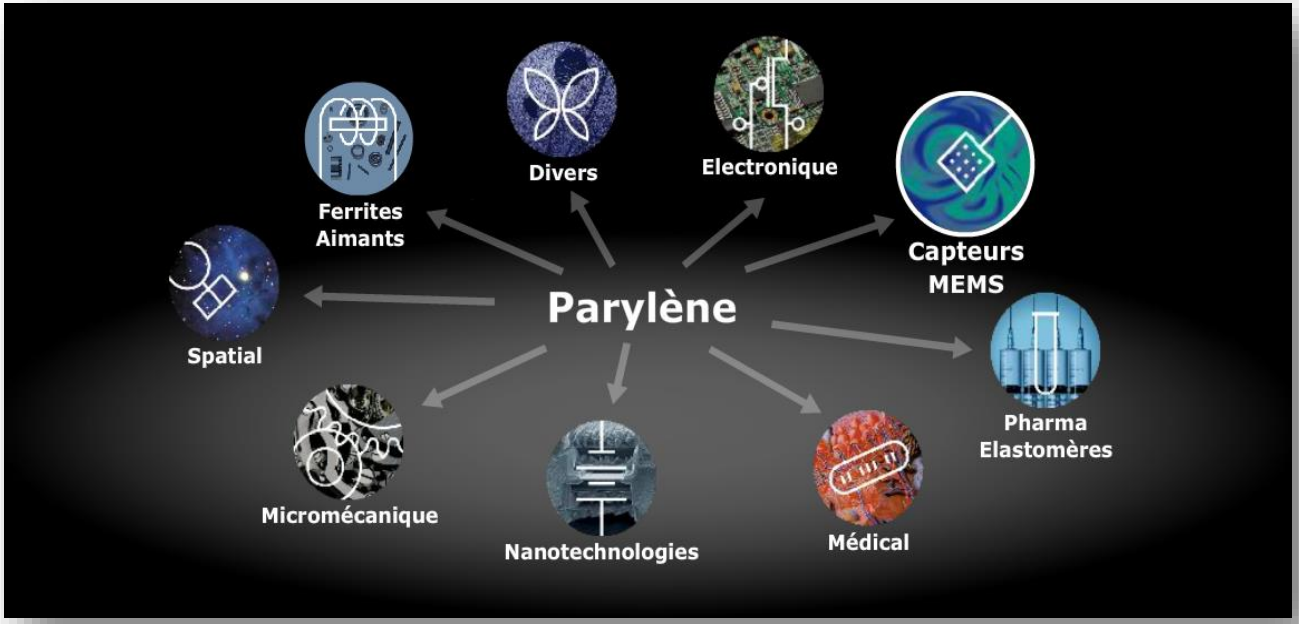
Comelec general presentation

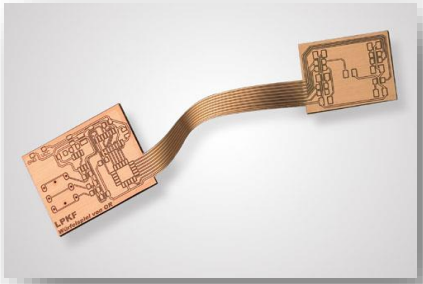
Comelec field of expertise and certifications



key requirements for an effective advanced packaging

General requirements :

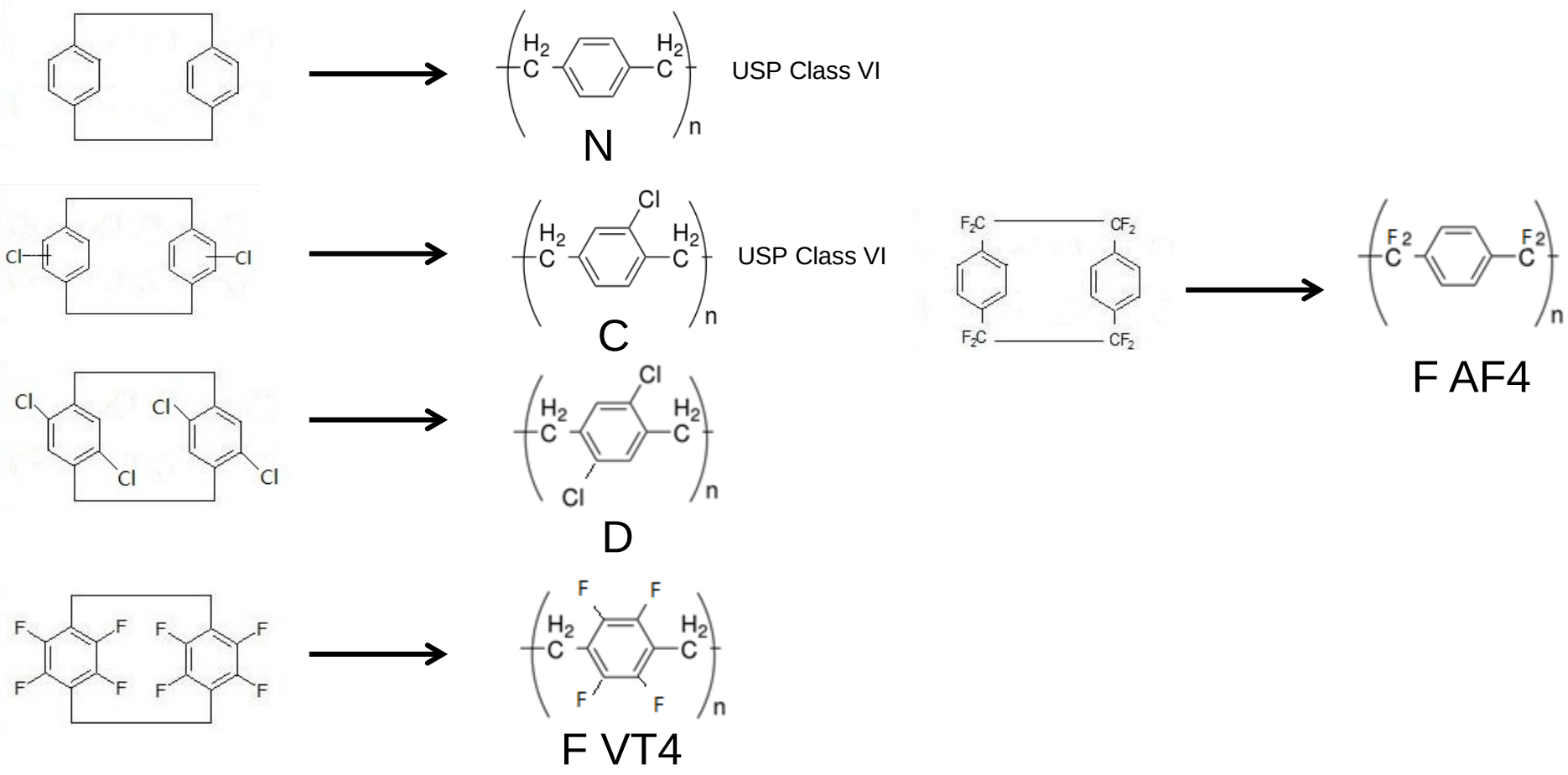
- Conformability even for micro/nanosystems
- Physical and chemical barrier
- Low water vapor permeability
- Adhesion to numerous substrates
- Higher operating temperature
- Low outgassing
- Transparency (for optical devices)
- low CTE
- Low permittivity
- High dielectric strength
- Low friction coefficient
- Biocompatibility
- Biostable
- Sterilization compliant
- Industrial and government compliance (USP, FDA, …)



Parylene technology understanding

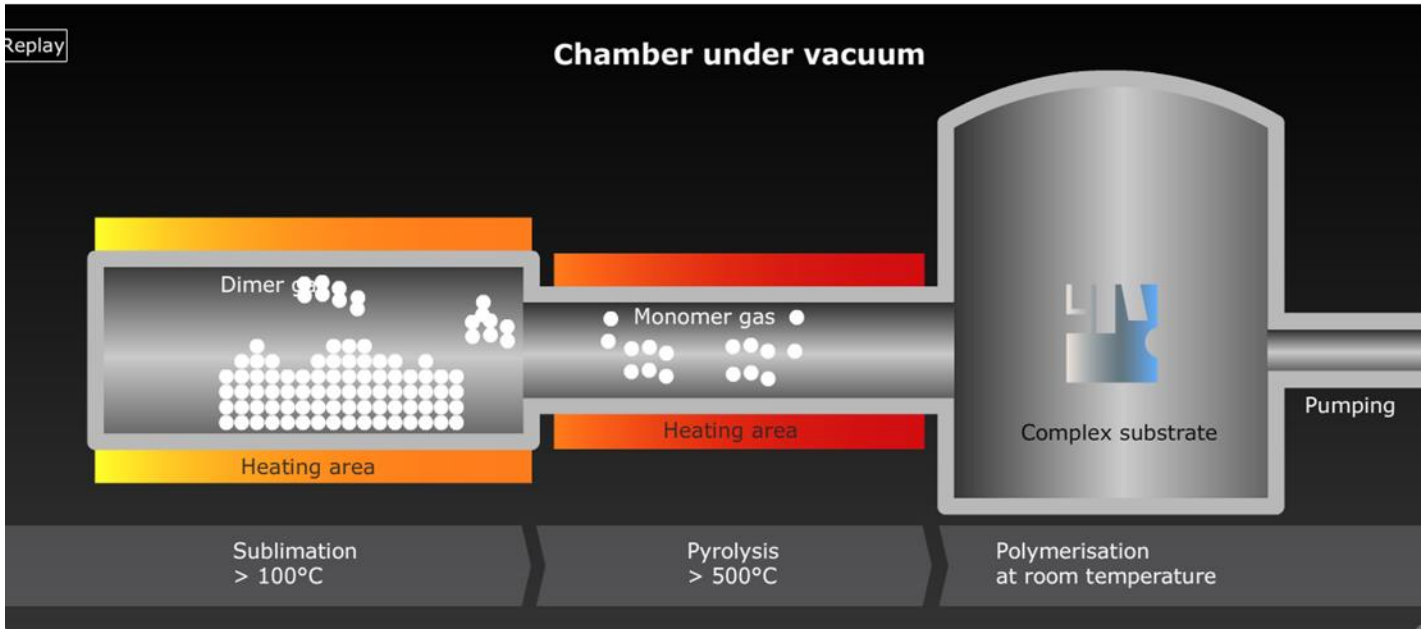
- Parylene refer to a general family : polyparaxylylene
- The starting material is the paracyclophane and its derivatives

Paracylophane derivatives and corresponding Parylene :



Parylene technology understanding

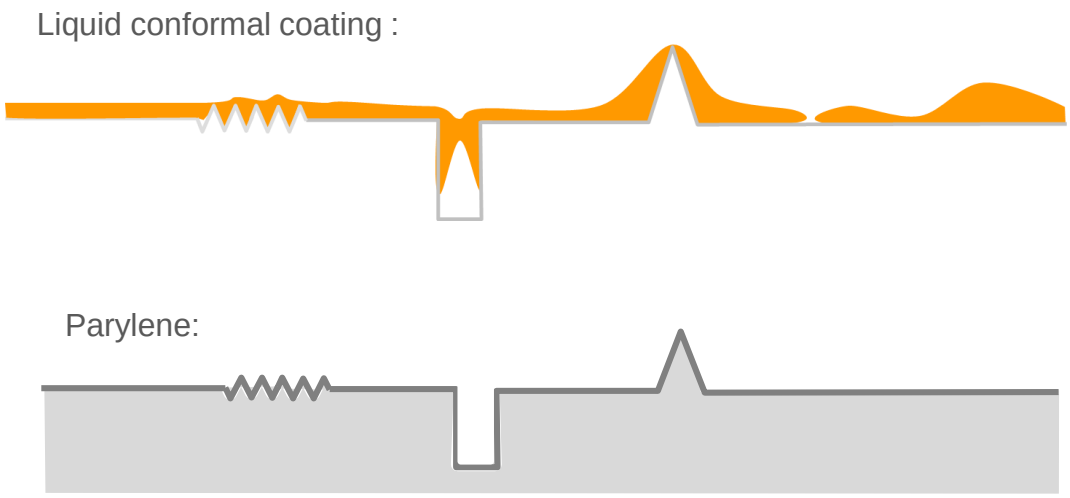
- Vacuum process (Vapor Deposition Polymerization) assimilated as CVD



Parylene technology understanding

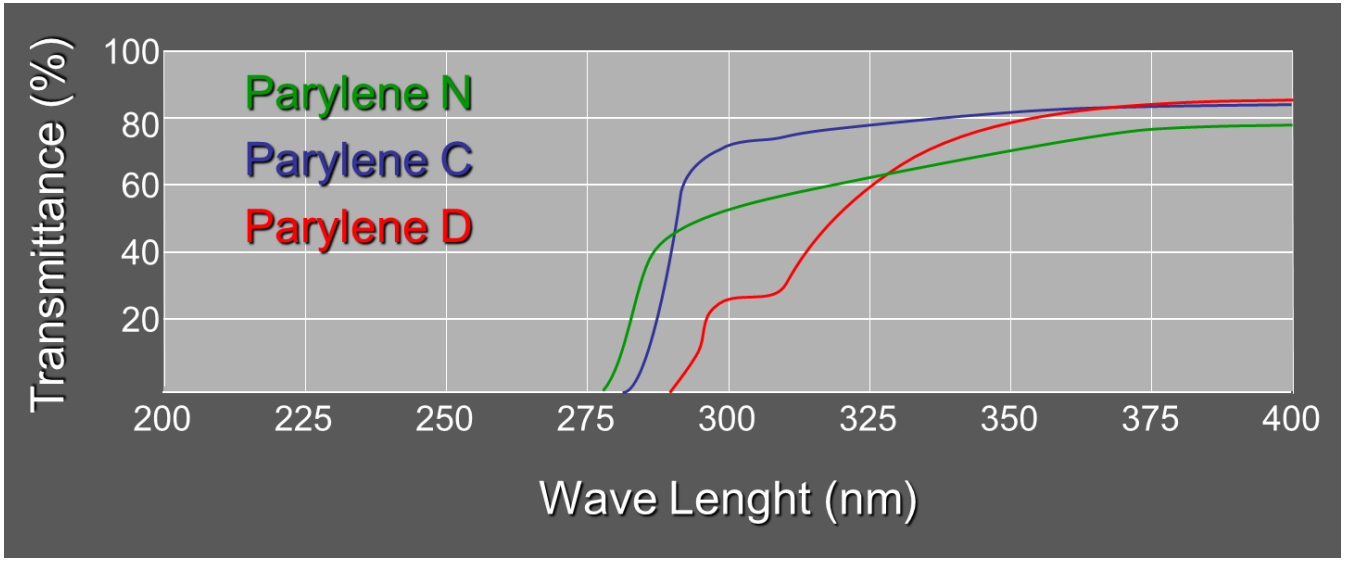
Process key features :

- Conversion rate is close to 100%
- By product are trapped by liquid nitrogen
- Green polymer (free of additives, plastisizer, catalyst)
- Pin hole free (50 nm)
- Free residual stress
- Thickness range from 10 nm to 100 µm
- Fully conformal
- Room temperature deposition
- High power of penetration
- Smooth surface
- Transparent coating



Parylene as an advanced packaging : key properties

Optical properties : Transparency

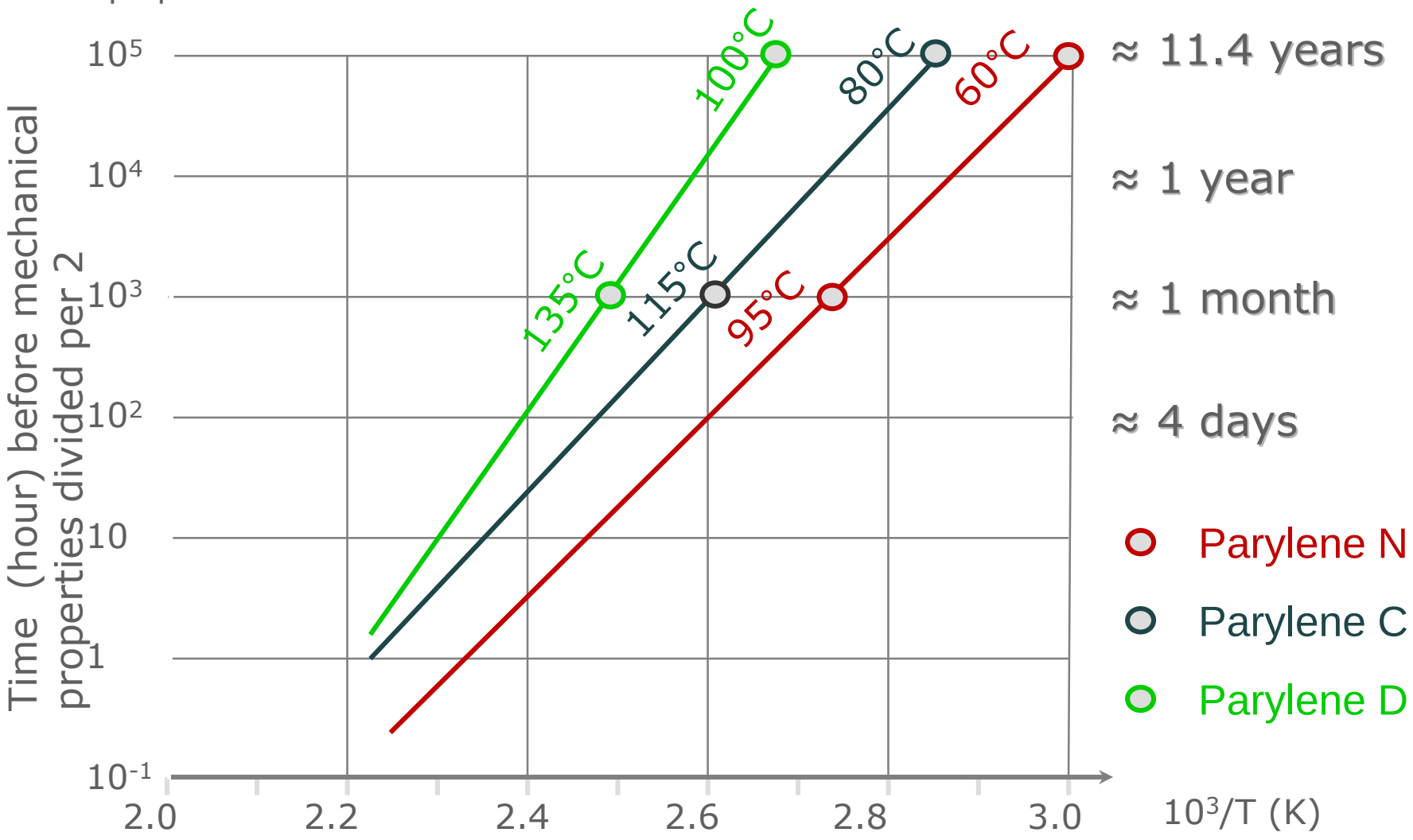


Properties	standard	Unit	PARYLENE Type		
			N	C	D
Density	D1505	g/cm^3	1.10	1.289	1.418
Refractive index @ 589 nm			1.661	1.639	1.669

- Good candidate for thin smart lenses as protective layer

Parylene as an advanced packaging : key properties

Thermal properties



Parylene as an advanced packaging : key properties

Barrier properties

Best compromise between oxygen permeability and WTR

Parylene as an advanced packaging : key properties

Chemical resistance : Swelling in %

	Parylene →	C		N		D	
	Temperature →	Amb.	75°C	Amb.	75°C	Amb.	75°C
SOLVENT	Dichlorobenzene	1.4	3	0.2	0.3	0.8	1.8
	Trichlorethylene	0.8	0.9	0.5	0.7	0.8	0.9
	Acetone	0.9	0.9 (56°C)	0.3	0.4 (56°C)	0.4	0.4 (56°C)
	Alcohol	0.1	0.2	0.3	0.3	0.1	0.1
	Toluene	1.32	-	0.3	-	3.69	-
ACID	Chlorydric acid 37 % - HCl	0	4.1	0.2	2.3	0.5	0.7
	Sulfuric acid 98% - H_2SO_4	0.4	5.1	0.2	5.3	0.8	7.8
	Nitric acid 71% - HNO_3	0.2	1.85	0.2	✞	0.5	4.9
	Fluorhydric acid 10% - HF	0.09		0.37		0.27	
BASE	Sodium hydroxide - NaOH	0	0.5	0.1	0	0.1	0.4
	Ammonium hydroxide - NH_4OH	0.2	0.4	0.3	0.4	0.1	0.9

Parylene as an advanced packaging : key properties

Dielectric properties :

Properties	ASTM	Unit	PARYLENE Type		
			N	C	D
Dielectric constant (k) @ 1 MHz	D150		2.65	2.91	2.8
Dissipation factor (δ) @ 1 MHz	D150		0.0006	0.013	0.002
Dielectric strength @ 25µm ↗ en V	D149	MV/m	280	220-250	220
Breakdown voltage @ 10µm	-	V	~ 4000	~ 3500	-
Résistivity @ 23°C, 50%HR	D257	Ω·cm	$1.4 \cdot 10^{17}$	$2.2 \cdot 10^{15}$	$3.1 \cdot 10^{16}$

Superior dielectric properties compared to liquid coating (Epoxy, silicone, PU)

Parylene as an advanced packaging : key properties

Dielectric properties : thickness vs breakdown voltage