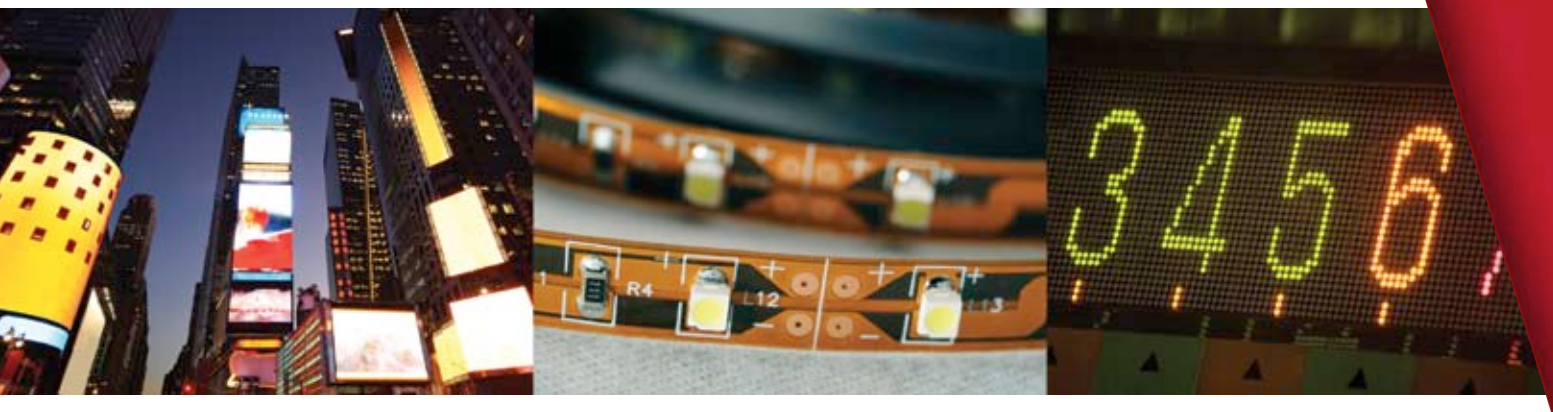
SPECIALTY COATING SYSTEMS™



SCS Parylene Coatings for LEDs

Parylene conformal coatings from Specialty Coating Systems are ultra-thin and pinhole-free, and provide unmatched protection for a wide array of LED applications.

From electronic displays to commercial applications to lighting for the automotive, marine and aircraft industries, LEDs must operate in harsh environments, including long-term UV exposure, temperature extremes and humidity. To ensure long-performance life (100,000 hours) while operating in extreme conditions, LEDs must be protected – and SCS Parylene conformal coatings provide that protection.

LED Applications

Due to their energy efficiency, reduced package size and long life span, global manufacturers are increasing the use of LEDs to replace existing lighting technologies. This allows manufacturers to offer new solutions to existing applications and designers to provide LED products for emerging technologies.

The following applications benefit from LED technologies today, and the list continues to grow:

- Video displays
- Transportation signage
- Aviation lighting
- Traffic signals
- Marine lighting
- Concert venue signage
- Electronic billboards
- Scoreboards
- Commercial refrigeration
- Vehicle lighting
- Outdoor illumination
- Structural lighting

Parylene Coating Properties that Protect

Ultra-thin and Lightweight

SCS Parylene coatings are applied via a vapor deposition process in which the Parylene raw material (dimer) vaporizes into a gas. The gas (Parylene monomer) enters the ambient temperature chamber and polymerizes on the substrate. Since the coating enters the deposition chamber as a gas, its penetration power is superb, enabling film to uniformly grow on all surfaces and edges, including inside the smallest crevices of a substrate.

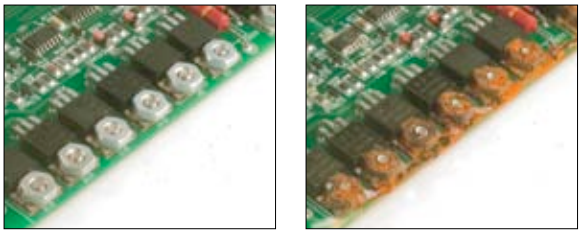
Parylene's unique deposition process allows ultra-thin films to be formed in thicknesses ranging from several hundred angstroms to 75 microns. These thin films are ideal as they do not add significant weight, potentially reducing the amount of structural framework necessary to support large LED signage.

Barrier Properties

SCS Parylenes provide superior pinhole-free, uniform barriers to protect against corrosive liquids, fluids, gases and chemicals, even with prolonged exposure to atmospheric conditions and elevated temperatures.

Circuit boards coated with SCS Parylene HT® were salt-fog tested by an independent testing facility. The coated boards showed no corrosion or salt deposits after 144 hours of exposure in accordance to ASTM B117-(03). (See Figure 1.) Boards coated with Parylene C exhibited similar results.

Figure 1: Circuit boards after 144 hours of salt-fog exposure



Coated with SCS Parylene HT *Uncoated*

SCS LED COATINGS

UV Stability and Optical Clarity

Many LEDs must be able to withstand endless hours of exposure to ultraviolet light. SCS Parylene HT offers excellent UV stability, showing no degradation or discoloration after more than 2,000 hours of accelerated UV testing. Additionally, SCS Parylene coatings are optically clear, so the coating does not reduce the color or lumens output of the LEDs.

Thermal Stability

Often, LED applications, and the coatings that protect them, encounter extreme temperatures. SCS Parylene HT is specifically engineered to provide long-term thermal stability up to 350°C, with short-term stability up to 450°C, providing reliable protection for the life of the LED.

Dielectric Properties

SCS Parylenes have excellent dielectric properties as they can be formed as thin, continuous films, free from defects and fillers that are commonly found in conventional coatings and tend to reduce dielectric strength.

Parylene coatings have low dielectric constants and dissipation factors, and high dielectric strengths, enabling electrical and communication signal transfer without absorption or loss.

Table 1: SCS Parylene Properties

		Method	Parylene HT	Parylene C	Parylene N	Acrylic (AR)[a,b]	Epoxy (ER)[a,b]	Polyurethane (UR)[a,b]	Silicone (SR)[a,b]
UV Stability		1	≥2,000 hrs	≤100 hrs	≤100 hrs	–	–	–	–
Service Temperature	**Continuous**		350°C	80°C	60°C	82°C	177°C	121°C	260°C
	Short-Term		450°C	100°C	80°C	–	–	–	–
Water Absorption (% after 24 hours)		2	<0.01	<0.1	<0.1	0.3	0.05 – 0.10	0.6 – 0.8	0.1
Water Vapor Transmission Rate (g•mm)/(m²•day)		3, 4, 5	0.22	0.08	0.59	13.9[c]	0.94[c]	0.93 – 3.4[c]	1.7 – 47.5[c]
Dielectric Strength V/mil		6	5,400	5,600	7,000	3,500	2,200	3,500	2,000
Dielectric Constant	**60 Hz**	7	2.21	3.15	2.65	–	3.3 – 4.6	4.1	3.1 – 4.2
	1 KHz		2.20	3.10	2.65	–	–	–	–
	1 MHz		2.17	2.95	2.65	2.7 – 3.2	3.1 – 4.2	3.8 – 4.4	3.1 – 4.0
Dissipation Factor	**60 Hz**	7	<0.0002	0.020	0.0002	0.04 – 0.06	0.008 – 0.011	0.038 – 0.039	0.011 – 0.02
	1 KHz		0.0020	0.019	0.0002	–	–	–	–
	1 MHz		0.0010	0.013	0.0006	0.02 – 0.03	0.004 – 0.006	0.068 – 0.074	0.003 – 0.006
Tensile Strength (psi)		8	7,500	10,000	7,000	7,000 – 11,000	4,000 – 13,000	175 – 10,000	350 – 1,000
Penetration Ability[d]			50 x dia.	5 x dia.	40 x dia.	Spray or Brush	Spray or Brush	Spray or Brush	Spray or Brush

a. *Handbook of Plastics, Elastomers, and Composites,* Chapter 6, "Plastics in Coatings and Finishes," 4th Edition, McGraw Hill, Inc., New York, 2002.
b. *Conformal Coating Handbook,* Humiseal Division, Chase Corporation, Pennsylvania, 2004.
c. *Coating Materials for Electronic Applications,* Licari, J.J., Noyes Publications, New Jersey, 2003.
d. Depth into tubing and crevices.

Test Methods:
1. ASTM G 154
2. ASTM D 570
3. ASTM F 1249 (at 100% RH, 38°C) (Parylene HT only)
4. ASTM F 1249 (at 90% RH, 37°C) (Parylene C only)
5. ASTM E 96 (at 90% RH, 37°C) (Parylene N only)
6. ASTM D 149
7. ASTM D 150
8. ASTM D 882

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