



# Vivion™

cyclic block copolymers

Enable Unlimited Possibilities



# 2 Key Technologies

## Complete Hydrogenation

- Efficient complete-hydrogenation
- Ensured product quality

## Anionic Polymerization

- Precisely controlled molecular weight
- Extremely low extractables



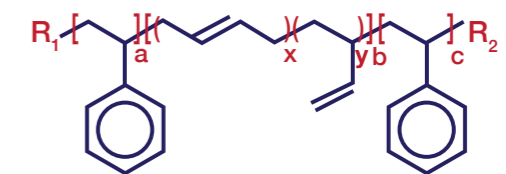
# ViviOn™

## Cyclic Block Copolymers (CBCs)

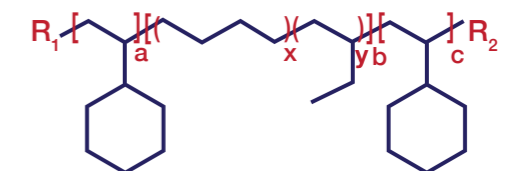
ViviOn™ is a family of novel cyclic block copolymers (CBCs), which are fully hydrogenated polymers based on styrene and conjugated dienes via anionic polymerization. This advanced material has remarkable thermal stability, excellent UV durability, extra-high transparency, low water absorption, low density and superb purity. These features offer the users of ViviOn™ with superior design flexibility, easy processing capability and low life-cycle costs. In addition, the flexibility of tailoring polymer micro-structure by adjusting the ratio of poly(cyclohexylethylene) (PCHE) and ethylene-co-1-butene (EB) provides ViviOn™ a wide range of properties from rigid plastics to soft elastomers.

## Complete Hydrogenation Technology

Styrene-Butadiene Copolymers



Cyclic Block Copolymers



**USI Corporation**, one of the largest polymeric material companies based in Taiwan, has a long history in producing and selling PE and EVA. The company acquired the CBC technology from Dow Chemical Co. in 2011 and initiated the world's first-ever CBC mass production line in Kaohsiung, Taiwan.



For more information, please refer to [www.usife.com](http://www.usife.com)

**1995**  
Initiated by Dow Chemical Co.

**2000**  
Fundamental research

**2005**  
Application development

**2011**  
USI - Technology acquisition, product research and market development

**2018**  
USI initiated the world's first-ever CBC mass production line in Kaohsiung, Taiwan



**ViviOn™**  
Cyclic Block Copolymers  
(CBCs)

## ViviOn™ Properties

Properties	Unit	Test Method (ASTM)	8210	1325	0510	0510HF	0510T	0510HT
<b>General Properties</b>								
Density	g/cm <sup>3</sup>	D792	0.94	0.94	0.94	0.94	0.94	0.94
Water Uptake	%	D570	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Melt Flow Rate (2.16kg, 230°C)	g/10min	D1238	35	1.3	-	-	-	-
Melt Flow Rate (2.16kg, 260°C)	g/10min	D1238	-	13	5	13	11	9
<b>Optical Properties</b>								
Refractive Index	-	-	1.51	1.51	1.51	1.51	-	-
Transmittance (380-760nm)	%	D1003	92	92	92	92	91.5	91
Haze	%	D1003	<1.0	<1.0	<1.0	<1.0	1.5	5
<b>Thermal Properties</b>								
Vicat Softening Temperature	°C	D1525	109	125	116	114	113	108
Heat Distortion Temperature	°C	D648	83	103	89	88	87	83
Glass Transition Temperature	°C	USI Method	115	128	120	120	119	115
<b>Mechanical Properties</b>								
Flexural Strength	MPa	D790	65	70	64	66	60	56
Flexural Modulus	GPa	D790	2.1	2.3	1.8	1.8	1.6	1.4
Tensile Strength (B.P.)	MPa	D638	35	37	36	35	35	25
Elongation	%	D638	12	14	20	15	16	100
Impact Strength (Charpy Notched)	kJ/m <sup>2</sup>	D6110	2.6	3.0	5.0	5.0	12	20
<b>Processing</b>								
Injection Molding			☉	☉	○	☉	☉	☉
Extrusion Molding				☉	☉	☉	☉	☉
Injection Stretched Blow Molding					○	☉	☉	☉

Please contact USI to obtain information on ViviOn™ special grades for Medical, Bio-diagnostic, and UVC Disinfection Applications.

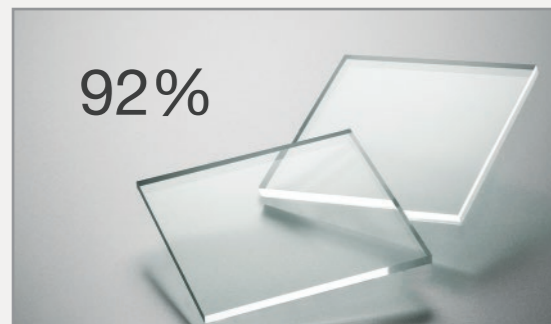
# Optical Applications

Improved brightness, clarity and viewing angle for your display

ViviOn™ is an innovative optical polymer with characteristics of low density, extra-high transparency, well-controlled light retardation, excellent UV durability, great chemical resistance, and low moisture uptake. Due to the unique chemical micro-structure, ViviOn™ can be processed advantageously in most optical fabrications including injection molding, extrusion and solvent casting.

Applications include: optical film, endoscope protective cover, and light guide strip.

## Superior High Transparency

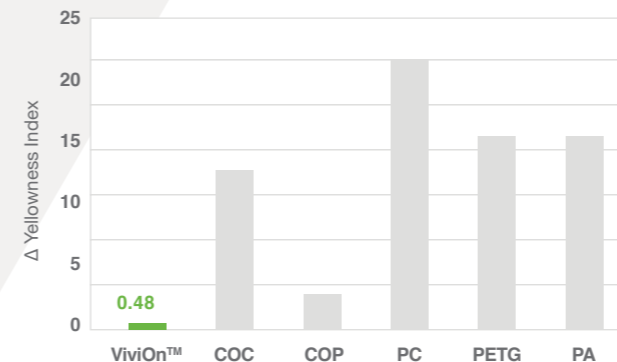


## Outstanding Thermal Stability

Time / Materials	ViviOn™	COC	COP
30 min			
60 min			

At 250°C oven, air

## Excellent Weatherability / UV Durability



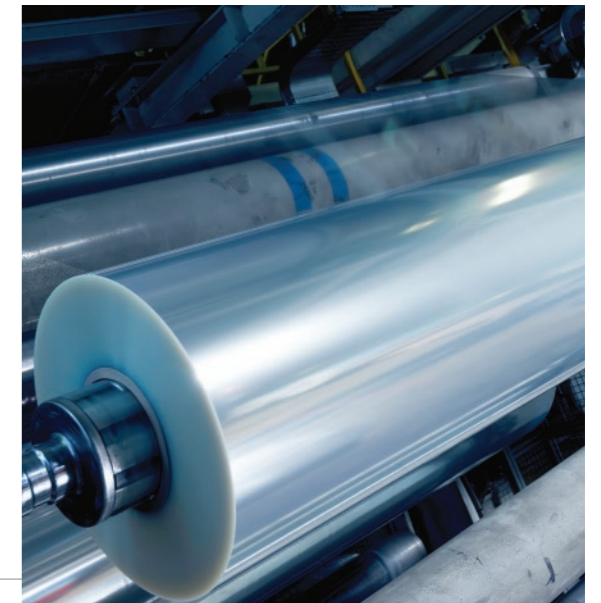
•ASTM G154  
 Wavelength : UVA 340 nm  
 Irradiation : 0.89 W/m<sup>2</sup>  
 Test duration: 1000 hrs  
 Each cycle include 8 hrs of UV exposure with uninsulated black panel temperature (60±3°C) and 4 hrs of condensation with uninsulated black panel temperature (50±3°C).

# Thinner & Brighter

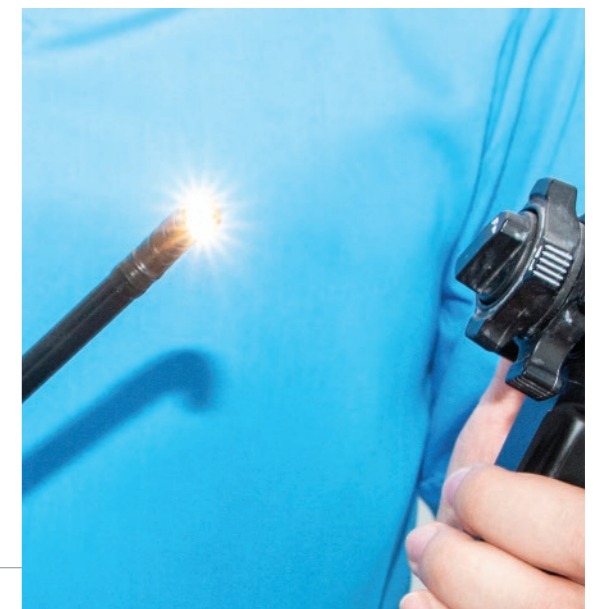
Light Guide Strip

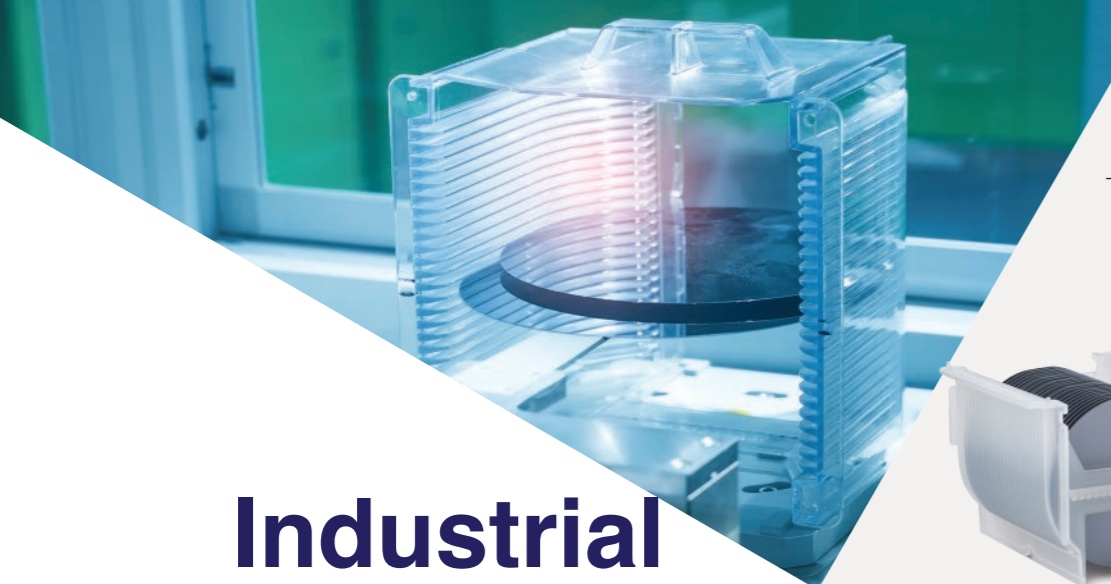


Optical Film

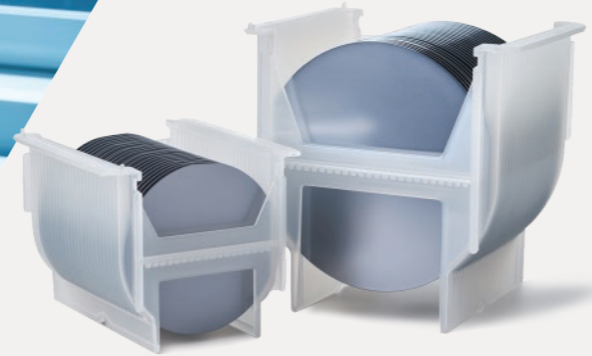


Endoscope Protective Cover





Advanced Semiconductor Container



# Industrial Electronic Applications

Clean & Exceed: Material with minimal contaminants for industrial applications.

ViviOn™ has been analyzed through Ion Chromatography (IC), ICP-MS, and GC-MS by SGS Lab. Comparing with other engineering polymers, ViviOn™ has low metal ion concentration, low heavy metal content, and low volatile organic compounds (VOC), which brings low particle generation, low outgassing, and high purity. In addition, ViviOn™ possesses excellent chemical resistance, great abrasion resistance, high hydrolysis resistance, exceptional dielectric strength, and outstanding radiation resistance. The aforementioned features could be applied to semiconductor fabrication products, carriers and electric packaging containers, etc.

ViviOn™ presents low Dk and low Df, which could increase data transmission speed and decrease its noise. Applications include: 5G electronics/antenna products and radar/IR sensor.

Regulation/Test	Test Details	Results
REACH (SVHC)	213 Substances of Very High Concern test (EU)	Passed
RoHS	10 Heavy Metals, Plasticizers	Passed
Halogen Free	Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I)	Passed

## Low Dk, Low Df

Properties	Test Method	Condition	ViviOn™ Sample Thickness		
			50µm	100µm	200µm
Dielectric Constant	DEA	10GHz	2.300	2.246	2.244
Dissipation Factor	DEA	10GHz	0.00016	0.00018	0.00041



Radar/IR Sensor

# Eyewear Applications

Light & Floating: Superior choice for water sports.

ViviOn™ displays low density floating property, high impact resistance, and Gamma/UV sterilizable, which makes it suitable for eyewear, e.g.: frame of sunglasses and sport glasses, medical safety goggles, etc.



## Low Density



## High Impact Strength

Charpy Impact Strength (kJ/m²)



# Medical Applications

Pure & Clean: An extremely clean and trustworthy material for medical devices

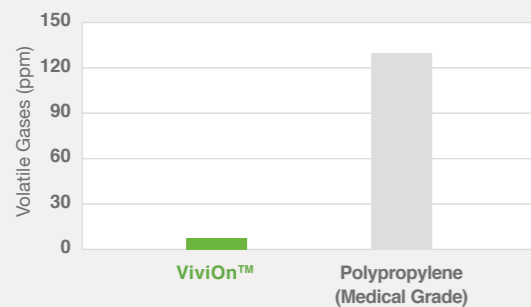
ViviOn™ is safe, reliable and durable for medical applications with features of extreme purity, good thermal stability, excellent UV durability, superb chemical resistance and outstanding clarity. The products made by ViviOn™ can be sterilized using Gamma and E-beam radiation, Ethylene Oxide Gas (EOG), providing medical professionals ease of use and compatibility.

ViviOn™ passes selected chapters of ISO10993 biocompatibility, US Pharmacopeia <88> Class VI and <661>, European Pharmacopeia 3.1.3, as well as JP Pharmacopeia 7.02. The material is listed in the U.S. FDA Type III Drug Master File 32470.

Applications include: pre-filled syringe, vial, and contact lens mold.

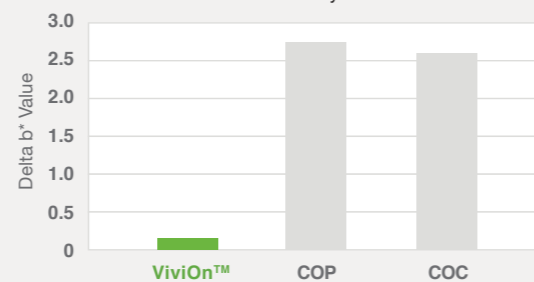
## Extremely Low Outgassing

Test condition: heat at 80°C for 2hrs, then measure volatile gases by headspace GC/MS.



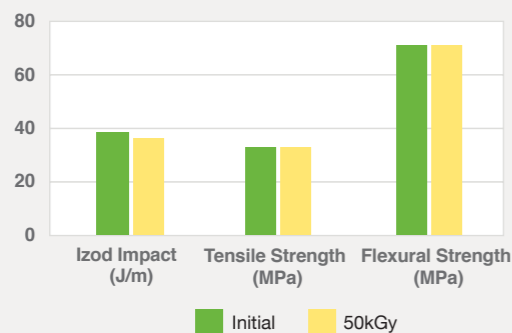
## Low color shift after Gamma irradiation

Degree of color shift after exposure to 50kGy of Gamma radiation then settled for 1 day.



## Mechanical properties after Gamma irradiation

Mechanical properties were measured before and after 3 weeks of Gamma irradiation.



## Sterilization Method

Gamma Radiation	✓
E-beam Radiation	✓
Ethylene Oxide Gas	✓

Regulation/Test	Test Details	Results
BPA Test	SGS Bisphenol A test	Not Detected
DMF	US FDA Drug Master File for pharmaceutical application	No. 32470
ISO10993 – 4/5/6/10/11	Hemolysis, Cytotoxicity, Muscle Implantation, Intracutaneous Irritation, Sensitization, Accute Systemic Toxicity	Passed
USP <88> Class VI	Acute System test, Intracutaneous test, Implantation test	Passed
USP <661>	Non-Volatile Residue, Heavy Metals (as Pb), Buffering Capacity	Passed
JP Pharmacopeia 7.02	Residue on Ignition, Heavy Metals (Pb, Cd, Sn), Foaming test, pH Value, KMnO4 Reducing Substances, UV Spectrum, Residue on Evaporation	Passed
European Pharmacopeia 3.1.3	European Pharmacopoeia 3.1.3	Passed
Extractables	Reflux, Sonication and Closed vessel extractions.	Neligible



Pre-filled Syringe



Vial



Contact Lens Mold

# Bio-diagnostic Applications

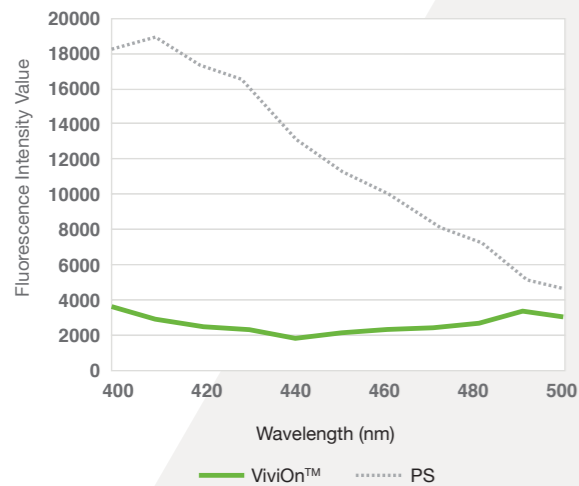
Accurate & Reliable: The material-of-choice for bio-diagnostic devices

ViviOn™ presents extreme cleanness and exceptional performance in its optical properties: higher UV transmittance and lower autofluorescence than other plastics to increase the accuracy and reliability of the analysis.

Applications include: cuvette, microplate and microfluidic chip (bio-chip) for UV and/or fluorescence detection.

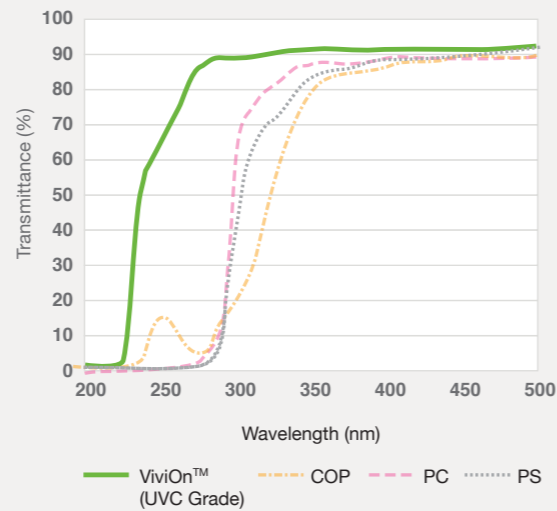
## Low Autofluorescence

Excitation: 350 nm, sample thickness: 1 mm



## High UV Transmittance

Sample thickness: 1 mm



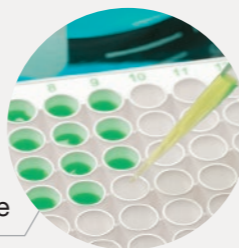
Microfluidic Biochip



Cuvette



Microplate



Solvent		Resistance
Acid	Hydrochloric acid 36%	○
	Sulfuric acid 40%	○
	Acetic acid > 94%	○
	Nitric acid 65%	○
Alkali	NaOH 50%	○
	Ammonia solution 35%	○
Alcohol	Methanol	○
	Ethanol	○
	Isopropanol	○
Ketone	Acetone	○
	Methyl Ethyl Ketone	○
Hydrocarbon	Hexane	✗
	Cyclohexane	✗
Others	DMSO	○
	Silicone oil	○
	Ethylene glycol	○

ViviOn™ resin & tensile bar specimen were immersed in the chemical or reagent for 2 days at room temperature, the specimen's weight loss and mechanical reduction were then measured. Resistant (○): weight loss < 1% and elongation at break% did not change significantly; Not Resistant (✗): weight change >5% or elongation at break% reduced by > 50%.

# Accurate & Reliable

# Deep Ultraviolet (UVC) Applications

Exceptional processability for a safe disinfection device

ViviOn™ is a medical grade plastic material with high UVC transmittance and durability for deep ultraviolet (UVC) applications. In comparison with other plastics, ViviOn™ maintains high UVC transmittance and a glass-like appearance under long-term UVC exposures, which makes it a suitable choice in portable UV sterilizer.

ViviOn™ can be fabricated into sheets and parts for UVC disinfection devices through conventional processes, e.g., injection molding, extrusion, etc. With its exceptional processability, superior chemical resistance, and low density, ViviOn™ provides a versatile flexibility in product design.

Portable UVC Sterilizer



## High UVC Sterilization Efficiency

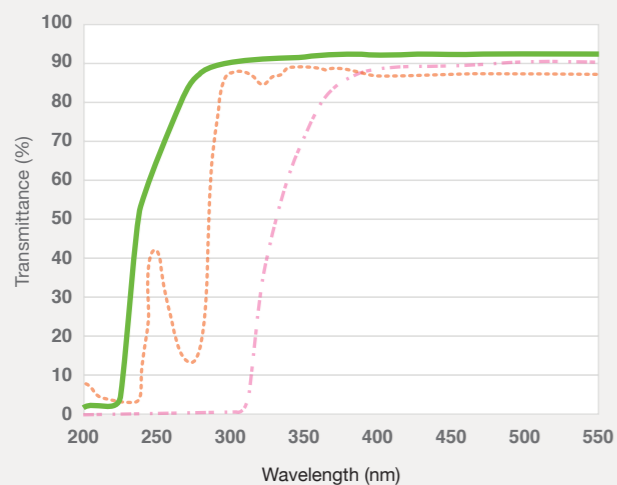
UVC Source: Philips 8W T5 (Wavelength: 253.7 nm)  
Distance: 1.6 cm, Plate Thickness: 1 mm

Sterilization Time (s)	Amount of E. coli (CFU/mL)	
	ViviOn™ (UVC Grade)	PETG
0 s	4.47 × 10 <sup>5</sup>	4.47 × 10 <sup>5</sup>
10 s	<10	4.37 × 10 <sup>5</sup>



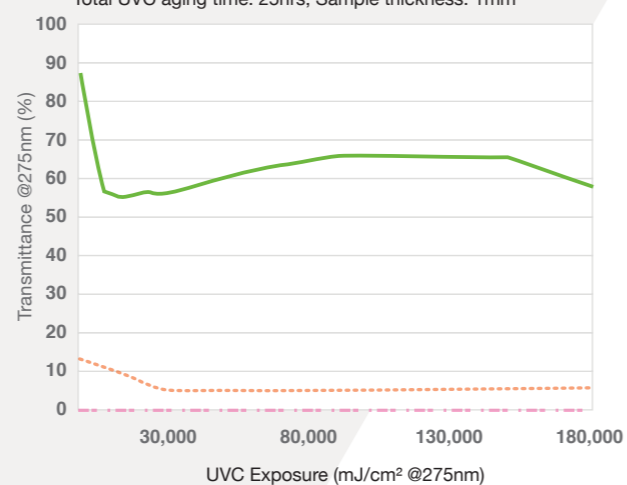
## High UVC Transmittance

Sample thickness: 1mm



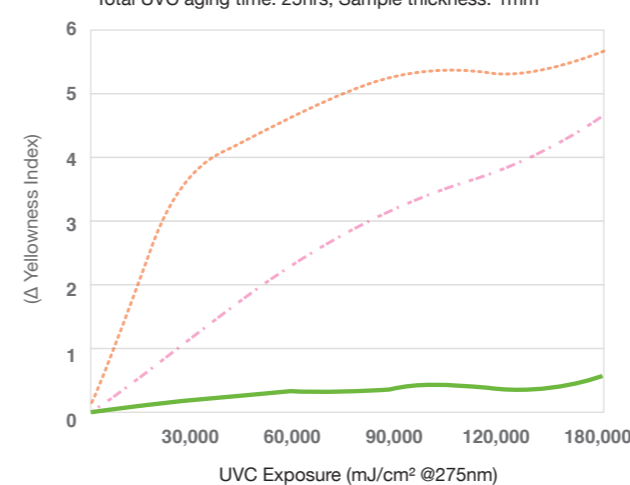
## Substantial UVC Durability

UVC Transmittance @ 275 nm  
UVC source: UVC LED 10mW × 150 pieces (Wavelength: 265-278nm)  
Distance: 4.5cm, Average irradiation: 2mW/cm<sup>2</sup>,  
Total UVC aging time: 25hrs, Sample thickness: 1mm



## Low Color Shift after UVC Exposure

UVC source: UVC LED 10mW × 150 pieces (Wavelength: 265-278nm)  
Distance: 4.5cm, Average irradiation: 2mW/cm<sup>2</sup>,  
Total UVC aging time: 25hrs, Sample thickness: 1mm



## Mechanical Properties after UVC Exposure

UVC source: UVC LED 10mW × 150 pieces (Wavelength: 265-278nm)  
Distance: 4.5cm, Average irradiation: 2mW/cm<sup>2</sup>,  
Total UVC aging time: 25hrs







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