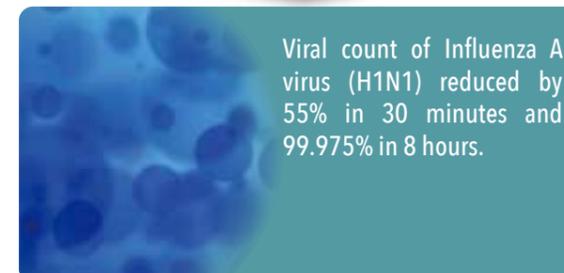
Reliability

Reliability demonstrated by safety and functionality tests

To ensure that customers can safely use our products, a variety of tests are performed to verify the effectiveness and for the improvement of quality.

Influenza A virus (H1N1)

99.9% reduction of viral count

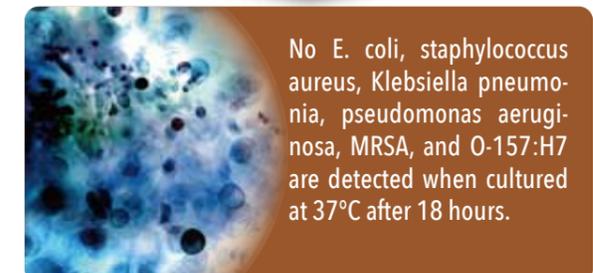


Viral count of Influenza A virus (H1N1) reduced by 55% in 30 minutes and 99.975% in 8 hours.

Anti-viral effect test: By Kitasato Research Center for Environmental Science

E. Coli (O-157), Staphylococcus aureus

Excellent antibacterial effect on E. coli (O-157), staphylococcus aureus, etc.



No E. coli, staphylococcus aureus, Klebsiella pneumonia, pseudomonas aeruginosa, MRSA, and O-157:H7 are detected when cultured at 37°C after 18 hours.

Antibacterial test: Japan Food Research Laboratories, JIS L1902: 2008

Toilet odors, putrid odors, etc.

Toilet odors and putrid odors are deodorized by 99% even in a dark room.



After two days in a dark room at 5°C, it removes 99.7% of ammonia odors (toilet odors), 99% of trimethylamine odors (putrid odor of fish, kitchen garbage, etc.), 97.4% of isovaleric acid odors (aging body odor), and 98% of formaldehyde odors (a substance causing sick house).

Deodorization Test: By Boken Quality Evaluation Institute, Detection tube method, Gas volume: 3-L and 5L Tedlar sampling bag

Safety test

The products passed the safety test for humans and animals.



Safety of the product was confirmed by closed patch tests on human skin, acute oral toxicity tests (mice), primary skin irritation tests (rabbits), skin sensitization tests (guinea pigs), eye irritation tests (rabbits), fish acute toxicity tests (oryzias latipes), mutagenicity tests, etc.

Safety test: By Japan Food Research Laboratories and Life Science Laboratories Ltd.



Confirmation by verification test

To ensure that customers can safely use high quality products, we are continuing the development, research and testing of our products every day, and also regularly conduct clinical tests.



Anti-viral effect test

Influenza viruses

Influenza A virus(H3N2): ATCC VR-1679

Properties of Influenza viruses

If infected, the body temperature will rise higher compared with a temperature due to the common cold, and is associated with a sore throat as well as joint pain and/or muscle pain, and outbreaks are feared.

Boken Quality Evaluation Institute
Test No.: 20218050147-3
November 19, 2018

Test Scheme

JIS L 1922:2016
Measurement of Virus Infectivity Titer: Plaque assay
4 hours of contact time was used according to the client's specification

Prevention of Hospital-acquired infection

Specimen description	Log (ATP value)	Anti-viral activity value
Standard cotton cloth Immediately after inoculation	Log (Va)	6.51
Standard cotton cloth 4 hours after inoculation	Log (Vb)	6.30
(1) Dianium Enhanced anti-viral power type	Log (Vc)	3.10
(2) NRC-TS (with fragrance)	Log (Vc)	2.30 or less
		3.4
		4.2 or larger

[Note] (1) Dianium, Enhanced anti-viral power type and (2) NRC-TS (with fragrance) are transferred from Boken Osaka No. 20218045379 (11/12/2018).

Antibacterial test

MRSA

Methicillin resistant Staphylococcus aureus IID1677

Properties of MRSA

Staphylococcus aureus is resistant to antibiotics due to mutation. It can cause suppurative diseases, pneumonia, blood poisoning, etc. and also causes hospital-acquired infections.

Boken Quality Evaluation Institute
Test No.: 20218050147-1
November 19, 2018

Test Scheme

JIS L1902: 2015
Bacterial liquid absorption method
Determination of total viable bacterial count: Pour plate culture method with culturing time of 18 hours
Test bacterial liquid with surfactant (Tween 80) added to 0.05% was used.

Prevention of Hospital-acquired infection

Specimen description	Proliferation value	Antibacterial activity value
Standard cotton cloth	2.6	
(1) Dianium Enhanced anti-virus power type		5.8
(2) NRC-TS (with fragrance)		5.8

[Note] (1) Dianium, Enhanced anti-viral power type and (2) NRC-TS (with fragrance) are transferred from Boken Osaka No. 20218045379 (11/12/2018).

We will continue verification through testing, collaborating in research and development and using independent bodies to confirm the safety oriented functions of the products and to develop products whose overall functions are enhanced.

Anti-mold Test

Trichophyton

Trichophyton mentagrophytes NBRC 32409

Properties of Trichophyton

Generic name of the filamentous fungus that causes athlete's foot. They proliferate in the soil or in the keratin of skin or nails.

Test Scheme JIS L1921: 2015 Absorption method

Prevention of secondary infection of athlete's foot

	Log (ATP value)	Growth value
Standard cotton cloth	Immediately after inoculation	-12.18
	42 hours after inoculation	-9.92
		2.3

(Condition for valid test: Growth value ≥ 1.5)

Specimen description	Log (ATP value)		Anti-mold activity value
	Immediately after inoculation	42 hours after inoculation	
(1) Dianium Enhanced anti-virus power type	Immediately after inoculation	-12.56	2.7
	42 hours after inoculation	-13.00	
(2) NRC-TS (with fragrance)	Immediately after inoculation	-12.21	3.1
	42 hours after inoculation	-13.00	

[Note] (1) Dianium, Enhanced anti-viral power type and (2) NRC-TS (with fragrance) are transferred from Boken Osaka No. 20218045379 (11/12/2018).

Boken Quality Evaluation Institute
Test No. 20218050147-2
November 19, 2018

Antibacterial test

E. Coli (O-157: H7)

Properties of E. coli

One kind of coliform bacteria that produce highly toxic verotoxin. If babies, infants, or aged people with a lower physical resistance are infected, more serious conditions may result, such as complications of the hemolytic uremic syndrome (HUS) which can result in renal dysfunction, neurological disorders, etc.

Test Scheme JIS L1902: 2008 Textiles - Determination of antibacterial activity and efficacy of textile products

Prevention of food poisoning (kitchen)

Category	Specimen	Total viable bacterial count per specimen		
		Determination 1	Determination 2	Determination 3
Immediately after inoculation	Control	4.5×10^4	4.3×10^4	5.3×10^4
	NRC processed	<20	<20	<20
Culturing at 37°C after 18 hrs	No processing	4.4×10^7	4.6×10^7	4.8×10^7

Category	Specimen	Immediately after inoculation	NRC processed (After 18 hrs)
Immediately after inoculation	Control		
Culturing at 37°C after 18 hrs	NRC processed		
	No processing		

Japan Food Research Laboratories

<20: Not detected

Antibacterial test

Klebsiella pneumonia

Properties of Klebsiella pneumonia

One kind of enterobacteria that causes pneumonia, urinary tract infections, or blood poisoning in a person having low immunity. It can cause hospital-acquired infections because it easily acquires resistance to antibiotics.

Test Scheme JIS L1902: 2008 Textiles - Determination of antibacterial activity and efficacy of textile products

Prevention of proliferation of bacteria causing pneumonia

Category	Specimen	Total viable bacterial count per specimen		
		Determination 1	Determination 2	Determination 3
Immediately after inoculation	Control	2.5×10^4	2.4×10^4	2.4×10^4
	NRC processed	<20	<20	<20
Culturing at 37°C after 18 hrs	No processing	4.3×10^7	5.7×10^7	3.9×10^7

Category	Specimen	Immediately after inoculation	NRC processed (After 18 hrs)
Immediately after inoculation	Control		
Culturing at 37°C after 18 hrs	NRC processed		
	No processing		

Japan Food Research Laboratories

<20: Not detected

Deodorization Test

Ammonia

Properties of ammonia

A strong base, highly stimulant, and the ammonia smell can frequently cause issues in odor countermeasures for the surrounding environment and the community, as well as impact workers' health, comfort in workspaces, etc. in fields where the ammonia smell is produced, and implementing effective odor countermeasures is very important.

Test Scheme Detection tube method (ammonia) Boken Quality Evaluation Institute, Kinki Office Test No.: 005185-1 June 5, 2009

Deodorant of toilet

Test Item	Ammonium (ppm)	NRC Catalyst	Empty test
Deodorant activity	0 minute	40	40.0
	2 hours later	0.2 or less	40.0
	24 hours later	0.2 or less	33.0
	48 hours later	0.2 or less	25.0

[Note] Specimen size 15cm x 15cm
Test container 5 L Tedlar gas sampling bag
Gas volume in the container 3 L
Initial gas concentration Ammonia 40 ppm
Gas measurement method Detection tube
Test conditions Dark room (at 5°C)
Empty test Empty test The test operation performed in the same manner without using the specimen.

* The data are our verification test results and we do not guarantee their accuracy, adequacy, comprehensiveness, implementability, etc.

Verification results

"Reference value of antibacterial activity 2.0". Definite antibacterial effect is confirmed. Specimen not processed showed no effective activity. * Safety of the product has also been confirmed by performing safety tests on animals and humans.

Product Lineup

More than 17 trillions of ultra-active nanodiamonds are sprayed by just one pull of the trigger.

Features of Dianum Spray

Effect	Component	Package	Fragrance
Anti-viral, antibacterial, deodorant, anti-mold, and antioxidative effects last a long time owing to the function of Dianum (NRC: Nanodiamonds catalyst) once sprayed on variety of materials.	Ultra-active nanodiamonds	Using high-quality spray trigger made in Japan, fine particles can be stably sprayed.	Fragrance contained will refresh your space once sprayed * Each person smells the odor differently

Spray bottle type easy to use. Products containing fragrance and for refilling are also available.

◆ Dianum Spray (Containing fragrance)



With fragrance

Spray type

Product name	Dianum Spray fragrance
Component	Nanodiamonds + Fragrance / Water / Nano-carbon
Size	50 mL / 120 mL / 180 mL



With fragrance

Spray refill bottle

Product name	Dianum Spray fragrance for refill
Component	Nanodiamonds + Fragrance / Water / Nano-carbon
Size	500 mL

◆ Dianum Spray



Spray type

Product name	Dianum Spray
Component	Nanodiamonds + Fragrance / Water / Nano-carbon
Size	50 mL / 120 mL / 180 mL



Spray refill bottle

Product name	Dianum Spray
Component	Nanodiamonds + Fragrance / Water / Nano-carbon
Size	500 mL

1-liter and 4-liter large bottles are available depending on your project

◆ Dianum Coat



■ Binder (Surface curing type) ■ No-binder (Penetration type)	
Product name	Dianum Coat
Component	Nanodiamonds / Water / Nano-carbon
Quantity	1,000 mL

Application of Dianum Coat (Example)



Applied on the floor



■ Binder (Surface curing type) ■ No-binder (Penetration type)	
Product name	Dianum Coat
Component	Nanodiamonds / Water / Nano-carbon
Quantity	4,000 mL



Applied on the wall

Interior finishing method with environmental purification power having antifouling, as well as anti-graffiti and anti-poster functions, and is also equipped with antibacterial and deodorizing functions using special catalysts

◆ Dianam Caulking



Single component type

Lead-free

Product name	Inorganic glass coating Base compound
Component	Isopropyl alcohol / Nanodiamonds
Quantity	500 mL



Two-component type

Lead-free

Product name	Inorganic glass coating Curing agent
Component	Isopropyl alcohol / Nanodiamonds
Quantity	500 mL

Dianam Caulking Application of Dianum Caulking on a toilet bowl



Application work



After application