



SCS ELECTRONICS COATINGS

Reliable protection for advanced electronics.



SPECIALTY COATING SYSTEMS™

A KISCO Company



INNOVATIVE SOLUTIONS FROM THE LEADER IN PARYLENE

With over 45 years of experience in Parylene engineering and applications, Specialty Coating Systems (SCS) is the world leader in Parylene conformal coating technologies. We're a direct descendant of the companies that originally developed Parylene, and we leverage that expertise on every project – from initial planning to process application.

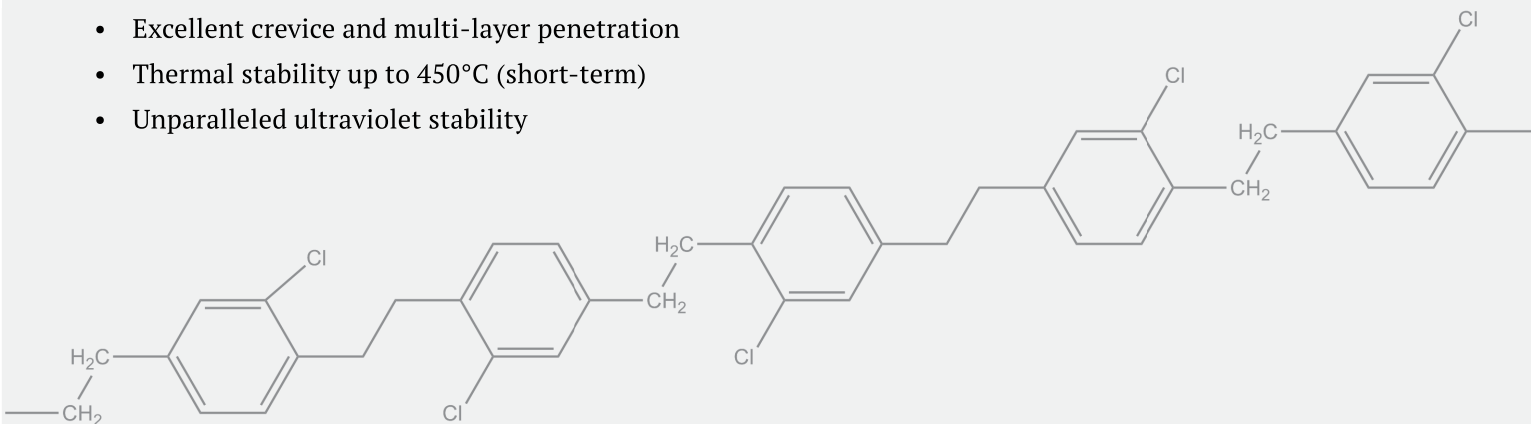
SCS employs some of the world's foremost Parylene specialists, highly experienced sales engineers and expert manufacturing personnel, working in state-of-the-art coating facilities in 12 countries worldwide. Our extensive, proactive approach to production and quality requirements gives our customers peace of mind and minimizes the resources they need to meet even the most challenging requirements and specifications.



SCS PARYLENE COATINGS

SCS combines the properties of Parylene with its years of experience, vast technology and worldwide resources to provide the electronics industry with reliable coatings and services, including Parylene HT[®], which is specifically engineered to withstand the most extreme conditions in the industry. Ultra-thin and pinhole-free, SCS Parylene conformal coatings offer exceptional properties, including:

- Excellent dielectric properties
- Excellent chemical and moisture barrier properties
- 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

SCS COMPLIES

As worldwide industry requirements and directives continue to evolve, SCS is at the forefront ensuring our products and services comply with relevant regulatory, environmental and biological standards.

SCS Parylenes comply with the European Union's RoHS (Restriction of Hazardous Substances) Directive. Additionally, SCS has lead-free, halogen-free and low VOC initiatives to support our customers. For more information about SCS certifications and standards, visit SCScomplies.com.

SCS PARYLENE COATING PROPERTIES

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 the defects and fillers commonly found in conventional coatings that tend to reduce dielectric strength.

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

THERMAL STABILITY

Many components in the electronics, automotive, avionics, military and medical industries require protection, especially when they encounter 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. The

METAL WHISKER MITIGATION

As a result of industry directives, pure metal plating is replacing lead in the solders used throughout the worldwide electronics industry. While safer for the environment, metal plating is known to form whiskers, which cause reliability problems for electronic systems. Parylene coatings suppress the formation of metallic whiskers, OSEs (odd shape eruptions) and dendrites.

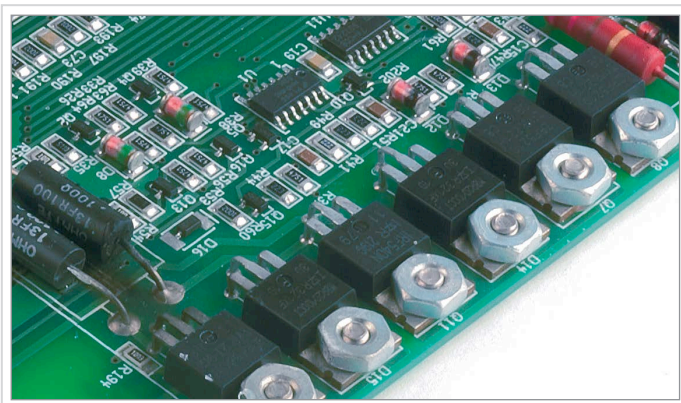
coating is well-suited for applications that may be used in harsh automotive environments, medical sterilization processes or space applications, to name a few.

BARRIER PROPERTIES

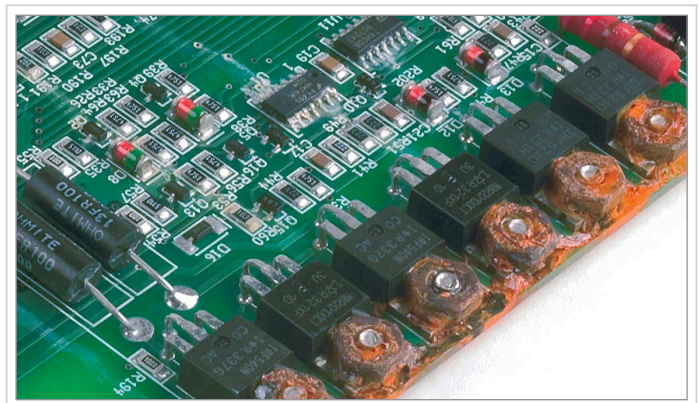
SCS Parylene coatings are excellent moisture and chemical barriers. Applied in the micron range — much thinner than industry standard coatings — Parylene provides a superior pinhole-free, uniform barrier to protect against corrosive liquids, fluids, gases and chemicals, even at elevated temperatures.

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.

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



Coated with SCS Parylene HT



Uncoated

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} |
|---|-------------------|-------------|------------|------------|-----------------------------|---------------------------|----------------------------------|------------------------------|
| Dielectric Strength V/mil | 1 | 5,400 | 5,600 | 7,000 | 3,500 | 2,200 | 3,500 | 2,000 |
| Dielectric Constant | 60 Hz | 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 | <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)/(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 |
| 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 | 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^d | | 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^e | | 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, 2005.

d. Depth into tubing and crevices.

e. Contact SCS Marketing for specific results.

Test Methods:

1. ASTM D149
 2. ASTM D150
 3. ASTM F1249 (at 100% RH, 38°C) (Parylene HT only)
 4. ASTM F1249 (at 90% RH, 37°C) (Parylene C only)
 5. ASTM E96 (at 90% RH, 37°C) (Parylene N only)
 6. ASTM D570
 7. ASTM G154
 8. ASTM D1894
 9. ASTM D882
 10. ASTM D785
- NA means not available or not applicable.

PROTECTION FOR ADVANCED ELECTRONICS

SCS can apply Parylene coatings to virtually any surface material, including metals, elastomers, resins, plastics and ceramics, 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.

SCS employs 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, LEDs, wafers, ferrite cores and other electronics packages, including MEMS, labs-on-chips and electrowetting technologies. Parylene’s outstanding penetration ability ensures total and uniform encapsulation of all components and crevices, with no meniscus, flowing or edge-effects. SCS offers coating facilities with AS9100 and ISO 9001 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, even withstanding high temperatures encountered during prolonged use in engines and systems. SCS Parylene HT shows no degradation or discoloration after more than 2,000 hours of accelerated UV testing. Additionally, SCS has extensive experience in automotive quality standards, including PPAP processes.

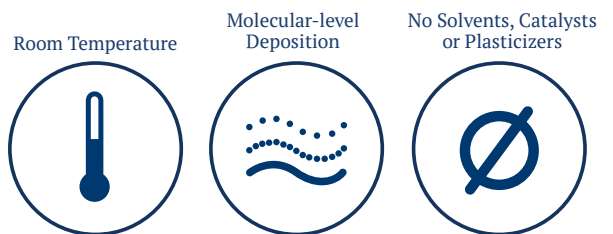
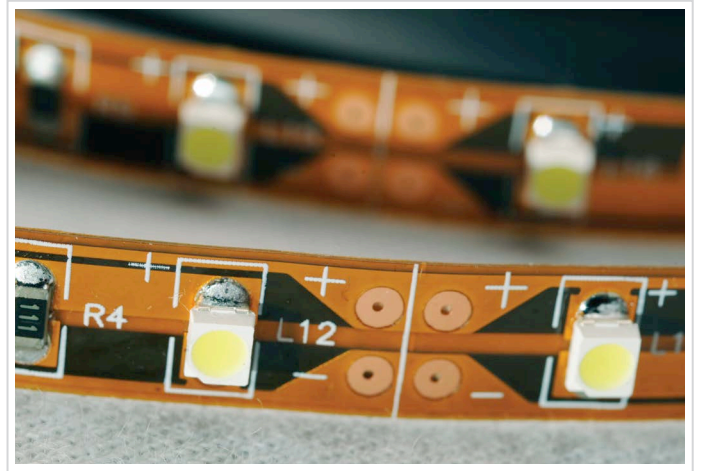
MILITARY/AVIONICS/AEROSPACE

SCS Parylenes offer durable protection in severe environments, being used in many military and aerospace applications, including equipment for international space programs. Parylene is also an excellent coating for electronics used in avionics 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 and devices from moisture, biofluids and biogases that can cause assemblies to fail prematurely. Such protection extends device life, prevents costly repairs and reduces the risk of failure.

SCS Parylenes provide an ideal surface modification for implantable medical devices such as cochlear implants, pacemakers and neurostimulation devices. The coating protects medical devices and components and serves as a biocompatible surface for tissue contact. SCS maintains U.S. FDA Device and Drug Master Files, which contain ISO 10993 biocompatibility data. These files are available for FDA reference on behalf of submissions made by SCS commercial coating service customers. The company also maintains ISO 14644 cleanroom facilities.



THE PARYLENE PROCESS

SCS Parylene coatings are applied in a room temperature vacuum chamber via a vapor deposition polymerization (VDP) process. Components to be coated are only required to have a reasonable vacuum tolerance. There are no solvents, catalysts or plasticizers involved in the coating process and, since Parylene coatings require no elevated temperature cure cycle, there are no associated cure stresses. Unlike Parylene coatings, conventional dipped, sprayed or brushed coatings may require catalysts, cross-linking, elevated temperatures or UV cure cycles to improve coating properties.



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