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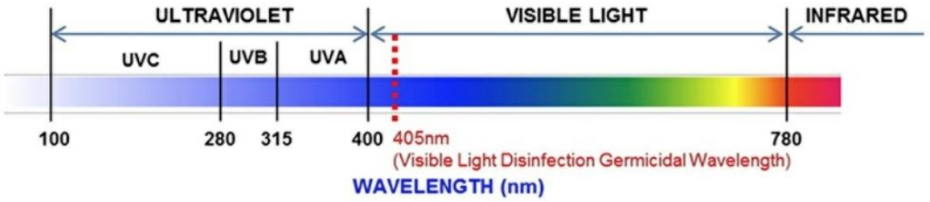
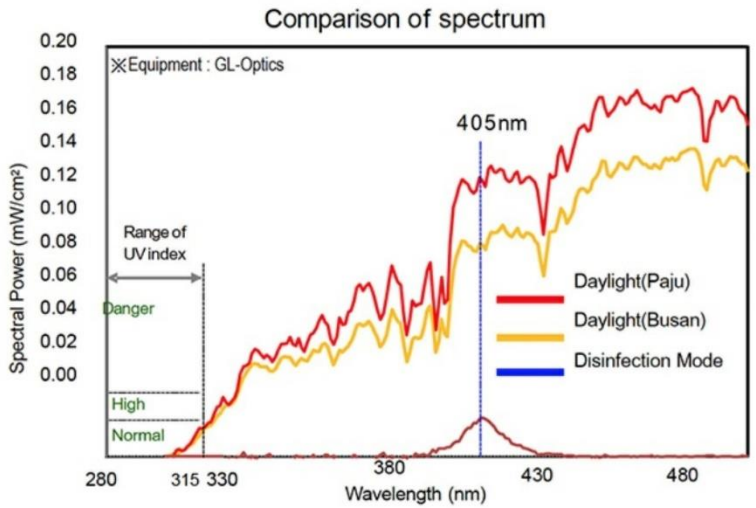
Visible Disinfection Concept

Visible Disinfection Concept





❑ **Non-contact disinfection type**

Continuous
Air Filters UV/
Plasma air handlers
Environmental sprays
Visible Light

Episodic
Chemical Vapor
UV Devices

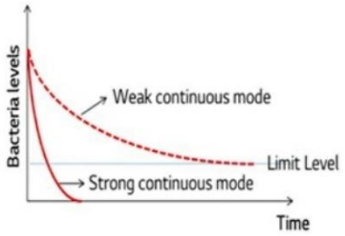
How does disinfection work? (ex.Operating room)

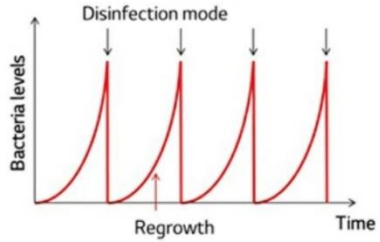
- Combine with Continuous mode(White) and Disinfection mode(Blue)

Continuous Mode (White+Blue Light)

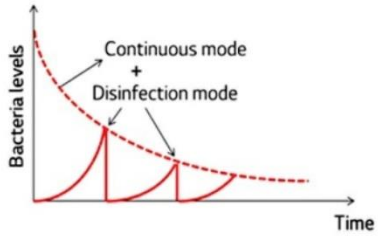
+

Disinfection Mode (Blue Light)





<Functional mix>

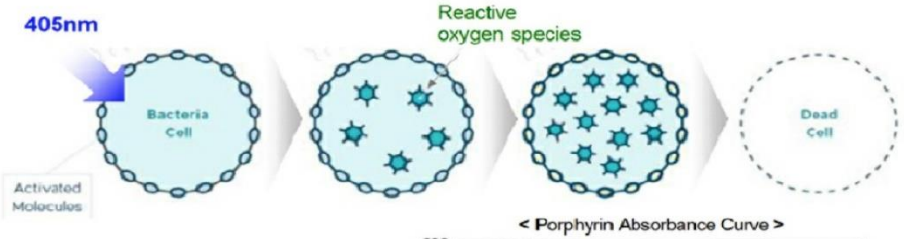


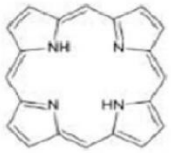
Difference between 405nm vs UV Sterilization

❑ Sterilization Type

• Porphyrin excitation (405nm)

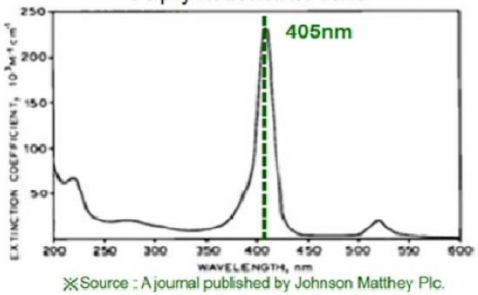
- ROS(Reactive oxygen species) created from reaction of 405nm light & porphyrin destroy cell inside of bacteria



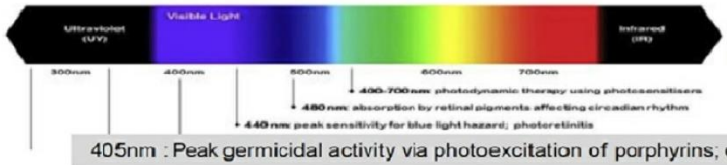


※Porphyrin : substance inside of bacteria that react with 405nm light

< Porphyrin Absorbance Curve >



※Source : A journal published by Johnson Matthey Plc.

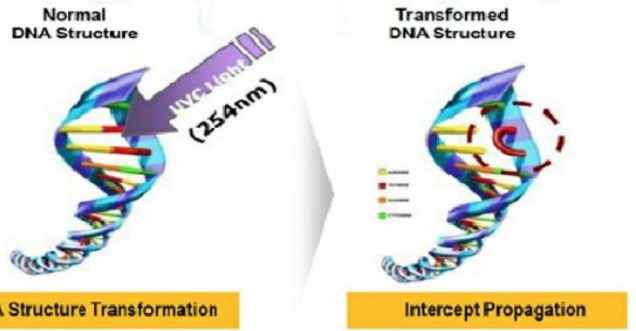


※ Source : Report of Seoul University

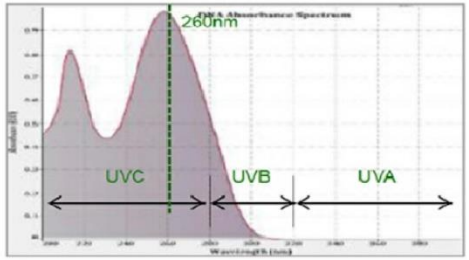
405nm : Peak germicidal activity via photoexcitation of porphyrins; oxidative damage

• Direct Photolysis (UVC)

- UV-C light deactivates bacteria, viruses and other microbes by breaking their DNA.
- The microorganism makes bacteria to lose reproductive capability.



< DNA Absorbance >



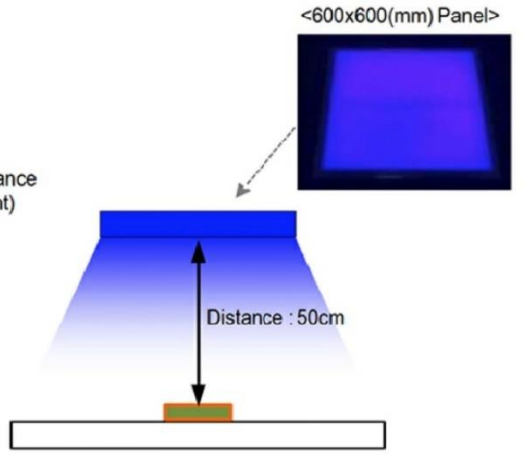
• Comparison by Wavelengths

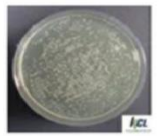
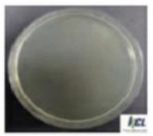
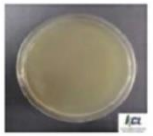
	UVC	UVB	UVA	405nm
Porphyrin excitation	X	X	X	**O**
Direct Photolysis	O	△	X	X
Characteristic	Have Impact on Human Body			**Harmless to Human Body**

405nm Sterilization Performance

❑ Test Result

- Test Lab : KCL Test room (37.0 ± 0.2°C)
- Pathogen Species : Escherichia coli ATCC25922
  Staphylococcus aureus ATCC 6538
- Test Method
  1) Pathogen Species is Located in the middle of Light Source
  2) Measure Reduction Rate of Bacteria after testing from 50cm Distance
     (Time and Intensity of Illumination of the Test are set by Test Client)



구분	600x600(mm) Panel	
	Before	After (50cm) - 87730 Dose
Escherichia coli ATCC 25922		
Staphylococcus aureus ATCC 6538		

✓Sterilization Performance by Time Difference

※Intensity of Illumination is from 380~780nm wavelength light

Power Output (mW)	Intensity of Illumination (mW/cm²)	Distance (cm)	Time (sec)	Dose (mJ/cm²)	Reduction Rate		Remark
					Escherichia coli	Staphylococcus aureus	
18150	2.708	**50**	9.0 (32400)	**87730**	**99.9%**	99.9%	KCL Test Report

✓Sterilization Performance by Intensity of Illumination

Power Output (mW)	Intensity of Illumination (mW/cm²)	Distance (cm)	Time (sec)	Dose (mJ/cm²)	Reduction Rate		Remark
					Escherichia coli	Staphylococcus aureus	
35900	5.410	**50**	4.5 (16200)	**87640**	**99.9%**	99.9%	KCL Test Report
18150	2.708	**50**	9.0 (32400)	**87730**	**99.9%**	99.9%	
8900	1.355	**50**	18.0 (64800)	**87770**	**99.9%**	99.9%	

405nm Effect on Human Body

IEC 62471 (Photobiological Stability Test)

- IEC 62471
  - Photobiological Stability Test : Testing Harmfulness Lighting Device (Human body and eyes)
  - Exempt / Low Risk / Mod Risk ; 3 Steps
  - **IEC 62471 Test Result: Exempt Grade**

→ Got 'Exempt' grade from Actinic UV/Near UV Emission Measurement

<Continuous Mode>

Report No.: 170600116SEL-003

IEC 62471

Table 6.1	Emission limits for risk groups of continuous wave lamps								P
Risk	Action spectrum	Symbol	Units	Emission Measurement					
				Exempt		Low risk		Mod risk	
				Limit	Result	Limit	Result	Limit	Result
Actinic UV	$S_{UV}(\lambda)$	E_S	$W \cdot m^{-2}$	0,001	5.06E-05	0,003	N/A	0,03	N/A
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	0.3216	33	N/A	100	N/A
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	1.33E+03	10000	7.3493	4000000	N/A
Blue light, small source	$B(\lambda)$	E_B	$W \cdot m^{-2}$	1,0*	N/A	1,0	N/A	400	N/A
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	28000/α = 280000	91.9752	28000/α = 280000	N/A	71000/α = 710000	N/A
Retinal thermal, weak visual stimulus**	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	6000/α = 60000	N/A	6000/α = 60000	N/A	6000/α = 60000	N/A
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	N/A	570	N/A	3200	N/A

* Small source defined as one with α < 0.011 radian. Averaging field of view at 10 000 s is 0.1 radian.
*' Involves evaluation of non-GLS source

<Sterilization Mode>

Report No.: 170600116SEL-001

IEC 62471

Table 6.1	Emission limits for risk groups of continuous wave lamps									P
Risk	Action spectrum	Symbol	Units	Emission Measurement						
				Exempt		Low risk		Mod risk		
				Limit	Result	Limit	Result	Limit	Result	
Actinic UV	$S_{UV}(\lambda)$	E_S	$W \cdot m^{-2}$	0,001	1.19E-04	0,003	N/A	0,03	N/A	
Near UV		E_{UVA}	$W \cdot m^{-2}$	10	3.1285	33	N/A	100	N/A	
Blue light	$B(\lambda)$	L_B	$W \cdot m^{-2} \cdot sr^{-1}$	100	2.32E+03	10000	11.3455	4000000	N/A	
Blue light, small source	$B(\lambda)$	E_B	$W \cdot m^{-2}$	1,0*	N/A	1,0	N/A	400	N/A	
Retinal thermal	$R(\lambda)$	L_R	$W \cdot m^{-2} \cdot sr^{-1}$	28000/α = 280000	113.5258	28000/α = 280000	N/A	71000/α = 710000	N/A	
Retinal thermal, weak visual stimulus**	$R(\lambda)$	L_{IR}	$W \cdot m^{-2} \cdot sr^{-1}$	6000/α = 60000	N/A	6000/α = 60000	N/A	6000/α = 60000	N/A	
IR radiation, eye		E_{IR}	$W \cdot m^{-2}$	100	N/A	570	N/A	3200	N/A	

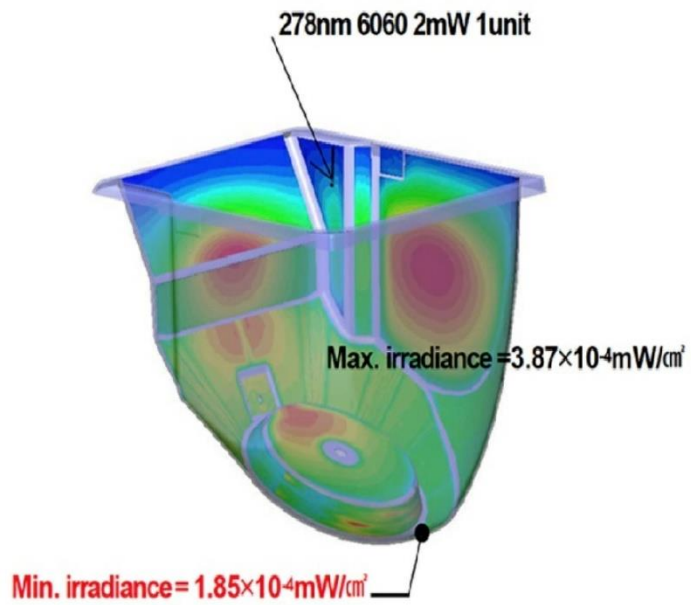
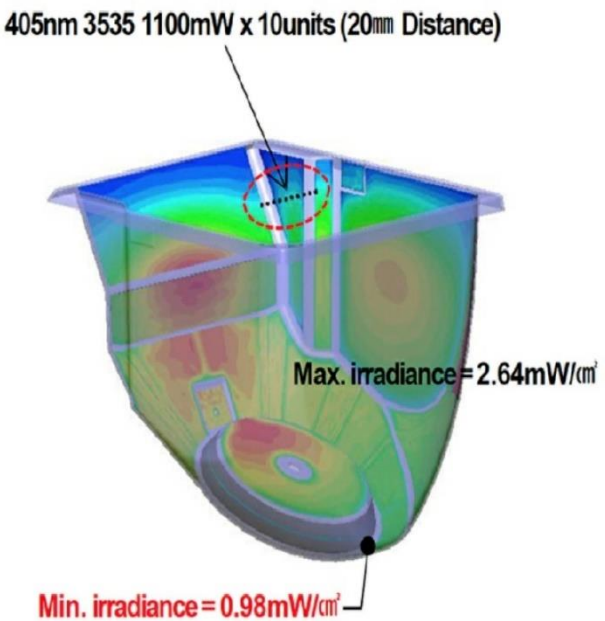
* Small source defined as one with α < 0.011 radian. Averaging field of view at 10 000 s is 0.1 radian.
** Involves evaluation of non-GLS source

LUXGLO

Comparison (278nm & 405nm)

Categories	UV-C (278nm)	405nm	Remarks
Disinfection Mechanism	Photochemical destruction of DNA	Oxidation damage by ROS (ROS: Reactive Oxygen Species)	-
Disinfection Time	Short	Long	UVC : 1.9 mJ/cm² 405nm : 88 J/cm² @ E.coli O157:H7 3log reduction (99.9%)
Disinfection Efficacy	Rapid Inactivation	Slow Inactivation	
Lifetime	Normal	Long	278nm : 15khrs+ @ L50 405nm : 50khrs+ @ L70
System	Simple, Compact	Complex	-
Plastic Discoloration	Yes (Polymer Damage)	No	-
Package Cost	High	Low	405nm needs multiple packages

Comparison (UV-C & UV-A)

Categories	UV-C	UV-A
Source	278nm 6060 2mW 1unit	405nm 3535 1100mW x 10 units
Irradiance Result		
Min. irradiance	1.85×10-4mW/㎠	0.98mW/㎠
Disinfection Time	2.8 hour (Target dose = 1.89 dose)	24.9 hour (Target dose = 87730 dose)

※ Target dose was calculated based on E. coil.

Location Used:

henderson hospital, in Nevada https://www.hendersonhospital.com/

Ambulatory Surgery Center, in South Carolina https://ascspartanburg.com/

Holy Family Memorial in Wisconsin https://www.hfmhealth.org/

The Dumke Gymnastics Center at the University of Utah https://www.utah.edu/

There are so many other places cannot list them all.

405um Technology

https://pubmed.ncbi.nlm.nih.gov/25066049/

https://stacks.cdc.gov/view/cdc/80239/cdc_80239_DS1.pdf

https://www.ajicjournal.org/article/S0196-6553(19)30746-1/pdf

UV-C Light Kills SARS-CoV-2

https://www.biospace.com/article/uv-c-light-kills-sars-cov-2-triggering-novel-lighting-options-for-public-spaces/

https://theweek.com/speedreads-amp/922121/humansafe-uv-light-could-key-reopening-indoor-spaces-study-shows

CNBC NEWS, UV light breaks down coronavirus particles in seconds

https://www.cnbc.com/amp/2020/06/17/signify-uv-light-coronavirus.html