

PCT

P A R A - C O A T
T E C H N O L O G I E S



www.PCTconformalcoating.com



Capability Briefing

Para-Coat Technologies, Inc. is a full-service conformal coating provider specializing in the application of Parylene polymer coatings. Our goal is to provide each customer the highest quality products and services.

What sets PCT apart?

- Comprehensive range of applications
- Extensive knowledge of equipment
- Over 10 years of experience
- Fast 5-day turnaround
- Unparalleled technical support
- Quality assurance
- ESD program
- Competitive pricing
- 100% customer satisfaction

Standards that PCT adheres to:

IPC-A-610 Acceptability Standard
 IPC-HDBK-830 Conformal Coating Selection
 IPC-J-STD-001 End Items Standards
 IPC Class 3 High Performance Electronics

Parylene Application Examples:

Catheters	Stents	Plastic Encapsulated
Coils	O-Rings & Polymer Seals	Microcircuits
Cores	Silicon Wafers	Sensors
Bobbins	Optical Devices	Transducers
Fiber Optic Components	Wire Harness Assemblies	Circuit Boards
Heat Exchangers	Magnets	Hybrid Circuits
Implants/Pacemakers	Photoelectric Cells	Elastomeric Keypads
Needles	Electrosurgical Instruments	LED Assemblies

Certifications:

ISO 9001:2015 Registered
 ITAR Registered

Industries Served:

- Automotive
- Medical
- Aerospace/Military & Defense
- Electronics

Conformal Coating Services:

- Parylene (XY)
- Acrylic (AR)
- Polyurethane (UR)
- Silicone (SR)
- Epoxy (ER)

Additional Services Offered:

At PCT, our highly-experienced staff offers conformal coating services, Parylene equipment sales and consulting services. We are specialists in Parylene coatings.

DUNS: 022635807

Primary NAICS: 34418

CAGE: 65CD2

Parylene (Type XY)

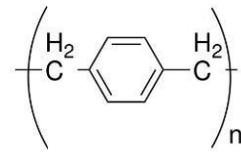
Parylene is a common generic name for a unique series of polymers based on paraxylene. The Parylenes are formed by the pyrolysis of a di-p-xylene (dimer) in a vacuum environment which is then deposited on the cooler, room temperature substrate within the vacuum chamber.

Parylene is applied in a vacuum as a gas that disperses evenly throughout the chamber to target surfaces the material forms as a clear polymer (plastic) film.

Para-Coat Technologies, Inc. offers two types of Parylene: Parylene N and Parylene C

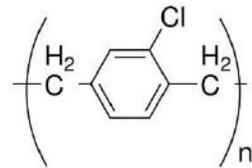
Parylene N

Parylene N is a completely linear, highly crystalline material. Parylene N is a primary dielectric, exhibiting a very low dissipation factor, high dielectric strength, and a low dielectric constant invariant with frequency. It is able to penetrate crevices more effectively than Parylene C because of the higher level of molecular activity that occurs during the deposition.



Parylene C

Parylene C is produced from the same raw material (dimer) as Parylene N, modified only by the substitution of a chlorine atom for one of the aromatic hydrogens. Parylene C deposits on substrates at a faster rate than Parylene N and is an excellent barrier with a useful combination of electrical and physical properties, plus a very low permeability to moisture and corrosive gases.



The Deposition Process:

Vaporization	Pyrolysis	Deposition
Dimer	Monomer	Polymer
<u>di-para-xylylene</u>	<u>para-xylylene</u>	<u>Poly-para-xylylene</u>
150°C, 1 torr	690°C, 0.5 torr	25°C, 0.1 torr



Parylene Coating for the Medical Industry

As medical devices become smaller and more compact, the use of Parylene coatings finds increasing value due to its molecular level deposition. Thin film, pinhole-free Parylene conformal coatings provide the ultimate protection for life-saving devices and instruments in the medical industry. Inert, vacuum deposited Parylene is biocompatible and biostable and offers excellent dry film lubricity, thermal stability, moisture, chemical and dielectric barrier protection. Additionally, Parylene is FDA-approved (with a USP XXII, Class VI biocompatibility rating) and is safe for use within the body.

- **Biocompatible**
- **Biologically stable**
- **Chemically inert**
- **Excellent dry film lubricity**
- **FDA-approved**
- **Non-toxic**
- **Resistant to fungal and bacterial proliferation**
- **Excellent dielectric properties**
- **Extremely lightweight**



Parylene Benefits for Medical Products

Parylene is the preferred choice of coatings for the protection of many types of medical products ranging from hearing aids, to pacemakers, nasal tubes, surgical hardware, and more. Parylene is an ideal barrier coating for medical products and devices.

Superior Protection. Parylene protects against moisture ingress on medical electronics. Parylene protects parts, hardware and electronics from contamination with blood and bodily fluids.

Biocompatible. Parylene is not rejected by the body's natural immune defense.

Dry-film Lubricity. Parylene is a dry film lubricant and reduces tackiness in elastomers. Parylene is a lubricious coating that is used extensively in medical guidewires, catheters and mandrels.

Ultra-thin and Truly Conformal. Parylene can be applied in such thin layers, and with such precise conformality, that it is a preferred coating for coronary and peripheral stents. Parylene can uniformly penetrate such small crevices that it can coat the inside diameter of drug delivery devices.

Chemical Resistant. Parylene is virtually impervious to harsh chemicals. It can withstand moisture, salts, and corrosive Sulphur compounds in the human ear.



Parylene Conformal Coating for Elastomers

- Dry film lubricity
- Pinhole-free barrier
- Truly conformal
- Thickness uniformity
- Thin, transparent and flexible
- Chemical and solvent resistance
- High surface bond strength



Coating Services for Elastomers

Parylene's ultra-thin, optically clear and flexible characteristics has been shown to enhance the performance of rubber and elastomer components by protecting surfaces and modifying surface properties. These improvements are made without degrading the functional performance of the part. Objects coated with this polymer film include a diverse range of rubber components, ranging from gaskets and seals to rubber keypads and medical catheters. Pinhole-free Parylene coating can prevent the transfer of substances into or out of a coated substrate, even in one or two micron layers. Due to its unique molecular structure, the parylene film barrier is practically insoluble in all known organic solvents up to 150 °C and extremely resistant to most of the inorganic reagents including strong acids and alkali. They are also effective barriers to corrosive agents.



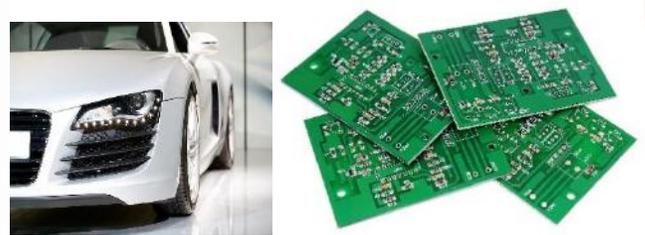
Dry-Film Lubricity, Elasticity, Barrier Resistance

Parylene's static and dynamic coefficients of friction allow coated elastomers to approach the dry-film lubricity of PTFE (Teflon). For example, tiny lead wires used inside flexible medical catheters must be both electrically insulated and chemically protected. The excellent dry-film lubricity of Parylene coating allows such surfaces to move easily in tight quarters. The external surfaces of rubber catheters also benefit functionally from the coating's lubricity. Parylene polymer tends to eliminate surface tack and stickiness without adding stiffness which is a useful property for items such as rubber keypads used on calculators, cell phones and other devices. In the case of keypads, the coating prevents dirt and oils from penetrating the elastomer surface, protects printed legends, and preserves keypad appearance.



Parylene Protective Coating for Electronics

- Military & Defense
- Consumer Electronics
- Wearable Technology
- Printed Circuit Boards
- Aerospace
- Automotive
- Medical
- LEDs



Protecting Advanced Electronic Devices

The electronics industry covers the widest selection and diversity of products, often overlapping with other industry specialties and categories such as Aerospace, Automotive, Military/Defense, Medical, Wearable Technology, Printed Circuit Boards (PCB) and LEDs. State-of-the-art protection is required for their advanced electronics to ensure improved functionality and reliability, and extended life under the harshest conditions. The unique properties of Parylene make it the most effective conformal coating offering the highest level of protection for a wide range of applications to a variety of industries.

Superior Barrier Properties

Parylene conformal coatings are capable of protecting electronics from environmental conditions that can hinder circuit performance and promote premature failure. Pinhole-free Parylene coating offers excellent crevice penetration, ideal barrier and insulating properties, high thermal and UV stability. Parylene provides protection against moisture, corrosive liquids, chemicals and solvents.

Excellent Dielectric Properties

Parylene has excellent dielectric strength because of its ability to form a thin, transparent film free from defects and fillers commonly found in conventional coatings that tend to reduce dielectric strength. Parylene's extremely high dielectric strength provides unique insulating properties and a low dielectric constant that is independent of frequency.



Commitment to Excellence!

Para-Coat Technologies, Inc. was established in 2010. We are an ISO 9001:2015 and ITAR certified manufacturer service provider specializing in the application of Parylene, Acrylic, Polyurethane, Silicone, and Epoxy conformal coatings. PCT conformal coatings find wide-ranging application in medical, electronic, automotive, military & aerospace industries. We are committed to providing consistent, quality service at a competitive price to ensure that we meet and/or exceed our customers' expectations.



Product Handling & ESD Precautions

PCT currently occupies a 15,000 square foot ESD protected facility located in Johnstown, Pennsylvania. Our responsible personnel adhere to ESD precautions at all times to be performed in accordance with IPC-J-STD-001. All assemblies are properly handled, thoroughly inspected and tracked through a fully documented production process. A 100% visual inspection is performed and coating thickness is measured to ensure and maintain the highest quality possible.



Experienced Staff & Fast Turnaround

Our experienced staff and proven process can accommodate all types of orders from full production to small engineering runs. We offer a fast 2-5 business day turnaround time for most orders (standard turn time for most businesses is 10 days). For those time-sensitive orders, we offer an expedited service in as little as 1 day depending upon the complexity and quantity.



Continuous Improvement

PCT is committed to continuously improve and grow while making the necessary investments to make sure we meet customers' conformal coating demands and requirements. We take pride in being a seamless extension to your manufacturing process.

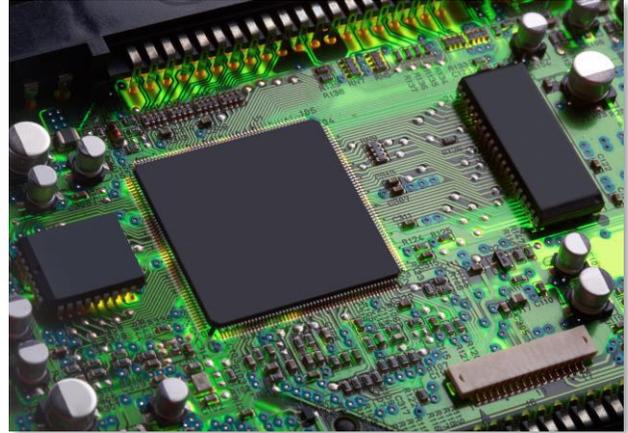


We Are The Conformal Coating Specialists!

Parylene Dimer Sales and Consulting Services

Para-Coat Technologies, Inc. offers Parylene dimer sales and consulting services.

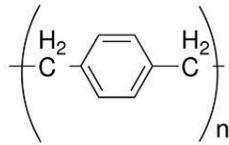
The purity of dimer is the most important part of selecting a raw material supplier. When the dimer contains less contaminant, a greater quality and more uniform film is achieved. PCT's dimer is 99% + pure and results in shorter, more efficient run times. We provide two types of high quality dimer, N and C, in various quantities and competitive pricing.



Parylene N and C supplied by PCT comply with USP biological testing requirements for Class VI plastics.

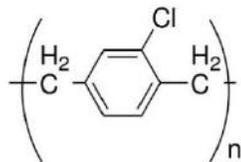
Parylene N

Type N Parylene provides particularly high dielectric strength, lower coefficient and very low permeability to corrosive gases.

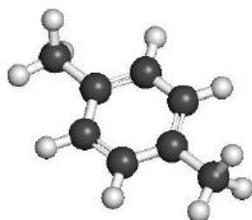


Parylene C

Type C Parylene is the most widely used and has a useful combination of electrical and physical properties.



If you operate your own Parylene coating equipment, PCT can provide you with high quality dimer at a competitive price.



Typical Features of the Parylene Film

- High gas barrier properties (H₂O, O₂, etc.)
- Exceptional rust prevention
- Strong resistance to solvents, acids and alkalis
- Excellent electrical properties of insulation and low dielectric constant
- Excellent mechanical properties at super low temperature
- Low out-gassing

Parylene General Properties/Benefits

- MIL-I-46058C, Type XY approved
- FDA approved—USP XXII, Class VI bio-compatibility rating
- UL Listed
- Completely pin-hole free barrier coating
- Fully conformal on any type of surface material or design
- Inert transparent polymer
- Meets NBC requirements (AR70 / AFR80 / Navinst 3400.2)
- Barrier to oxygen, moisture, chemicals, solvents, and carbon dioxide
- Thermal mechanically stable between -200°C and 150°C
- Extremely high dielectric 5,000 volts per 0.001” minimum
- Excellent adhesion properties
- Low stress coating that does not form sites prone to crack initiation
- Low / minimal impact on package cooling
- Hydrophobic
- Barrier to ionic and moisture species
- Chemical and fungal resistance
- Non-contaminating coating and coating process – no solvents, catalysts or other by-products are introduced during coating application
- Entire process is accomplished at room temperature, alleviating temperature stress
- Particle encapsulation / immobilization
- No outgassing (NASA approved)



Data Obtained following appropriate ASTM methods

Typical Mechanical Properties	Parylene N	Parylene C
Tensile Strength, psi	6,500	10,000
Tensile Strength, MPa	45	69
Yield Strength, psi	6,300	8,000
Tensile Strength, MPa	43	55
Tensile Modulus, Mpa	2,400	3,200
Elongation at break, %	40	200
Yield elongation, %	2.5	2.9
Density, g/cm ³	1.110	1.289
Coefficient of friction:		
Static	0.25	0.29
Dynamic	0.25	0.29
Water Absorption: % (24hr)	0.01 (0.019")	0.06 (0.029")
Index of refraction	1.661	1.639

Typical Electrical Properties	Parylene N	Parylene C
Dielectric strength, short time (Volts/mil at 1 mil)	7,000	6,800
Volume resistivity 23°C, 50% RH (Ohm-cm)	1x10 ¹⁷	6x10 ¹⁶
Surface resistivity, 23°C, 50% RH (Ohm)	10 ¹⁵	10 ¹⁵
Dielectric constant:		
60Hz	2.65	3.15
1,000Hz	2.65	3.10
1,000,000Hz	2.65	2.95
Dissipation factor:		
60Hz	0.0002	0.020
1,000Hz	0.0002	0.019
1,000,000Hz	0.0002	0.013

Typical Barrier Properties	Parylene N	Parylene C
<i>Gas Permeability</i>		
cm ³ - mil/100in ² - 24hr - at(23°C)		
Nitrogen	7.7	0.95
Oxygen	30	7.1
Carbon Dioxide	214	7.7
Hydrogen Sulfide	795	13
Sulfur Dioxide	1.89	11
Chlorine	74	0.35
<i>Moisture Vapor Transmission</i>		
g - mil/100in ² - 24hr, 37°C, 90%RH	1.50	0.14
1mil = 1/1000in = 25.4 microns		

Typical Thermal Properties	Parylene N	Parylene C
Melting Temperature (C°)	410	290
Linear Coefficient of expansion (10 ⁻⁵ /°C)	6.9	3.5
Thermal conductivity, @ 25°C watts/Meter. Kelvin	0.120	0.082

(Acids, Alkalis and Solvents)

Swelling (Thickness change, %) on immersion in various chemicals for 10-16 μ m thickness film. (Typical values only)

Chemicals	Immersing Condition	Parylene C		Parylene N		Typical Values	
						Epoxies	Urethanes
Hydrochloric acid 10 %	75 / 120min	A	-0.28	A	+0.08	B ~ C	C ~ D
Sulfuric acid 10 %	75 / 120min	A	-0.28	A	+0.07	A ~ B	C ~ D
Nitric acid 10 %	75 / 120min	A	-0.28	A	+0.15	D	D
Hydrofluoric acid 10 %	50 / 120min	A	+0.09	A	+0.37	B	D
NaOH solution 10 %	75 / 120min	A	-0.28	A	+0.15	A ~ B	B ~ C
NH4OH solution 10 %	75 / 120min	A	-0.38	A	+0.15	A	B ~ C
Hydrogen peroxide water (H2O2)	50 / 120min	A	0.00	A	0.00	C ~ D	C ~ D
n-Octane	75 / 120min	A	+0.28	A	+0.29	C	B
Toluene	75 / 120min	A	+1.32	A	+0.30	C	C
Monochlorobenzene	75 / 120min	A	+1.04	A	+0.37	D	
Pyridine	75 / 120min	A	+0.28	A	+0.29	D	C
2-Propanol (IPA)	50 / 120min	A	0.00	A	+0.07	C	B
Acetone	50 / 120min	A	-0.09	A	+0.15	C ~ D	C

A- Excellent Resistance B- Good Resistance C- Possible to Use with Difficult D- No Good to Use
[Typical Values of Epoxies and Urethanes are not tested by the same condition, but reference only]



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