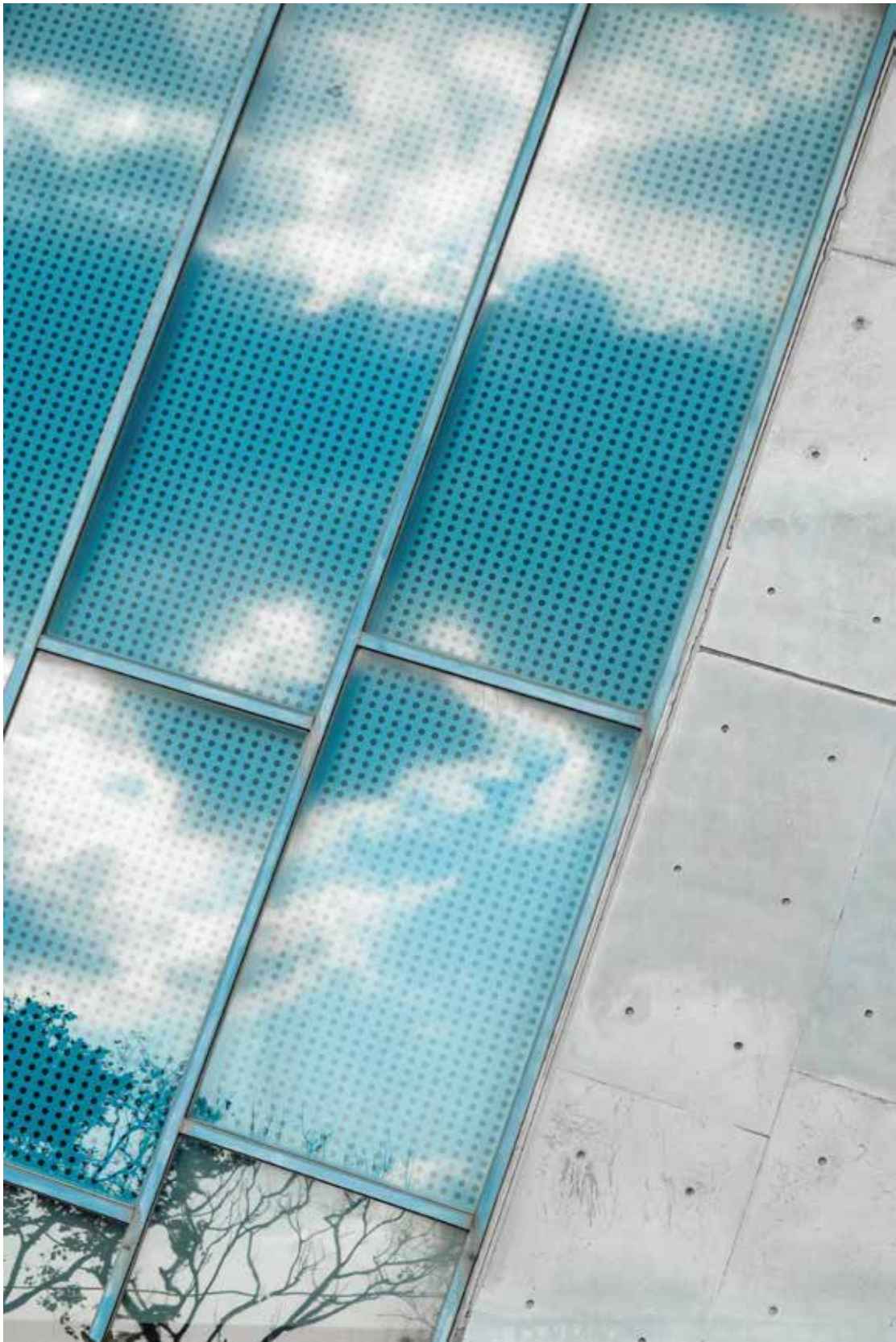
ShinEtsuMicroSi

Shin-Etsu Chemical Co.

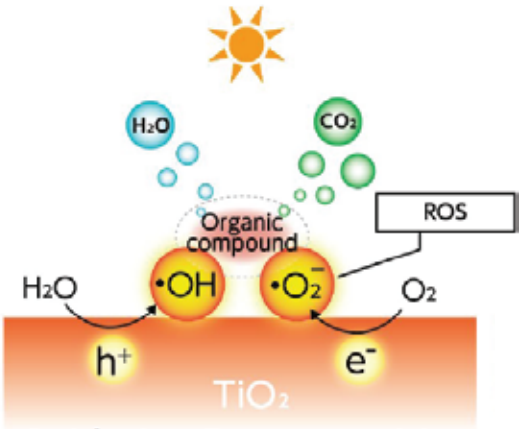
Photocatalyst



Characteristics of Photocatalyst

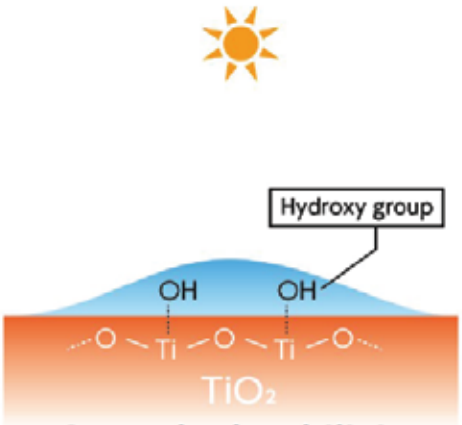
Photocatalyst coatings are the next-step of the coatings industry. They are self-cleaning, deodorizing, transparent coatings that can be applied for both external & internal applications. The applications range from solar panels, exterior walls, roofing, glass windows, and interior surfaces.

Our photocatalyst has two primary characteristics that create the effects desired in a photocatalytic coating: Oxidative Decomposition and Super Hydrophilicity



Oxidative Decomposition

When titanium dioxide absorbs light, active oxygen radicals are generated on its surface. These radicals attack organic matter and can break it down to harmless carbon dioxide and water.



Super hydrophilicity

The chemical structure of the photocatalyst surface changes and hydroxyl groups are generated. Since these groups strongly attract water molecules, the photocatalytic surface becomes "super hydrophilic," meaning that water easily spreads over it.

Self Cleaning:
The oxidation on the surface causes the organic matter on the surface to decompose and the hydrophilic nature of the coating allows for the remaining particles to wick off. This effect is described as self-cleaning.

Odor Suppression:
Another effect of the photocatalyst is an odor suppressant. As odor molecules attach to the surface, the oxidative decomposition mechanic breaks down the molecules into H2O and CO2.

Features of Photocatalyst

Features:

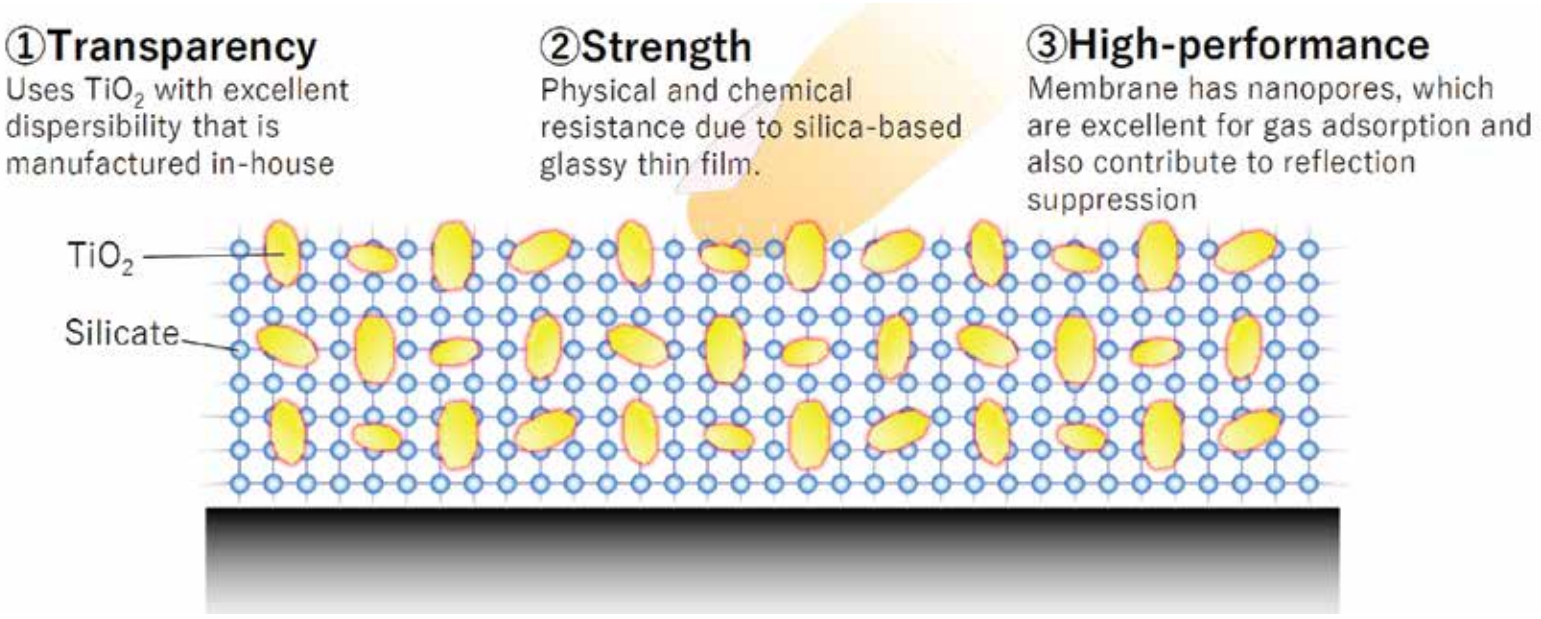
VOC Free:
No solvents needed. Reduces energy and CO_2 emission during application and drying processes.
Low Viscosity:
Forms a uniform, fast drying liquid film that is ideal for spray gun application.
Neutral pH:
No corrosion of metal. Easy to handle.
Simple Ingredients:
Consists of only titanium dioxide and silicon oxide (amorphous silica-based), and contains no toxic substance (e.g. heavy metals or other irritants).
Safety:
Safety of formulation has been confirmed by a third-party organization.*
Acute oral toxicity: >2,000 mg/kg
Negative for eye irritation, primary skin irritation, and mutagenicity

*Japan Food Research Laboratories

Photo: Tersus EG

Superior Ultra-thin Film:

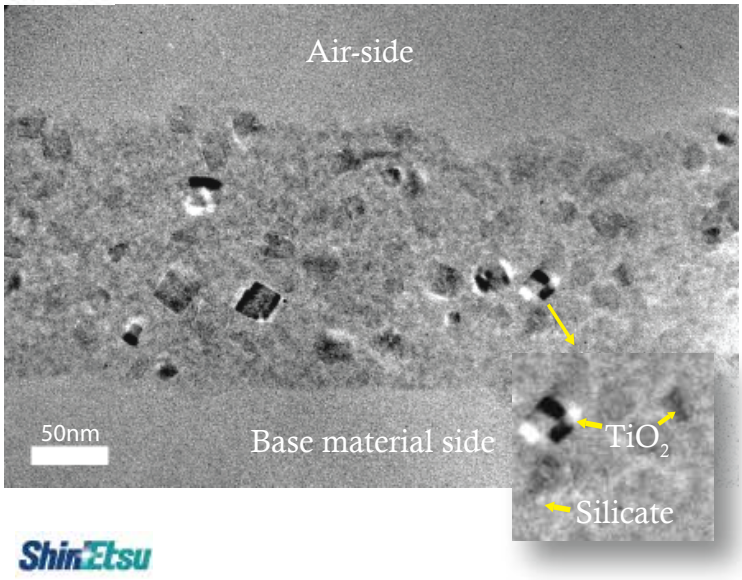
Shin-Etsu has developed, in-house, both the titanium dioxide and silicate binders. This is what forms the above thin films that have a perfect balance of transparency, strength, and performance.



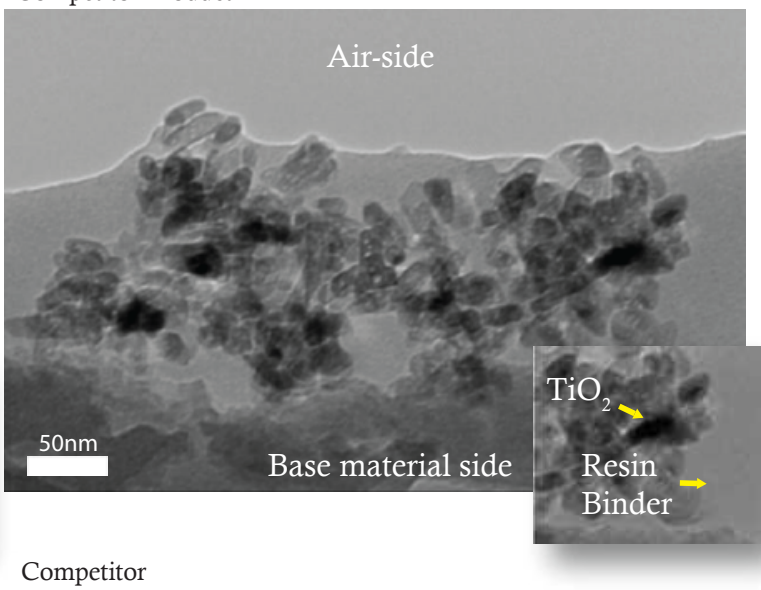
Superiority of Shin-Etsu Photocatalyst

Observations of Shin-Etsu and competitor photocatalytic thin films with Transmission Electron Microscopy (TEM)

ShinEtsu Tersus EG



Competitor Product



ShinEtsu

- High transparency due to a uniform dispersion of TiO_2 particles
- High photo reactive properties due to TiO_2 exposure to surface

Competitor

- Low transparency of film due to agglomeration of TiO_2 particles
- Low photo reactive properties due to TiO_2 being buried in resin binder

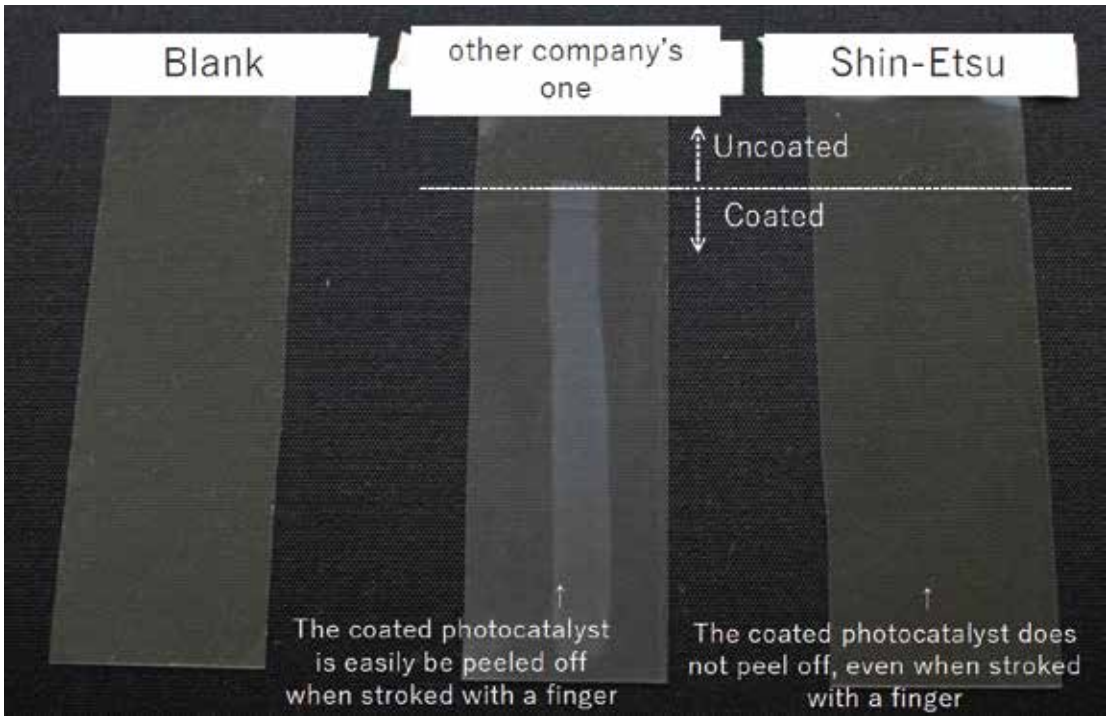
Coating film of Shin-Etsu product:

- Showed no reflectance on surface
- Maintained a strong, uniform coating

Coating film of competitor's product:

- Showed a whitish reflection on surface
- Coating film does not adhere well after heat drying

【Coating condition】
Base material: PET film
Amount of agent: about 20g/m²
Hot air drying at 80°C/20min



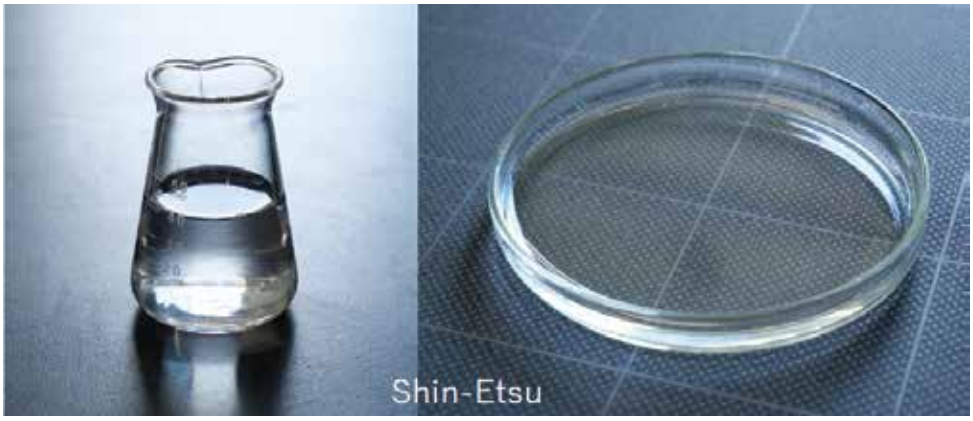
Superiority of Shin-Etsu Photocatalyst

Transparency:

Shin-Etsu's photocatalyst product revolutionizes photocatalytic coatings by creating a nearly transparent liquid and film. This level of transparency allows for the photocatalytic film to be applied to painted/coated surfaces without sacrificing color quality, and to glass/clear substrates while maintaining transparency.

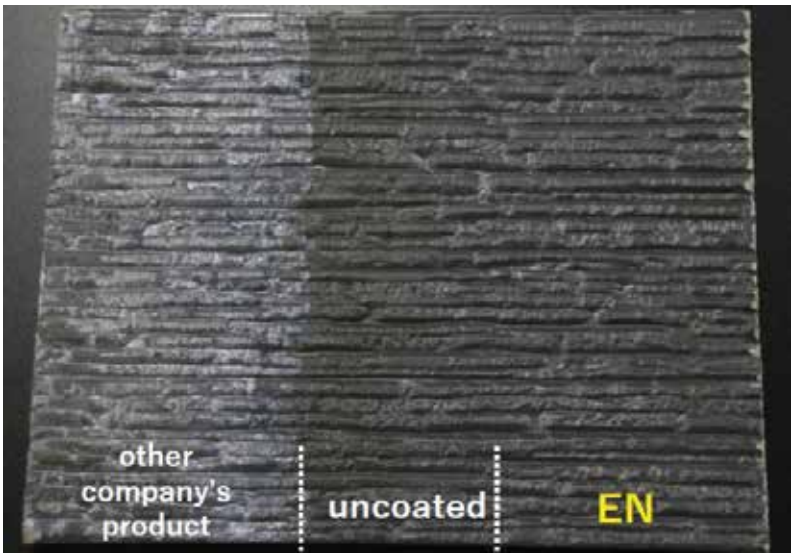
Shin-Etsu Product:

The TiO_2 found in Shin-Etsu's photocatalyst products is uniformly dispersed throughout the solution . This uniform dispersion results in a clear, near-transparent liquid as seen on the right.



Competitor Product:

The TiO_2 found in competitor products is not uniformly dispersed and agglomerates easily in solution. This causes the liquid to have a turbid, milky haze as seen on the right.



Eliminated Whitening Issues:

As seen in the image on the left, the black masonry panel coated with a competitors product has a white coloring. This is caused by the reflectance of light off of the agglomerated TiO_2.

The side coated with Shin-Etsu's Tersus EN shows minimal amounts of reflectance, allowing it to be coated seemlessly on a dark surface.

Shin-Etsu's Photocatalyst

Tersus EN (UV)

Photocatalyst coating agent
- For Exterior
- High activity
- High transparency

Tersus EG (UV)

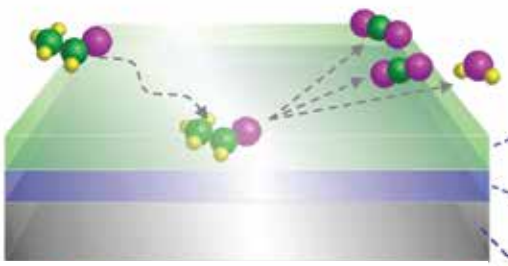
Photocatalyst coating agent
- For Glass
- Especially high transparency

Tersus RN (UV + VIS)

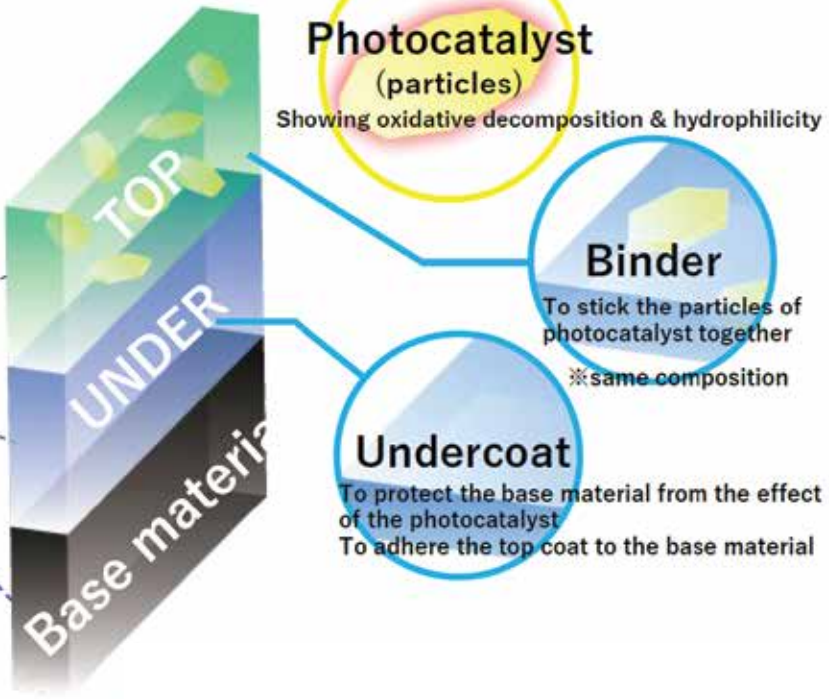
Photocatalyst coating agent
- For Interior
- Reactive under both UV light and visible light
- High activity
- High transparency

Scutum S

Protect coating agent
- Undercoat
- High transparency
- High adhesion to top coat (photocatalyst)
- Low reflection

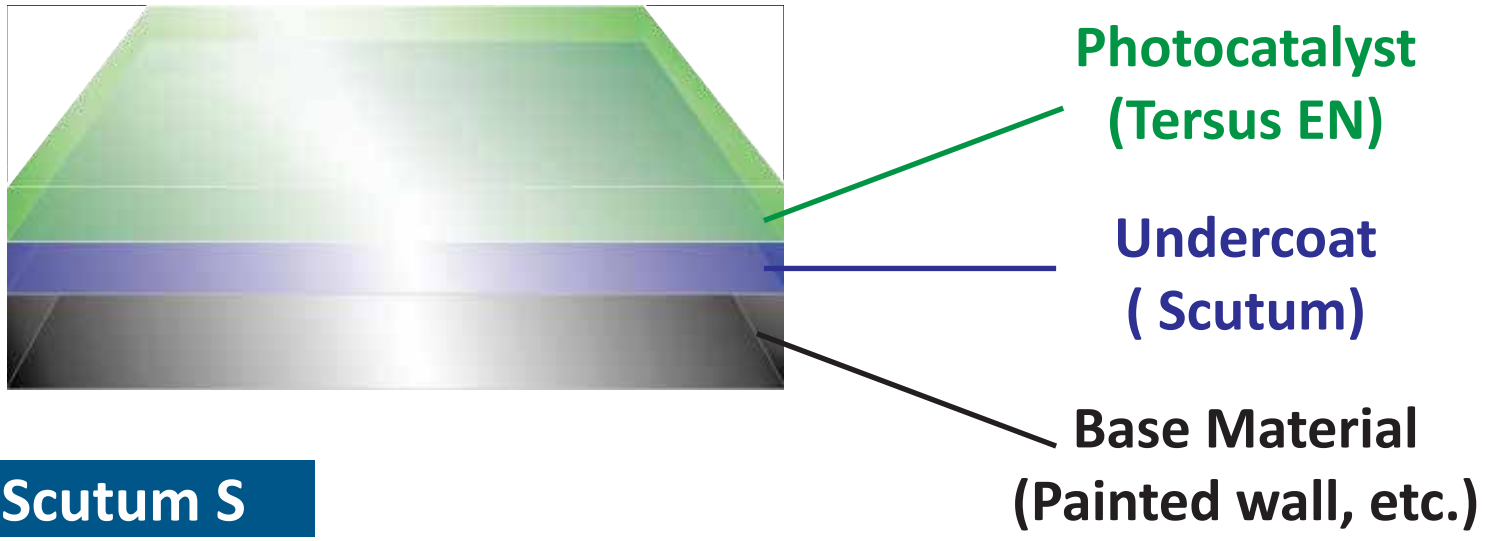


Coating film is completed in up to 2 applications after cleaning base material



Product: Scutum (Undercoat)

The Scutum material is used as an undercoat for the Tersus products. It acts as a primer for various purposes to ensure adhesion and protection of the base material.
There are 2 Scutum products: **Scutum S and Scutum PM**



Scutum S

The Scutum S is a silicid acid oligomer solution that acts as the protective shield for the organic substrate beneath the photocatalyst layer. It is used as an undercoat to the Tersus EN and is an essential component if you are applying photocatalyst to an outside organic surface. It is a thin, transparent coating that is ~99% water and adheres to most substrates. While the Scutum S is not photoreactive, it does have high hydrophilicty.

Why Use Scutum S?

When the oxidative decomposition on the photocatalytic layer begins, it will start to decompose organic matter on both the surface of the coating and on the substrate. Scutum S provides a shielding layer for the substrate to protect it from this decomposition.

If the substrate does not have a Scutum S undercoat and the photocatalytic reaction occurs, the photocatalyst layer will slowly decompose the organic matter on the surface over time. This will cause no visibile damage to the surface, but the photocatalyst layer will begin to peel off.

Scutum PM

The Scutum PM is a silicone emulsion that is used as a priming agent for the Tersus material when applied to concrete.

Why Use Scutum PM?

Concrete tends to have a very porous surface, causing the water-based Tersus to be soaked deep into the base material and not receive adequate light exposure. The Scutum PM creates a layered surface over top of the concrete allowing for the photocatalyst to sit on top of the base material and maintain light exposure.

Product: Tersus EN (Photocatalyst)

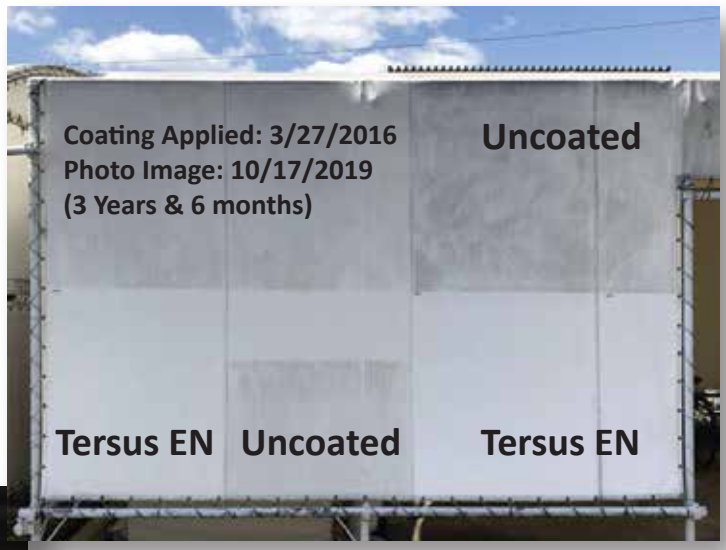
The Tersus EN is an exterior photocatalyst coating intended for use in areas with sunlight exposure for the intended purpose of self-cleaning. As the UV rays touch the Tersus EN, oxidative decomposition begins: decomposing organic matter found on the surface of the substrate. This reaction combined with the extreme hydrophylicity of the coating cause the surface matter to wick off when exposed to water.

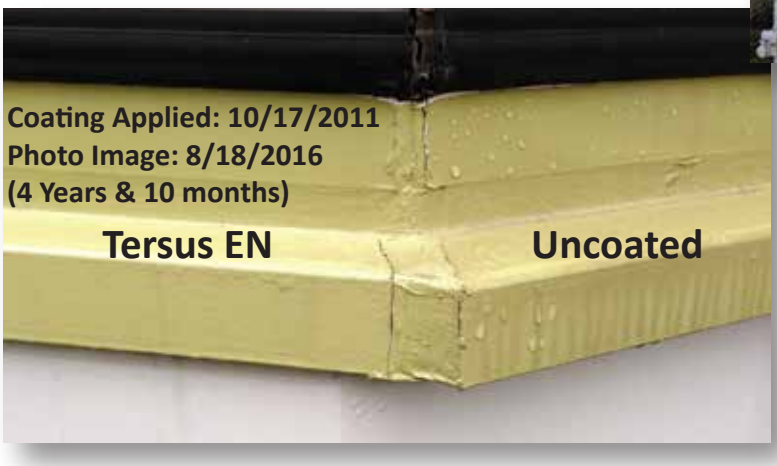
Example Applications

PVC Tent Fabric:

In the image to the right, the Tersus EN is applied to a PVC fabric sheet with a Scutum S undercoat. When exposed to the weather, the surface of the coated side cleans itself with no need for human interaction.

Over a 3 year and 6 month period, the photocatalyst remains on the surface and is performing identical to when first applied





Painted Siding:

In the image to the left, the Tersus EN is applied to painted siding with a Scutum S undercoat. As seen in the image, no zebra striping (water lines) remain on the surface as the water is effectively spread evenly and wicked away. Leaving no watermarks or dirt.

Over a 4 year and 10 month period, the photocatalyst remains on the surface and is performing identical to when first applied

Why Use Tersus EN?

Tersus EN both eliminates the need for expensive cleaning for exterior surfaces and can improve the lasting quality and lifespan of your coated surfaces.

As a self-cleaning coating, the photocatalyst does not require chemical cleaners to keep a surface clear from dirt and stains. This saves the end user money on cleaning services and products.

If dirt and other organic matter remains on a surface for long it can cause discoloration and possibly can degrade the surface coating. With Tersus EN, these surface particles are wicked away with water and cannot cause these harmful effects.

Product: Tersus EG (Photocatalyst)

The Tersus EG is a glass exterior photocatalyst coating intended for use in areas with sunlight exposure for the intended purpose of self-cleaning. As the UV rays touch the Tersus EG, oxidative decomposition begins: decomposing organic matter found on the surface of the glass. This reaction combined with the extreme hydrophylicity of the coating cause the surface matter to wick off when exposed to water.

Example Applications

Car Window

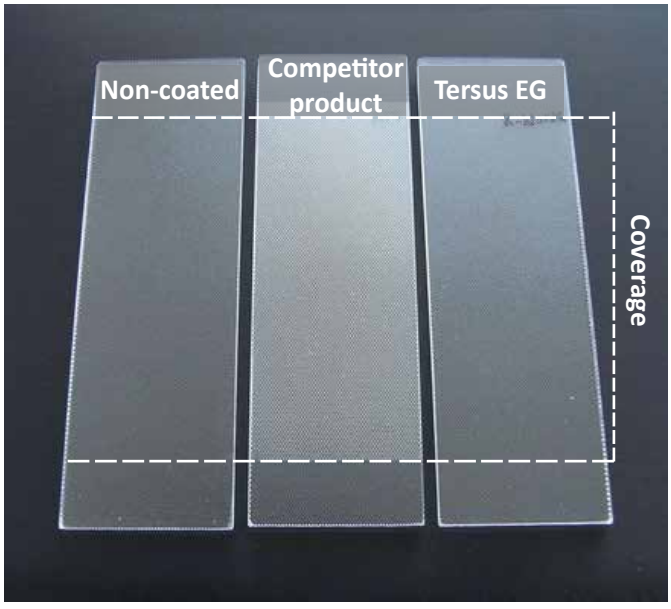
In the image to the right, the Tersus EG has been coated on ~half of the driver's-side window. The coated side spreads the water evenly across the surface without beading.

Water that is beaded up and remains on the surface when drying will leave behind a dirt residue as seen in the second image. Meanwhile, the photocatalyst coating has wicked the water away completely and leaves behind no residue, creating a clean surface.

Embossed glass

In the image to the left, the Tersus EG and a competitor product was applied to embossed glass. This test was conducted to show reflectance of the photocatalytic product on a clear surface.

The Tersus EG panel has almost no reflection and is still transparent, while the competitor product has a strong reflection and is noticeably tinted white.



Why Use Tersus EG?

Much like Tersus EN, the Tersus EG provides you with a self-cleaning, strong coating film that eliminates the need for constant cleaning.

This allows for increased light transmittance, lower haze values, and (for solar panel applications) increased efficiency.

Product: Tersus RN (Photocatalyst)

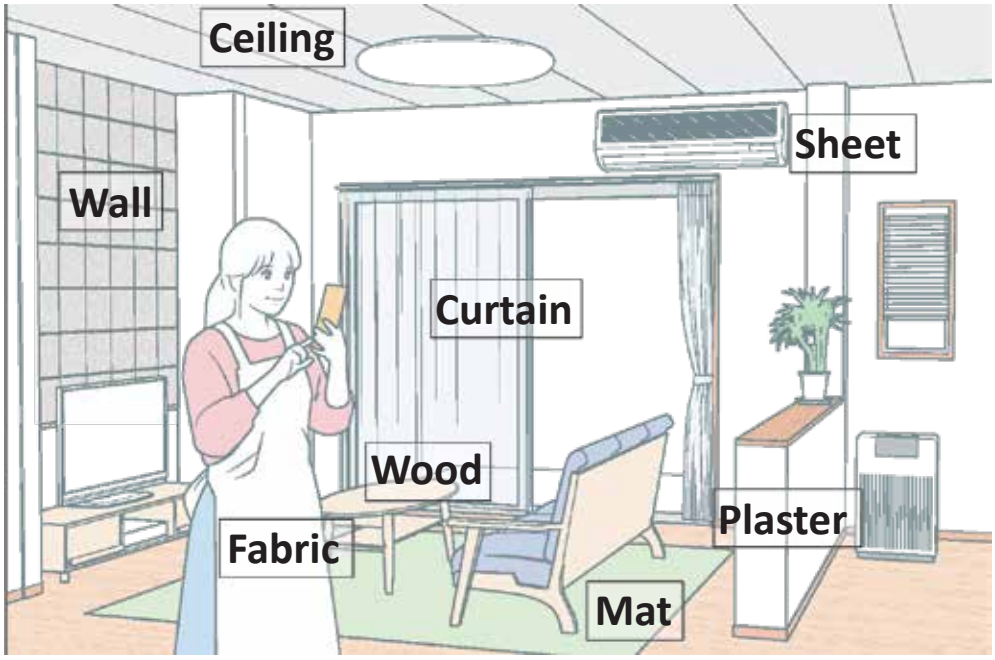
The Tersus RN is an interior photocatalyst coating for use in areas with indirect or visible light exposure for the intended purpose of deodorization and as an anti-allergen. As the light rays touch the Tersus RN, oxidative decomposition begins: decomposing organic matter found on the surface.

Example Applications

Indoor Surfaces

The Tersus RN can be applied to many indoor substrates as depicted to the image on the right. Because it has a short drying time at room temperature and is non-toxic, this coating can be applied to many in-house and office surfaces.

There are two primary benefits the Tersus RN will add: **deodorization** and **anti-allergen.**



Deodorization

The thin photocatalyst film strongly absorbs volatile organic compounds (small gas molecules) that cause living odors and decomposes them over time. Many common odors such as ammonia and formaldehyde molecules can be reduced to near 0% residual amounts.

Anti-allergen

Allergens, such as pollen, that rests on the surface of the Tersus RN are inactivated by the oxidative decomposition process. When exposed to fluorescent light, residual pollen percentages can be reduced by 60% in only 4 hours.

Why Use Tersus RN?

Many rooms take long periods of time to circulate new air and dilute the odors and gasses present. The Tersus RN provides relief to rooms that may or may not have well circulated air flow from allergens and odors. It neutralizes these particles, leaving behind a cleaner and more livable atmosphere.

For More Information On Photocatalyst:

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