



comelec

PARYLENE COATING



## THE EUROPEAN SPECIALIST AND LEADER IN PARYLENE COATING

A Swiss company created in 1979 offering a technological solution to a demand arising from the highly demanding watch industry, Comelec has grown its reputation over the years thanks to our expertise and the high quality of our services. By focusing all our resources and skill on the development and use of Parylene coating, we have become the European leader in the field.

Seeking to better meet the specific needs of an extremely extensive range of applications for Parylene, we continue to expand our services based on a spirit of partnership with each of our clients.

Our proficiency in plasma technologies makes new applications possible in diverse cutting-edge industries such as microelectronics or medical technologies.

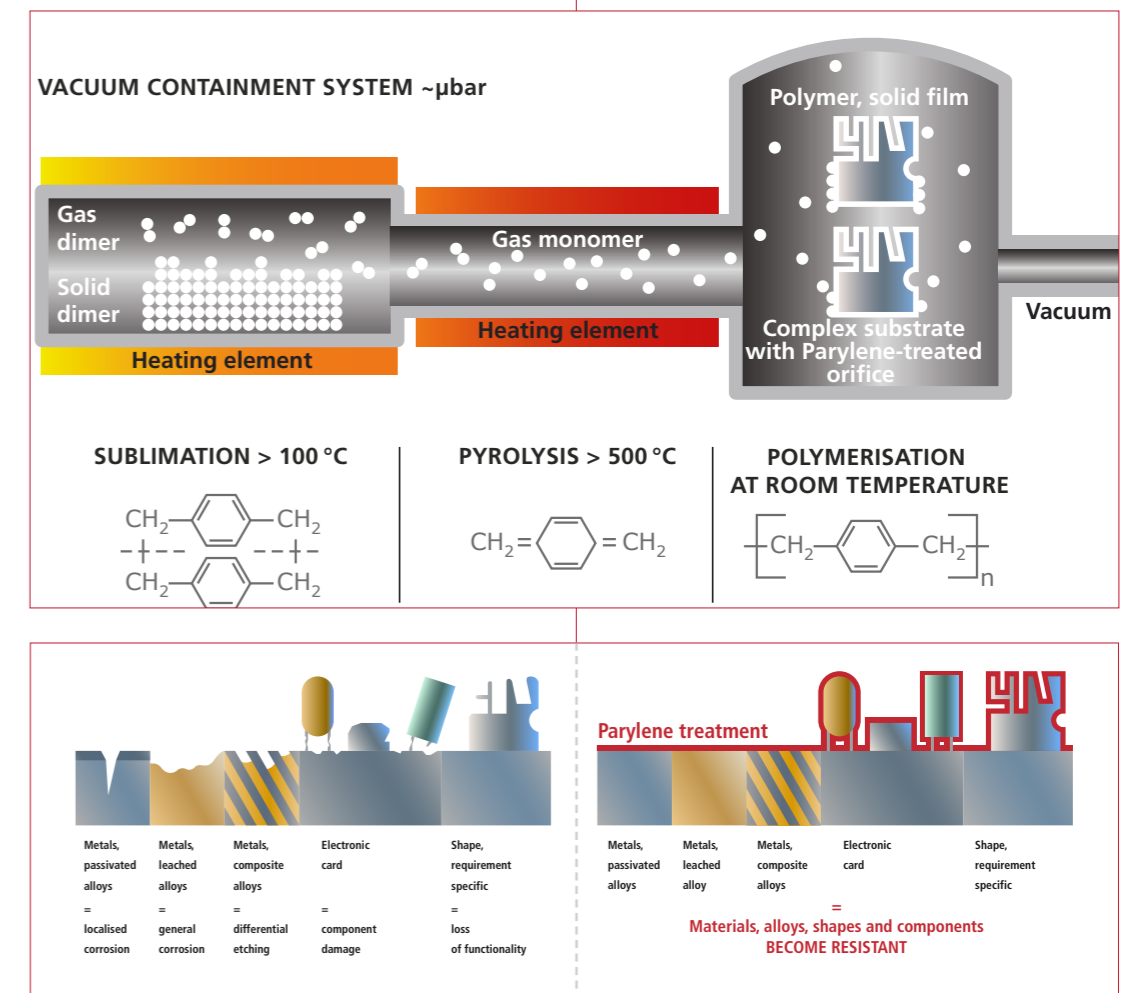
**PARYLENE FILM  
IS THE ONLY ONE  
OF ITS KIND TO CONTAIN  
ALL THE CHARACTERISTICS  
THAT MAKE IT  
AN EXCEPTIONAL COATING SOLUTION :**

**GENERAL APPEARANCE:** Parylene is the generic name for a family of polymers with more than 20 variations. Only five of these are widely used. Thanks to its excellent mechanical, electrical and physicochemical properties, Parylene is used in a wide range of cutting-edge sectors. In contrast to other protective coatings which are painted, immersed or pulverised on a substrate, Parylene is applied using a process of evaporation in a vacuum chamber. During this process, a precursor called a "dimer" which comes in powder form, is heated at around 150°C. The dimer thus goes from a solid state to a gas (sublimation). The following step involves splitting the dimer into two active monomers. This separation occurs at 650°C in a tubular oven. Upon arrival in this chamber, the gaseous monomer spontaneously polymerises when it comes into contact with the substrate. Finally, gases that have not reacted are caught in a liquid nitrogen trap between -90 °C and -120 °C. The process uses neither a catalyser nor toxic additives and has a conversion rate of nearly 100 %.

Parylene is a highly technical coating that is ultra-thin and transparent, physically and chemically neutral, inert, biocompatible, insulating and protective, of a thickness that can be sized both easily and precisely (from 50 nm to 100 microns). It is totally uniform, pinhole-free and can be applied to small technical components. One of its most remarkable advantages is its form-fitting and penetrating nature.

The combination of these qualities make it an extremely interesting player in the most demanding technological fields, including electronics, micro-electronics, space and aeronautics, medical technologies, pharmacology (elastomers, silicone and plastics), sensors and mems, nanotechnologies, micromechanics, magnets and ferrites.

**TECHNICAL PROPERTIES:** the process of vacuum deposition at room temperature endows this coating with unparalleled characteristics. It is free of any internal stress. Due to its extreme power of penetration, it conforms perfectly to even the most complex-shaped objects with a constant thickness (perfect conformability). Its thickness can be easily adjusted in a range of 50 nm to more than 100 µm. Its significant physicochemical inertia and the continuity of film, even in minimal thicknesses (less than 100 nm on Wafer Si), leads to it being used primarily as an insulating coating (for an aggressive and/or electric environment). It offers highly effective protection against humidity or hostile environments (such as for sensors) and is resistant to all solvents, acids and bases at room temperature. As it is biocompatible and resistant to scratches as well as to various sterilisation processes, it is an ideal candidate for medical packaging.





**ELECTRONICS, MICROELECTRONICS AND OPTRONICS**

- Certified approved under MIL-I-46058C and IPC-CC-830 specifications.
- Excellent electrical insulator.
- Protects against moisture and hostile environments.
- Highly resistant to solvents, acids, and bases.
- Form-fitting coating: protection for projecting parts and sharp edges.
- Deposition process takes place at room temperature.
- Applied without solvents or other additives, no pollution.
- Film is pinhole-free, no internal stresses.
- Mechanical reinforcement (welds, bonding, maces etc.).
- Immobilises particles of sintered materials.
- Optical and acoustic properties superior to conventional polymers.
- Flexible film that can be used as a substrate.



**SPACE AND AERONAUTICS**

- Ultrathin film that generates a slight overload.
- Encapsulation and environmental protection.
- Excellent dielectric properties.
- Thermochemical behaviour.
- Insignificant degassing/outgassing (NASA and ESA-approved).
- Reliable, configurable deposition process.
- Vibration resistant.



**MEDICAL TECHNOLOGIES**

- Biocompatible and bio-stable: FDA certified according to ISO 10993 and film certified USP Class VI.
- Completely form-fitting, uniform, and pinhole-free, and thickness can be adjusted.
- Very chemically resistant.
- Excellent electrical insulator.
- Single-component film with no solvents, catalysts, or additives.
- Clean, manageable implementation process.
- Very good sterilisation behaviour.
- Very low permeability to gases and water vapour.
- Low coefficient of friction, hydrophobic nature.
- Favours tissue fixation.
- Anti-microbial properties.



**PHARMACOLOGY, ELASTOMERA, SILICONE AND PLASTICS**

- Non-reactive, inert, pinhole-free barrier.
- Very high chemical resistance.
- Low coefficient of friction, hydrophobic (configurable).
- Clean, manageable implementation process.
- Single-component film with no solvents, catalysts, or additives.
- Biocompatible: FDA-certified (USP Class VI Package), ISO 10993.



**SENSORS AND MEMS**

- Excellent dielectric properties (permittivity, bulk resistance, tg, ...).
- Barrier against aggressive environments.
- Film transparent to a wide range of wavelengths.
- Ultrathin, form-fitting, uniform, and pinhole-free coating.
- Unrivalled ability to penetrate and encapsulate.
- Process does not alter elements.



**FOOD AND COSMETIC**

- Food contact approval : FDA, EU 10/2011 et USP Class VI.
- Very good barrier propertie against vapour, flavour and gas.
- Hydrophobic and non-adhesive properties.
- Low friction coefficient.
- Transparent layer with high purity (catalyst free, plasticizer free,...).
- Chemical protection against aggressive formulations.
- Excellent sterilisation behaviour.



**NANOTECHNOLOGIES**

- Layer with excellent dielectric properties (permittivity, tg, ...).
- Sacrificial layer.
- Layer with unusual optical behaviour.
- Final encapsulation.
- Protection from nanoparticles.



**MICROMECHANICS**

- Transparent film of adjustable thickness.
- Excellent dielectric properties (permittivity, tg, ...).
- Tribological properties: low friction coefficient, solid lubricant.
- Environmental barrier.
- Fully configurable deposition process.



**MAGNETS AND FERRITES**

- Unequaled ability to encapsulate.
- Excellent electrical insulator.
- Barrier against harsh environments (low permeability, chemical resistance).
- Mechanical reinforcement for sintered materials.
- Layer with excellent dielectric properties (permittivity, tg, ...).
- Layer with unusual optical behaviour.
- Final encapsulation.



**OTHER**

- Finishing layer with specific surface properties.
- Protection for fragile elements and art objects (conservation).

## PARYLENE TREATMENT



Treatment services are our main business. We treat your items in a controlled environment meeting your specifications. We guarantee customised, optimal surface activation. Comelec has a machine pool with various chamber sizes allowing us to meet clients' requirements for trials or for large-scale production. Based on your needs, we offer five types of Parylene ranging from the simplest chemical structure to fluorinated Parylene resistant to high temperatures. Comelec has short turnaround times for treatment services. The standard time frame is ten business days, with expedited service available upon request. All parameters and operations are recorded for each treatment to ensure complete traceability in line with our quality management system.

## MASKING AND UNMASKING



This activity is key to achieving the service. Our qualified staff offer a high-precision, high-quality service on a wide range of products. We undertake to define the best masking/unmasking technique, to design and produce the tools required and to adapt our solutions according to regulatory requirements. Comelec masters most technologies allowing removal of Parylene using chemical or physical means.

## PLASMA TREATMENT



Comelec has plasma systems that enable it to improve adhesion of the Parylene coating to some substrates, or to alter the surface energy of Parylene (and many other materials) so as to make it either hydrophilic or hydrophobic. Other possibilities are also offered such as the deposition of a thin inorganic layer or grafting of active molecules. Plasma may be in situ (in the same deposition chamber as the actual Parylene) or ex situ (on a separate chamber). Not only does Comelec have the necessary resources to provide you with service and advice; we also have the plasma equipment best suited for your application.

## EQUIPMENT CONSTRUCTION



As both users and designers, we build equipment that is easy to use, fast, and simple to maintain. Our machines are CE certified and guarantee excellent repeatability. They record deposition parameters for traceability purposes. Our key strength is offering standard Parylene coating equipment to which a plethora of options can be grafted, resulting in a unique production or development tool adapted to product scalability requirements. Our equipment has been tried and tested in various industrial sectors, in the clean rooms of cutting-edge industries, and in top European research centres. Comelec provides both custom start-up of the machines at your production site, and after-sales service. This equipment is delivered all over the world through a distributor network.

## CONSULTING



With a wealth of nearly 40 years of expertise, and an active research and development department, Comelec offers technical consulting, assistance in implementing and optimising treatment in your production chain and the construction of customised equipment incorporating advanced functionalities.

## SALE OF RAW MATERIAL



Comelec is also a distributor of dimers, used in N-, C-, and D-type Parylene films. Dimers are available as a fine powder packaged in 500g boxes.

PROPERTIES	Method ASTM	Units	Biocompatible	
			Parylene C	Parylene N
■ Density	D1505	g/cm <sup>3</sup>	1.289	1.10 - 1.12
■ Refractive index	Abbe refra.	n <sub>D</sub> <sup>23</sup>	1.639	1.661
■ Refractive index to the square	-	-	2.69	2.76
■ Penetration power	Exp.	-	5x	40x
<b>Mechanical</b>				
■ Tensile modulus	D882	GPa	3.2	2.4
■ Yield strength	D882	MPa	55	42
■ Tensile strength	D882	MPa	70	45
■ Yield elongation	D882	%	2.9	2.5
■ Elongation to break	D882	%	-	10-30
■ Rockwell hardness	D785	-	R80	R85
■ Coefficient of friction - static	D1894	-	0.29	0.25
■ Coefficient of friction - dynamic	D1894	-	0.29	0.25
<b>Thermal</b>				
■ Melting point	DSC	°C	290	420
■ Glass transition temperature	DSC	°C	13-80	35-80
■ Continuous Service Temperature during 100,000h	-	°C	80	60
■ Continuous Service Temperature during - 1,000h	-	°C	115	95
■ Linear coefficient of expansion to 25 °C	TMA	K <sup>-1</sup>	3.5·10 <sup>-5</sup>	6.9·10 <sup>-5</sup>
■ Calorific value at 25 °C or 20 °C SCS	-	J/(g·K)	1/0.712	1.3/0.837
■ Thermal conductivity	C177	W/(m·K)	0.084	0.126
<b>Electrical</b>				
■ Dielectric constant - 60 Hz	D150	-	3.12	2.65
■ Dielectric constant - 1 kHz	D150	-	2.98	2.65
■ Dielectric constant - 10 kHz	-	-	-	-
■ Dielectric constant - 100 kHz	-	-	-	-
■ Dielectric constant - 1 MHz	D150	-	2.91	2.65
■ Dielectric constant - 1 GHz	-	-	2.81	-
■ Dissipation factor - 60 Hz	D150	-	0.023	0.0002
■ Dissipation factor - 1 kHz	D150	-	0.017	0.0002
■ Dissipation factor - 10 kHz	-	-	-	-
■ Dissipation factor - 100 kHz	-	-	-	-
■ Dissipation factor - 1 MHz	D150	-	0.013	0.0006
■ Dissipation factor - 1 GHz	-	-	0.001	-
■ Dielectric strength at 25µm - short-term voltage upsurge	D149	MV/m	220-250	280
■ Dielectric strength at 25µm - Stepwise voltage increase	D149	MV/m	185	235
■ Breakdown voltage DC at 1 µm	-	V	~ 1100	~ 500
■ Breakdown voltage DC at 10 µm	-	V	~ 3500	~ 4000
■ Breakdown voltage DC at 25 µm	-	V	~ 5500-6250	~ 7000
■ Volume Resistivity at 23 °C, 50 % RH	D257	Ω·cm	2.2·10 <sup>15</sup>	1.4·10 <sup>17</sup>
■ Surface Resistivity at 23 °C, 50 % RH	D257	Ω	6.9·10 <sup>16</sup>	1.0·10 <sup>13</sup>
<b>Barriers</b>				
■ Water absorption (after 24h)	D570	%	< 0.1	< 0.1
■ Water vapour transmission at 38 °C and 100 % relative humidity	F1249-06	g.mm.m <sup>-2</sup> .J <sup>-1</sup>	0.1	0.75
<b>Gas permeability at 25 °C</b>				
■ N <sub>2</sub>	D1434 F3985-05	cm <sup>3</sup> .mm / m <sup>2</sup> .j.bar	0.4	3.00
■ O <sub>2</sub>	D1434 F3985-05	cm <sup>3</sup> .mm / m <sup>2</sup> .j.bar	2.9	15.2
■ CO <sub>2</sub>	D1434 F3985-05	cm <sup>3</sup> .mm / m <sup>2</sup> .j.bar	3.1	86
■ H <sub>2</sub>	D1434 F3985-05	cm <sup>3</sup> .mm / m <sup>2</sup> .j.bar	42	220
<b>Degassing / Outgassing</b>				
■ Total mass loss (TML)	E 595	%	0.13-0.28	-
■ Collected Volatile Condensable Materials (CVCM)	E 595	%	0-0.03	-
■ Water Vapour Regained (WVR)	E 595	%	0-0.02	-



## OUR ASSETS

- 40 years of expertise.
- The quality of our services.
- A dynamic team focused on innovation.
- A listening ear to ensure customer satisfaction.
- Our position as the leader in our field.
- Continuous improvement of working methods.

Though modestly sized, COMELEC offers big-time quality thanks to the commitment and accountability of all its employees, each of whom is highly qualified in specific skill areas. This characteristic, along with our ability to listen to our customers' needs, enables us to be highly responsive and a model of flexibility.

The high quality and reproducibility of our Parylene coatings are ensured through compliance with our Quality Management System procedures (ISO 9001-2015 certified).

We are easily accessible, being strategically located in Switzerland, the heart of Europe.

## PROPERTIES OF PARYLENE

- Conformity and uniformity of thickness.
- Ultra-thin and pinhole-free.
- Hermeticity and chemical inertia.
- Electric insulating layer.
- Heat resistant.
- Biocompatible.

## APPLICATIONS

- Electronics, microelectronics and optronics.
- Space and aeronautics.
- Medical technologies.
- Pharmacology, elastomers, silicone and plastics.
- Sensors and MEMS.
- Food and cosmetic.
- Nanotechnology.
- Micromechanics.
- Magnets and ferrites.

## SERVICES

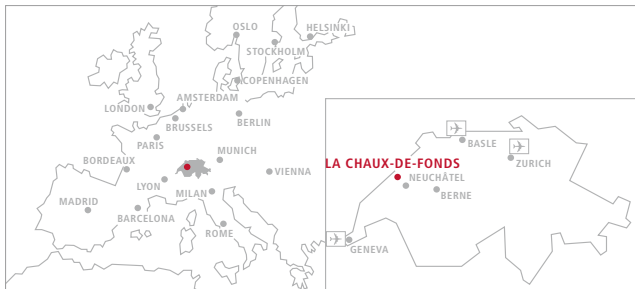
- **Treatment:**  
our key activity in a controlled environment meeting your specifications.
- **Consulting:**  
40 years of expertise.
- **Equipment:**  
reliable, easy to use and maintain.
- **Sale of Parylene raw materials.**

PARYLENE IS CERTIFIED ACCORDING TO THE FOLLOWING STANDARDS AND DIRECTIVES:



# comelec

PARYLENE COATING



Comelec SA - Rue de la Paix 129 - CH-2301 La Chaux-de-Fonds  
Tel. +41 32 924 00 04 - Fax +41 32 924 00 03 - admin@comelec.ch

**w w w . c o m e l e c . c h**