

OSP CO.,LTD

OS PHOTOCAT[®]

Visible-light driven photocatalyst



OSP 오에스피 주식회사
OSP CO.,LTD

OS Photocat was manufactured by OSP Co., Ltd. by transferring the original technology of LX Hausys. Quality responsibility for manufactured products lies on OSP Co., Ltd.
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OSP
goes to the world



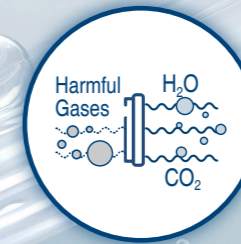
OS PHOTOCAT[®] Overview

OS Photocat



Nano-sized Redox Material Platinum and Tungsten-Trioxide Activates under Visible Light & Ultra Violet Spectrum

OS Photocat Filter



Redox Reaction Turns Harmful Gases into Water and Carbon-Dioxide

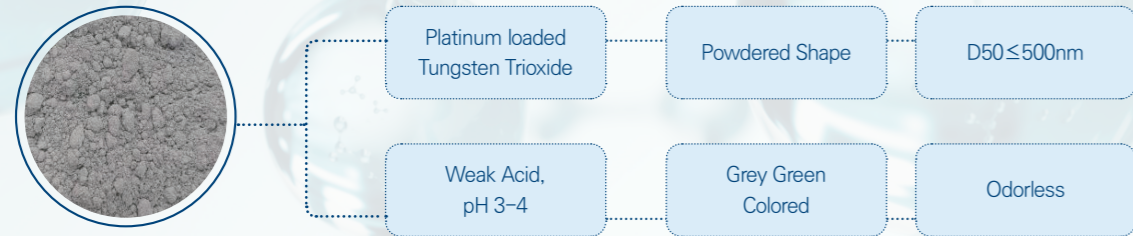
Filter Applications



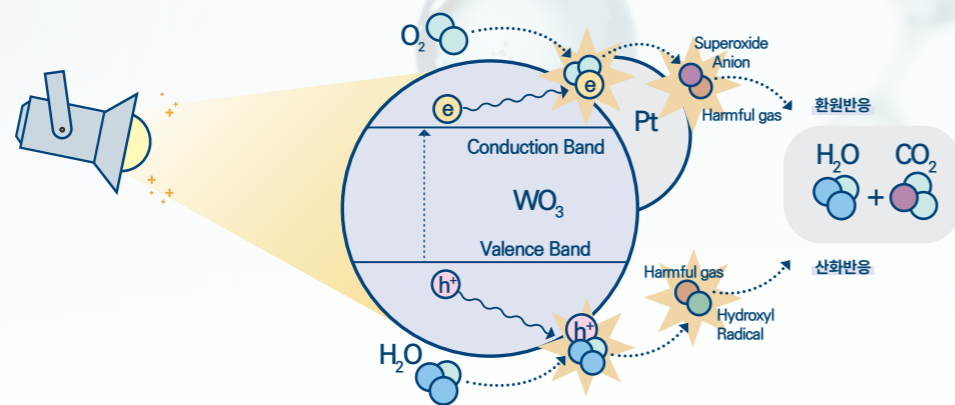
Air Purifier Filter
Air Conditioner Filter
Cabin Filter

Visible-light driven photocatalyst Material Specification

Physical Properties



Reduction-Oxidation Mechanism

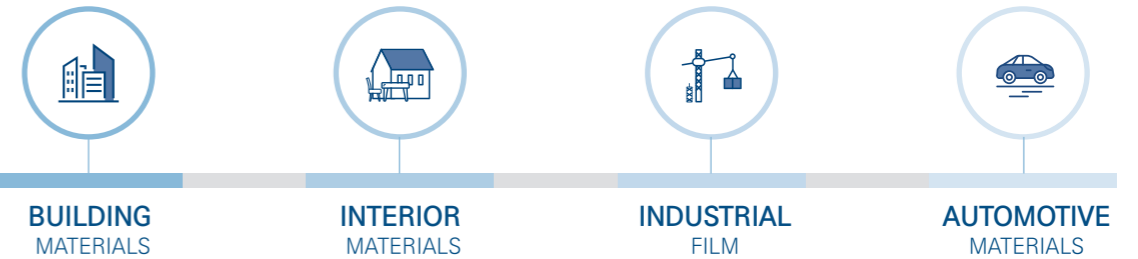


About Visible-light driven photocatalyst

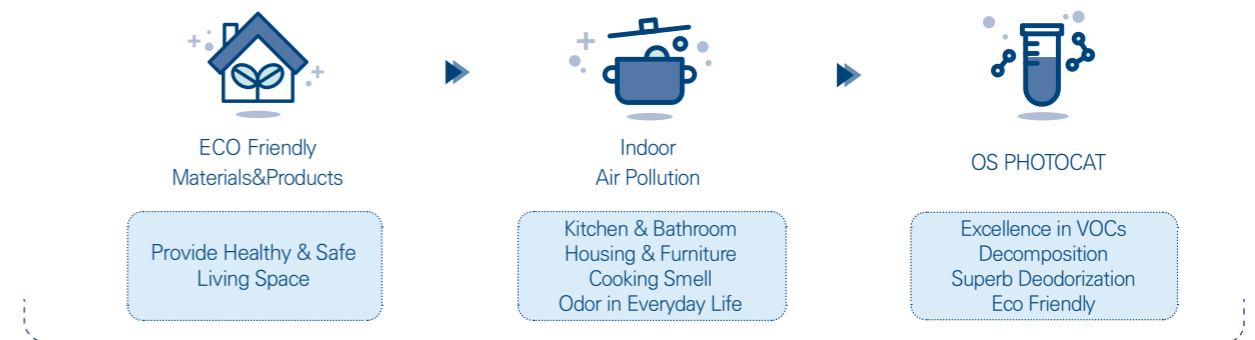
- Sunlight has about 5% ultraviolet light and most of it is visible light. Visible light has less energy than ultraviolet light.
- TiO_2 : Energy band gap 3.2eV(electric Volt) WO_3 : Energy band gap 2.6eV(electric Volt)
- TiO_2 is activated only in ultraviolet light. Products that claim to be active in visible light are those that have been modified by supporting TiO_2 with metals (Fe, Cu, and others).
- The energy band gap of WO_3 is lower than TiO_2 and therefore is activated in visible light. WO_3 alone can be used as a photocatalyst, but its performance can be improved by supporting metals.
- Like the redox mechanism above, electrons move from valence band to conduction band when light shines onto WO_3 , and the moved electrons tend to return to the valence band again (activation drops as more electrons return).
- WO_3 can be made to perform mechanisms repeatedly by supporting metals (Fe, Cu, Pt, and others), and Pt is known to perform the best, followed by Cu and Fe.
- To improve performance, metals (Fe, Cu, Pt, and others) are supported, platinum (Pt) induces a reduction reaction to an over-electronic state by radical reaction with electrons (e^-), and the valence band side induces an oxidation reaction due to insufficient electrons (h^+).

I. Background

Business Domain



OS PHOTOCAT Development Background

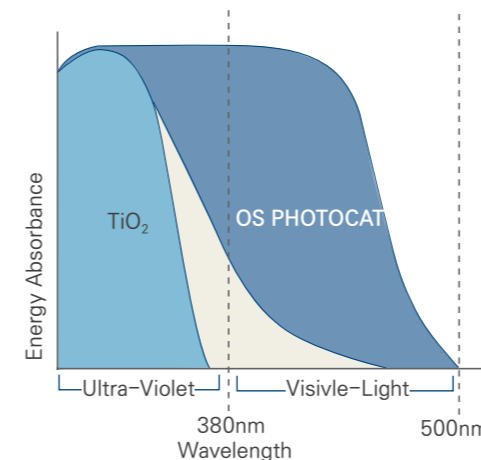


II. OS PHOTOCAT

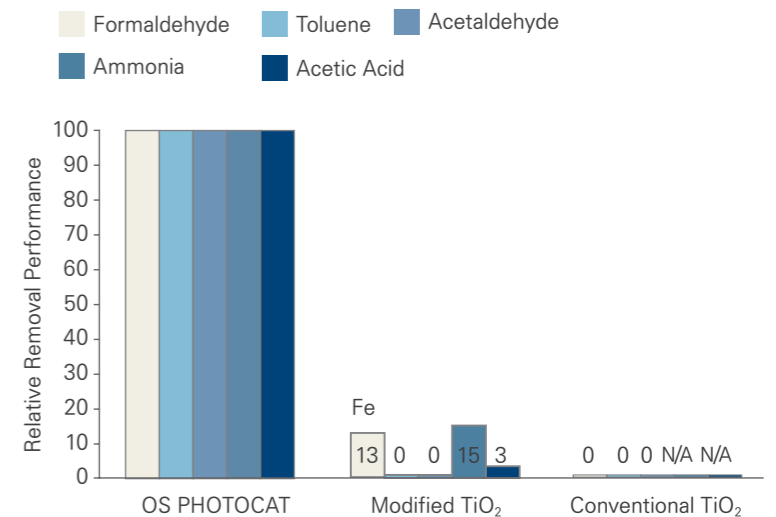
OS Photocat provides unparalleled gas decomposition and deodorization performance compared to existing photocatalytic materials under visible-light; integrating platinum's high catalytic activity and Tungsten-trioxide's superb energy absorbing capability from visible-light spectrum.

Key Features

- Commercialize Using LX Hausys' Patented Technology
- OS Photocat absorbs and utilizes large amount of energy from UV & visible light
- Wide range of potential applications



Performance Comparison Under Visible-Light



- TiO_2 : Widely used photo catalyst
- Mod TiO_2 : Modified to induce activation under visible light

- Refer to Appendix A for Detailed Experimental Method
- N/A: Not Available

III. Material Summary

Visible-light driven photocatalyst decomposition performance

	Substance Name	Test Method	Samples	Analysis	Performance
Air Purifier Performance Validation: 5 Major Gases	Acetaldehyde	Small chamber method: Attachment 1 (JIS R 1751-6)	Powder @ Glass	HPLC	87%
	Formaldehyde				91%
	Toluene				100%
	Acetic acid	CO ₂ generation test - Attachment 2	Powder	GC-MS	71.8ppm/hr
	Ammonia	Gas bag test - Attachment 3 (100ppm / 30min)			Detector tube
TVOC	Benzene	Gas bag test - Attachment 4 (5ppm / 6hr)	Powder @ Non-woven cloth	HPLC	80%
	Ethyl benzene				99%
	m-, p-Xylene				
	Styrene				
	o-Xylene				
Living Odors	Nonenal	Gas bag test - Attachment 5 (270ppm / 2hr)	Powder @ Activated carbon	GC-MS	93%
	Diacetyl	Gas bag test - Attachment 6 (1700ppm / 1hr)	Powder	Detector tube	94%
	Hydrogen disulfide	Gas bag test - Attachment 7 (2ppm / 1hr)			5 : Very bad odor ↓ 0 : No odor
	Methyl mercaptan		99%		
	TMA		Sensory evaluation - Attachment 8 (Evaluation conditions differ for different substances)	Powder @ Activated carbon + LED Kit	
	Cigarettes	4.5 → 2			
	Sausage stew	4.5 → 1.3			

Decomposition Performance Data

5 Major Indoor Harmful Gases

Material	Formaldehyde	Toluene	Acetaldehyde	Ammonia	Acetic acid
	Removal Efficiency(%)			Removal Rate (ppm/hr)	CO ₂ evolution (ppm/hr)
OS PHOTOCAT	91	81	87	405.1	125.3
Cu TiO ₂		0	0	9.7	3.8
Cu WO ₃	0	36	34	6.0	6.7

Hydrogen sulfide	Methyl mercaptan
90	99

Odor in Daily Life (Rotten Food Smell) Removal Efficiency(%)

Other Harmful Gases (TVOC) Removal Efficiency (%)

Benzene	Ethyl benzene	m-, p-, o- Xylene	Styrene
80	99	99	99

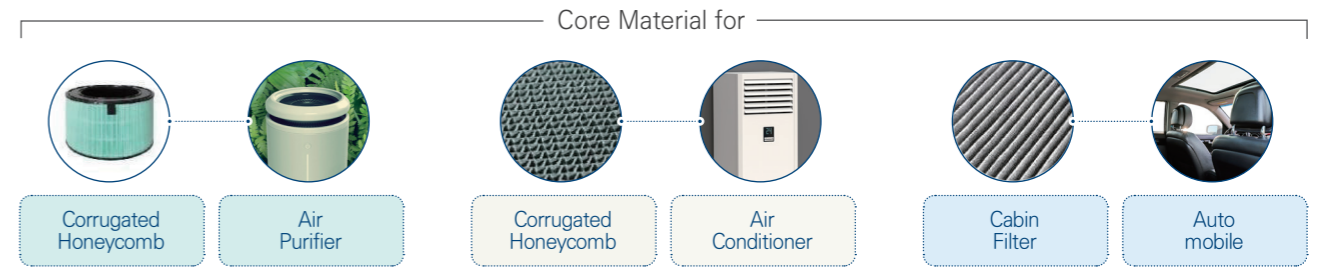
Anti bacterial Activity (%)

Escherichia coli	Staphylococcus aureus
≥99.9	≥99.9

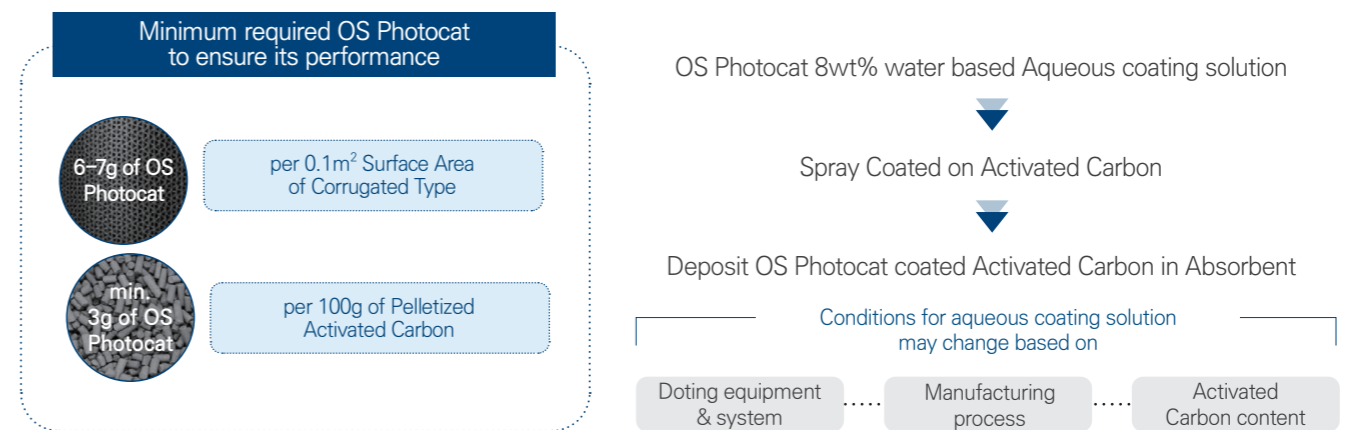
Refer to Appendix A for Detailed Experimental Method

IV. Current Applications

Air Filter Application



Use of Material Guide



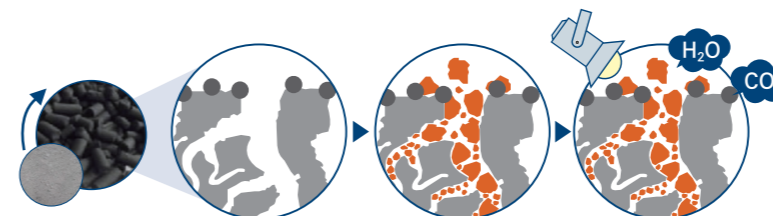
V. Superiority of OS PHOTOCAT

Gas Re-emission Prevention Mechanism

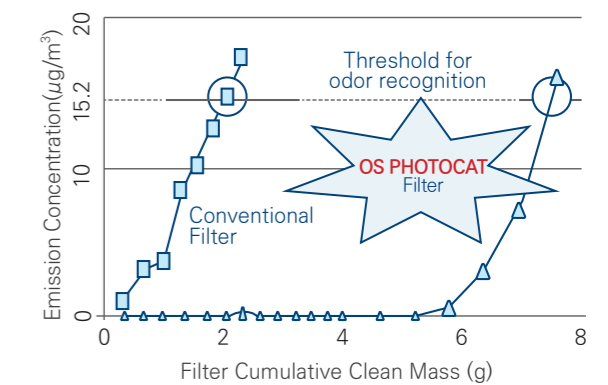
Conventional Filter : Gas removal process of regular Activated Carbon(AC) filter



OS PHOTOCAT Filter : Gas decomposition process of



Acetic acid Re-emission Test Result



Beyond this threshold, filter replacement is required. OS Photocat filter provides enhanced lifetime.

OS Photocat coated AC filter

OSP Sales Reference

LG Electronics Products Line-up



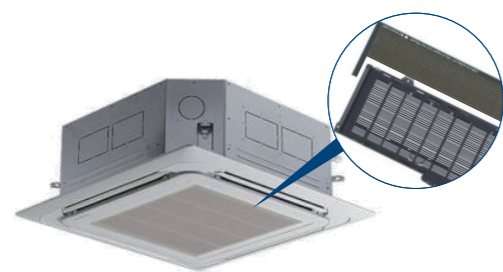
SIGNATURE

BLACK Deodorization Filter



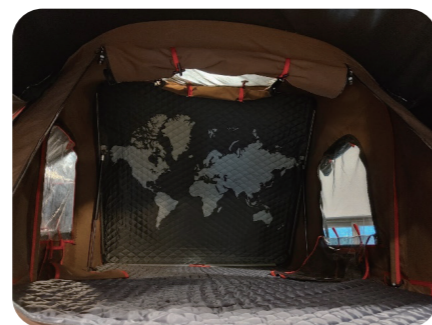
PuriCare 360° Pet

Corrugated Honeycomb Type



System A/C

Filter for 1 way, 4 way system A/C



Roof-top tent

Daily OS PHOTOCAT

With OS PHOTOCAT Photocat in our daily lives

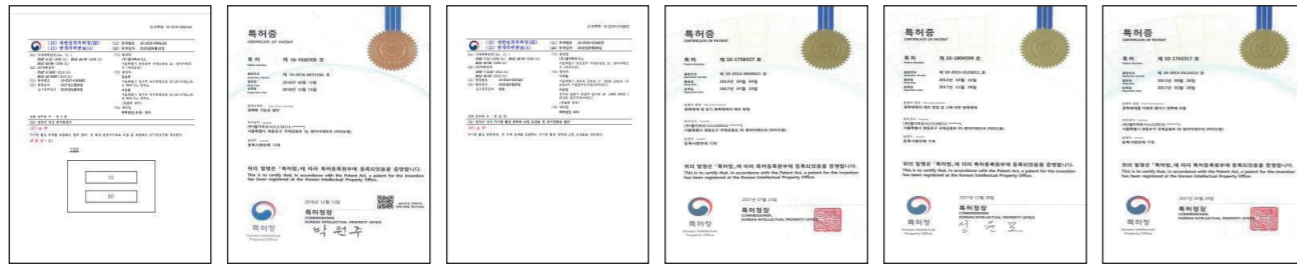


Use of various photocatalysts

House & Office	Indoor wallpaper, windows, handrails, curtains, carpets, hair brushes, masks, (toilet, faucet, etc.), air purifiers, etc.	
Factory	handrails, etc.	
Hospital	Hospital mask, gown, , furniture	
Airplane	System air conditioner, escalator handle, airport cart, etc.	
Life	subway	Subway seat, subway handle, window handle
	automobile	Seat, Room mirror, air conditioner filter
	mart	cart, basket

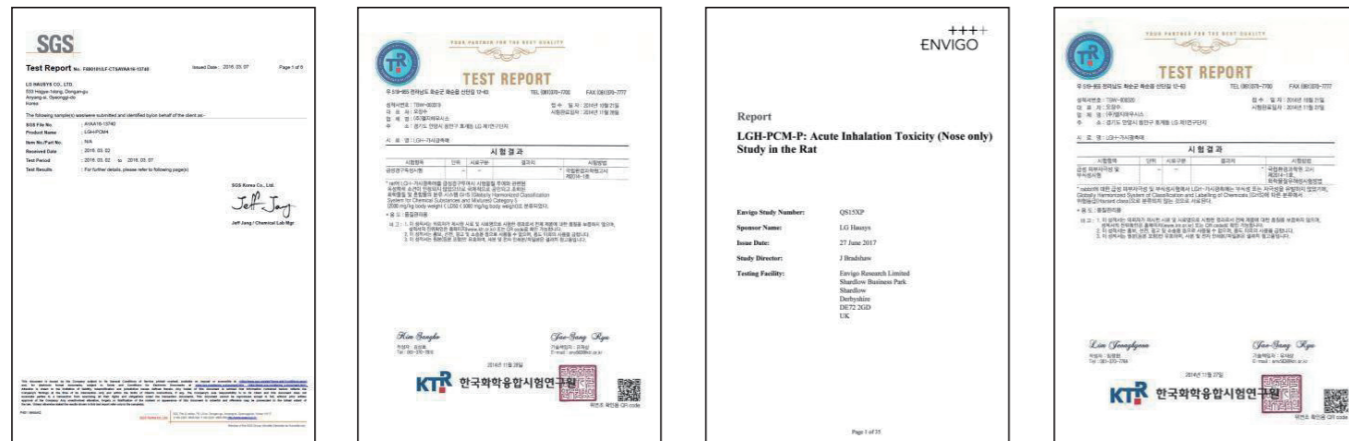
Patent Status

▪ List of Related Patents



Patent Number	Application Date	Title	Application Status	Applied countries
10 1804599	2013.10.22	METHOD FOR PREPARING PHOTOCATALYST AND PHOTOCATALYST PREPARED THEREFROM	Registered	KR(Registered)
10 1743317	2013.09.26	LED PHOTOCATALYSTS MODULE USING PHOTOCATALYSTS	Registered	KR(Registered) US(Registered)
10 1758427	2014.04.04	PHOTOCATALYST AND METHOD FOR PREPARING THE SAME	Registered	KR(Registered)
10 2016 0104823	2015 02 26	VISIBLE LIGHT ACTIVE PHOTOCATALYST COATING COMPOSITION AND FILTER FOR AIR	Pending Registered	KR US(Registered) JP(Registered) EU CN
10 1930709	2016 06 13	PHOTOCATALYST FUNCTIONAL FILTER	Registered	KR(Registered)JP CN
10 2019 0064143	2017 11 30	AIR PURIFIER	Pending	KR

Safety Certification



<p>Heavy Metal Detection Test</p> <p>4 Heavy Metal (Cd, Pd, Hg, Cr) and Flame Retardants(PBBs/PBDEs) are not detected</p>	<p>Acute Oral Toxicity Test</p> <p>No toxicological findings according to results of acute oral toxicity test</p>	<p>Acute Inhalation Toxicity Test</p> <p>No toxicological findings according to results of acute inhalation toxicity test</p>	<p>Acute Dermal Toxicity Test</p> <p>Not corrosive nor irritant : not classified as hazardous material</p>
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Appendix A. Harmful Gas & Odor Removal Experimental Method

▪ Five Major Harmful Gases

Formaldehyde, Toluene, Acetaldehyde		
Standard ISO 18560 1:2014 (JIS R 1701 6)		
Method	Test chamber method (20L chamber)	
Specimen	OS PHOTOCAT coated glass plate (0.002m ² glass plate, 0.02g of OS PHOTOCAT)	
Conditions	Gas Concentration	0.1ppm
	Light Source	white LED (1,000 lux)
	Temperature/ Humidity	25°C/50%
	Air Flow Rate	10L/hr(continuous)

Acetic acid		
Method	CO ₂ Evolution Rate (NIMS)	
Specimen	OS PHOTOCAT powder(0.4g)	
Conditions	Gas Concentration	400ppm
	Light Source	Xe lamp with glass filter
	Wavelength	400~530nm
	Temperature	25°C

Ammonia		
Method	Gas-bag Test(3L)	
Specimen	OS PHOTOCAT coated glass plate	
Conditions	Gas concentration	100ppm
	Light source	white LED (1,000 lux)
	Temperature	25°C

▪ Other Malodor & Harmful Gases

Hydrogen sulfide, Methyl mercaptan		
Method	Gas-bag Test (3L)	
Specimen	OS PHOTOCAT powder (0.5g)	
Conditions	Gas Concentration	1.6ppm of Hydrogen sulfide 2.5ppm of Methyl mercaptan
	Time Duration	60 minutes
	Wavelength	405nm LED
	Power consumption	3.3W

Benzene, Ethyl benzene, m-,p-,o-Xylene, Styrene		
Method	Gas-bag Test (5L)	
Specimen	OS PHOTOCAT coated glass plate	
Conditions	Gas Concentration	5ppm
	Light Source	white LED (1,000 lux)
	Time duration	6 hours

Appendix B. Anti-bacterial Activity Experimental Method

▪ Bacteria

Escherchia coli, Staphylococcus aureus		
Standard	JIS R 1702	
Method	Film adhesion method	
Specimen	OS PHOTOCAT coated fabric	
Conditions	Light Source	white LED (1,000 lux)
	Time Duration	8 hours
	Temperature	25°C
Testing Institute	Korea Apparel Testing & Research Institute	

