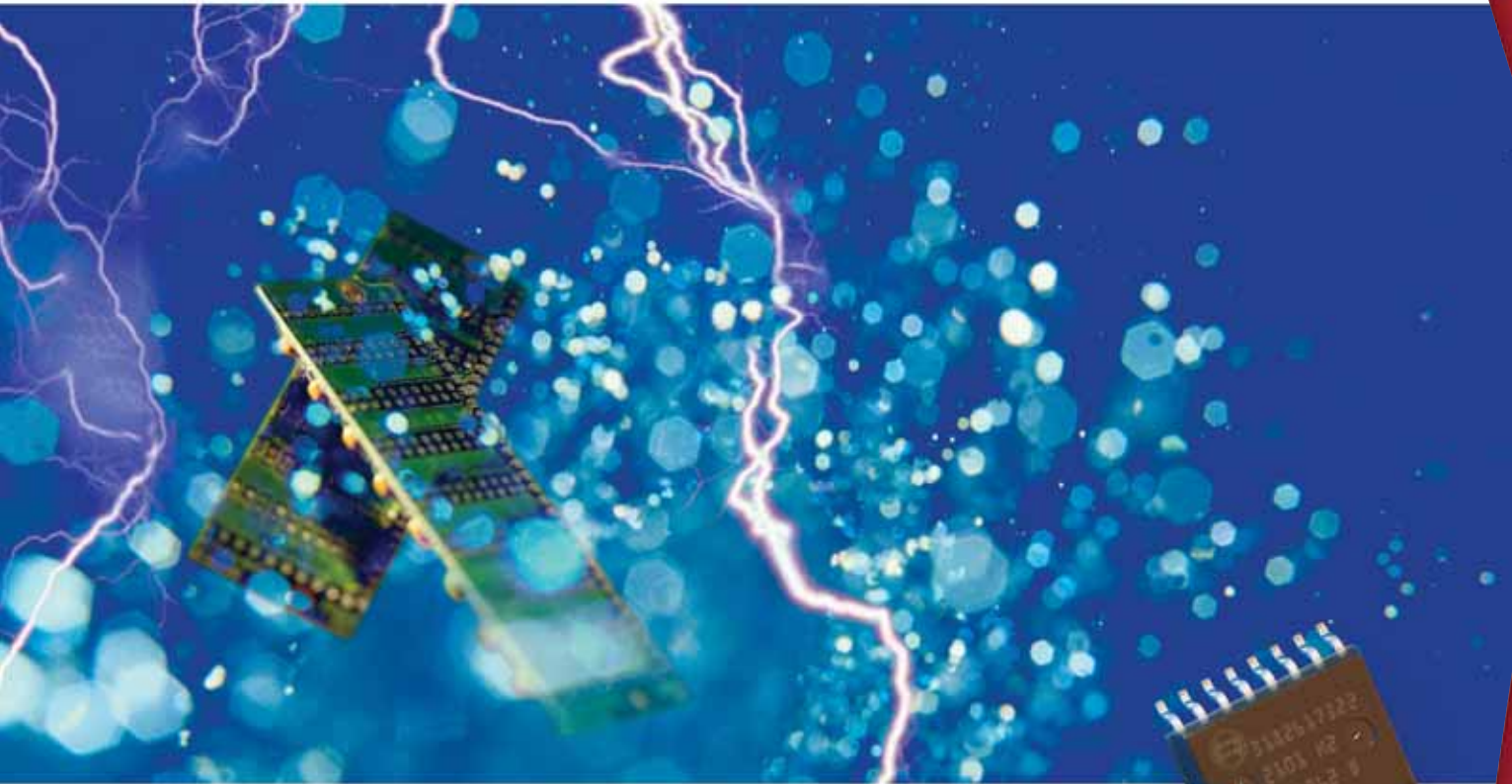
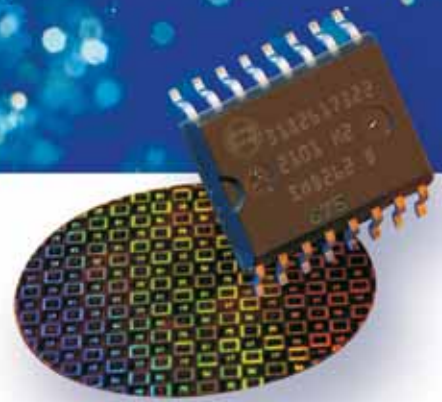




SPECIALTY COATING SYSTEMS™



Reliable protection for advanced electronics.



SCS ELECTRONIC COATINGS

Specialty Coating Systems is the global leader in delivering Parylene conformal coating solutions for advanced technologies. For more than three decades, customers have turned to SCS for the planning, developing, engineering and applying of thin-film Parylene polymer coatings to their critical components.

A team of the world's foremost Parylene specialists, strict quality control systems, and state-of-the-art coating facilities across the Americas, Asia and Europe ensure SCS customers receive the most innovative, precise and consistent coating processes . . . for components and applications where compromise is not an option.

No matter the end use, electronic components must meet a complex and exacting set of specifications to ensure reliability and a trouble-free life. SCS provides innovative solutions for protecting advanced technologies in many environments and industries, including electronics, automotive, military and medical.

### SCS Parylene Coatings

Ultra-thin and pinhole-free, SCS Parylene coatings offer exceptional properties for electronic component protection. SCS combines the properties of Parylene with its years of experience, vast technology and worldwide resources to provide Parylene coatings and services you can rely on, including Parylene HT<sup>®</sup>, specifically engineered to withstand the most extreme conditions in the industry.

The benefits of SCS Parylene coatings include:

- Excellent dielectric properties
- Excellent chemical, moisture and electrical barrier
- Biocompatible and biostable protection
- Ultra-thin, conformal coating of all exposed surfaces
- Excellent crevice and multi-layer penetration
- Thermal stability up to 450°C (short-term)
- Unparalleled ultraviolet stability

### Environment - Friendly Coatings and Processes

#### RoHS Compliance

Independent testing has certified that SCS Parylene coating services and dimer are in compliance with the European Union's Restriction on the use of Hazardous Substances (RoHS) in Electrical and Electronic Equipment Directive 2002/95/EC. Similar regulations exist in other countries as well.

Upon request, SCS will provide customers with RoHS Certificates of Compliance for its Parylene services, dimer and A-174 Silane products.

#### Tin Whisker Mitigation

As a result of the RoHS directive, pure tin plating is replacing lead in the tin-alloy solder used in the worldwide electronics industry. While safer for the environment, tin plating is known to form tin whiskers, which cause reliability problems for electronic systems. Parylene coatings suppress the formation of metallic whiskers, OSEs (odd shape eruptions) and dendrites. In a recent study<sup>1</sup>, various conformal coatings, including silicones, acrylic, urethane-acrylic and Parylene C, were evaluated. SCS Parylene C was the best of the tested coatings for suppressing OSEs and whisker formation. Please contact SCS to discuss Parylene's ability to mitigate tin whiskers.

### Parylene Coating Properties that Protect Dielectric Properties

SCS Parylenes have excellent dielectric properties. Their high dielectric strength is attributable to the fact that they can be formed as thin, continuous films, free from defects and the fillers commonly found in conventional coatings, both of which tend to reduce dielectric strength.

SCS Parylene HT has the lowest dielectric constant and dissipation factor and a high dielectric strength in comparison to industry standard coatings, enabling electrical signal transfer without absorption or loss.

#### Barrier Properties

SCS Parylene coatings are excellent moisture and chemical barriers. Applied in the micron range – much thinner than industry standard coatings – Parylene provides a superior pinhole-free, uniform barrier to protect against corrosive liquids, fluids, gases and chemicals, even at elevated temperatures.

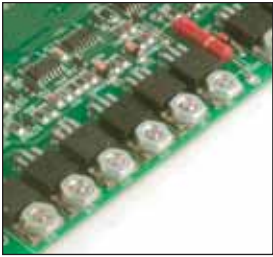
Circuit boards coated with SCS Parylene HT were salt-fog tested by an independent testing facility. The coated boards showed no corrosion or salt deposits after 144 hours of exposure in accordance to ASTM B117-(03) (See Figure 1). Boards coated with Parylene C exhibited similar results.

<sup>1</sup>Woodrow, T. A., and E. A. Ledbury, "Evaluation of Conformal Coatings as a Tin Whisker Mitigation Strategy," IPC/JEDEC 8th International Conference on Lead-Free Electronic Components and Assemblies, San Jose, CA, 2005.

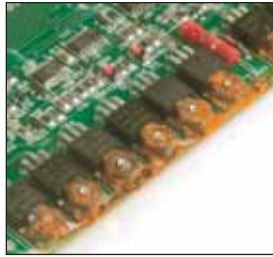
## Thermal Stability

Many components in the electronics, automotive, military and medical industries require thermal protection from extreme environments. SCS Parylene HT is specifically engineered to provide long-term thermal stability up to 350°C, with short-term stability up to 450°C, and is thus well-suited for applications that may be used in harsh automotive environments, medical sterilization processes or space applications, to name a few.

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



Coated with SCS Parylene HT



Uncoated

## Useful in Many Electronics Applications

SCS can apply Parylene coatings to virtually any surface material, including metals, resins, elastomers, plastics, ceramics and glass, in thicknesses ranging from a few hundred angstroms to several mils. Parylene polymerizes as a uniform, thin-film coating that conforms to all surfaces, edges and crevices of a substrate, including the interior of multi-layer electronic packages. As a result of its ultra-thin application, Parylene adds little dimension or mass to critical, weight-sensitive components. Additionally, Parylene does not require any solvents, catalysts or curing agents throughout the coating process.

We employ the unique properties of Parylene to provide specialized, conformal coating solutions to customers in a variety of industries, including:

### Electronics

SCS Parylene coatings are conformal and uniform, ensuring complete coverage of circuit boards, ferrite cores and other electronics packages, such as MEMS, labs on chips, electrowetting lenses, and boards used in metering applications. Parylene's outstanding penetration ability ensures total and uniform encapsulation of all components and crevices, with no meniscus, flowing or edge-effect flaws. SCS offers coating facilities with ISO 9001:2000 certifications to ensure quality processes and coatings.

### Automotive

Ultra-thin Parylene coatings protect critical automotive sensors, circuit boards and other electronic components from harsh chemicals, fluids and gases, as well as high temperatures encountered during prolonged use in automotive engines and

systems. SCS Parylene HT shows no degradation or discoloration after more than 2,000 hours of accelerated UV testing. SCS has many years of experience in automotive quality standards, including PPAP processes.

### Military/Aerospace

SCS Parylenes offer extreme tolerance of severe environments and are used in many military and aerospace applications, including equipment for international space programs. Parylene is also an excellent coating for electronics used in aerospace applications and military vehicles and equipment, to protect against elements such as dust, sand, moisture, and chemical and biological agents. SCS Parylenes are listed on the QPL for MIL-I-46058 and are also recognized as meeting the requirements of IPC-CC-830.

### Medical

SCS Parylenes protect medical electronic components from moisture, biofluids and biogases that can cause assemblies to fail prematurely. Such protection not only extends device life and prevents costly repairs, it also reduces the risk of failure at the most critical times.

Listed in the FDA's Biomaterials Compendium, SCS Parylenes provide an ideal surface modification for implantable medical devices such as cochlear implants, pacemakers and their components. The coating protects medical devices and components and serves as a biocompatible surface for tissue contact. SCS maintains US FDA Device and Drug Master Files that may be referenced in FDA submissions by SCS commercial coating service customers. The company also has ISO 14644 cleanroom facilities.

### SCS Parylene Services

SCS Parylene coatings are applied in a vacuum chamber via a vapor deposition polymerization (VDP) process. Components to be coated are required to have only a reasonable vacuum tolerance. There are no solvents, catalysts or plasticizers involved in the coating process and since Parylene deposition occurs at ambient temperatures, there are no associated cure stresses. Unlike Parylene coatings, other industry coatings may require catalysts, elevated temperatures or cure cycles to improve coating properties.

With advances in SCS' worldwide resources and technologies, Parylene coatings are cost-competitive and, in many cases, less expensive than traditional coatings. In addition to a proven track record of timely processing and delivery of customer parts, SCS has years of experience with industry quality standards.

Table 1		Method	Parylene HT	Parylene C	Parylene N	Acrylic (AR) <sup>a,b</sup>	Epoxy (ER) <sup>a,b</sup>	Polyurethane (UR) <sup>a,b</sup>	Silicone (SR) <sup>a,b</sup>
Dielectric Strength V/mil		1	5,400	5,600	7,000	3,500	2,200	3,500	2,000
Dielectric Constant	60 Hz	2	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	2	<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
Water Vapor Transmission Rate (g•mm)/(m <sup>2</sup> •day)		3, 4, 5	0.22	0.08	0.59	13.9 <sup>c</sup>	0.94 <sup>c</sup>	0.93 - 3.4 <sup>c</sup>	1.7 - 47.5 <sup>c</sup>
Water Absorption (% after 24 hours)		6	<0.01	<0.1	<0.1	0.3	0.05 - 0.10	0.6 - 0.8	0.1
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	-	-	-	-
UV Stability		7	≥2,000 hrs	≤100 hrs	≤100 hrs	-	-	-	-
Coefficient of Friction	Static	8	0.15	0.29	0.25	-	-	-	-
	Dynamic		0.13	0.29	0.25	-	-	-	-
Tensile Strength (psi)		9	7,500	10,000	7,000	7,000 - 11,000	4,000 - 13,000	175 - 10,000	350 - 1,000
Penetration Ability <sup>d</sup>			50 x dia.	5 x dia.	40 x dia.	Spray or Brush	Spray or Brush	Spray or Brush	Spray or Brush
Rockwell Hardness		10	R122	R80	R85	M68 - M105	M80 - M110	68A - 80D (Shore)	40A - 45A (Shore)
USP Class VI Polymer			Yes	Yes	Yes	Not All	Not All	Not All	Not All
Biocompatibility <sup>e</sup>			ISO 10993	ISO 10993	ISO 10993	NA	NA	NA	NA

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.

e. Contact SCS Marketing for specific results.

**Test Methods:**

1. ASTM D 149
2. ASTM D 150
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 570
7. ASTM G 154
8. ASTM D 1894
9. ASTM D 882
10. ASTM D 785

NA means not available or not applicable.

## Innovative solutions for advanced technologies.

Specialty Coating Systems leads the industry in providing Parylene solutions for our global customers' advanced technologies. SCS is a direct descendant of the companies that originally developed Parylene, and we have more than 35 years of experience and expertise that we leverage on every project for our customers – from the initial planning phases, to advanced engineering, to the development of application processes.

Our worldwide resources include highly experienced sales engineers, some of the world's foremost Parylene specialists, and expert manufacturing personnel, working in nine state-of-the-art coating facilities around the globe. In addition to Parylene services, we design and manufacture industry-leading Parylene deposition systems; liquid spray, dip and spin coating systems; ionic contamination test systems; and UV and thermal cure units. Our equipment is used in environments that range from university and research labs to high-volume production applications.

Our extensive and proactive approach to production and quality requirements – testing, validating, documenting and processing – provides our customers peace of mind and minimizes their resources needed to meet the most challenging industry specifications and quality requirements.

**RoHS**  
COMPLIANT



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