

Physical properties of KGK SAR25C12

KGK Chemical Corp.

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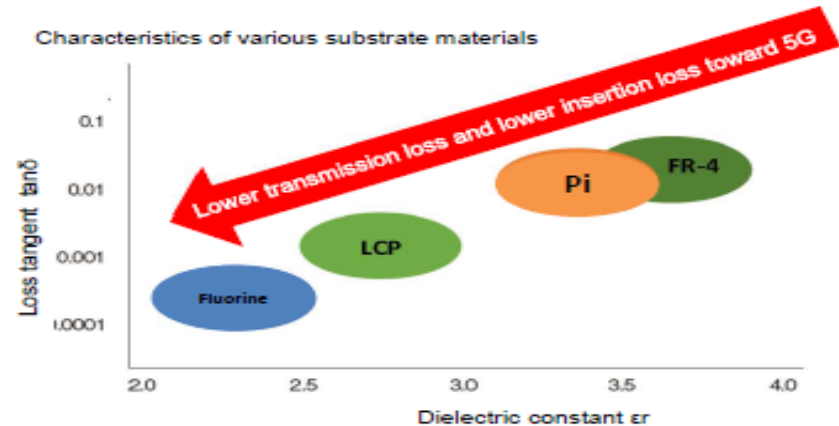
For 5G 《Connected Car/IoT》 ~ Required FPC substrate materials ~

*Low dielectric, power saving, low heat generation, low noise

*Low frequency dependence

*High thermal conductivity

Dielectric properties of various substrate materials



Conventional polyimide film absorbs moisture a lot.



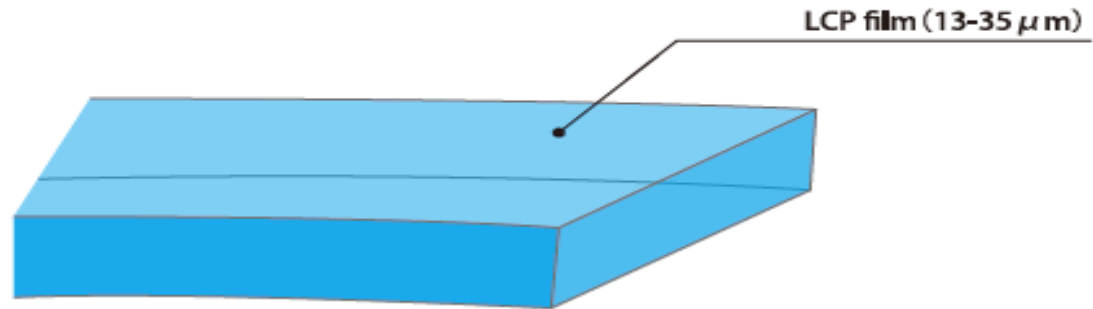
Film forming technology for liquid crystal polymers

《KGK's original film forming technology》

A Technology for removing the orientation of LCP by solution casting (solvent molding) instead of melt molding.

[Feature]

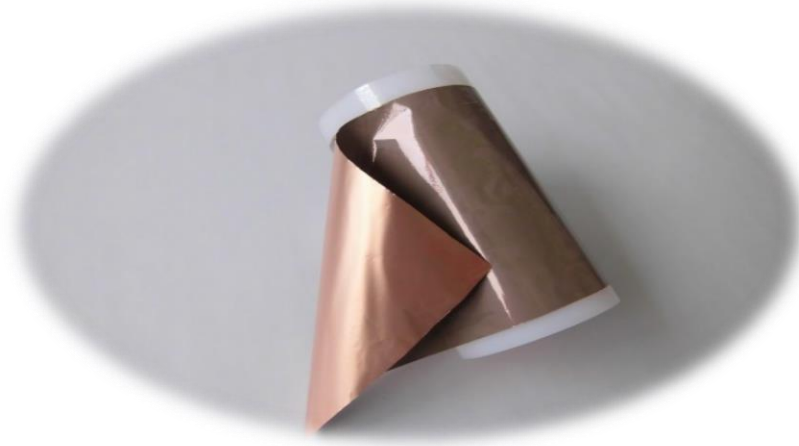
Thin film is possible
by casting.



Liquid crystal polymer film (LCP), copper foil laminate (FCCL)

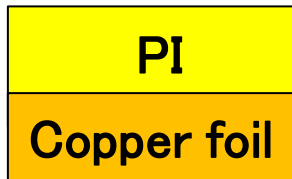
KGK's strengths

Integrated production from LCP to FCCL



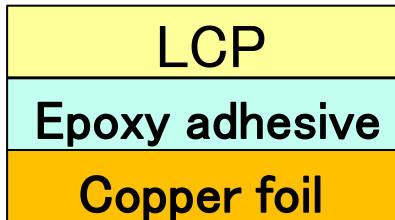
Liquid crystal polymer film (LCP), copper foil laminate (FCCL)

Conventional



Uses PI film with heat resistance and insulation

Existing FCCL configuration①



- Fused LCP film
- Adhesion to copper foil with epoxy adhesive

Issues of existing FCCL

***Cannot achieve the low dielectric properties required for 5G**



KGK SAR25C12 Date

Thickness (um)	Cu		12	
	LCP		25	
	Cu		-	
Technical Data	Cu	Roughness of Resist Side(um)	Ra	0.25
			Rz	1.03
		Roughness of Lami Side(um)	Ra	0.25
			Rz	1.03
		Tensile Strength(MPa)	As Produced	330
			After Annealed	250
		Elongation (%)	As Produced	16
			After Annealed	20
Technical Data	LCP	Tg (°C)		250
		CTE (ppm/K)		36(TMA)
		Tensile Strength (MPa)		8.7×10^1
		Tensile Modulus (GPa)		8.7×10^{-2}
		Elongation (%)		11%
		Moisture Absorption (%)		< 0.1
		Dk (10GHz)		3.39
		Df (10GHz)		0.0039
		Insulation Resistance (Ω)		5.6×10^{10}
		Volume Resistivity (Ω)		2.0×10^{12}
		Surface Resistance (Ω)		5.6×10^{10}
Voltage Breakdown (V/um)		200		



Liquid crystal polymer film (LCP), copper foil laminate (FCCL)

《KGK FCCL features》

LCP

Copper foil

New FCCL
configuration

- LCP with low dielectric properties is used as an insulating material.
- By forming a film on copper foil, no adhesive is required, and it has low dielectric properties of LCP.

KGK original 5G compatible technology

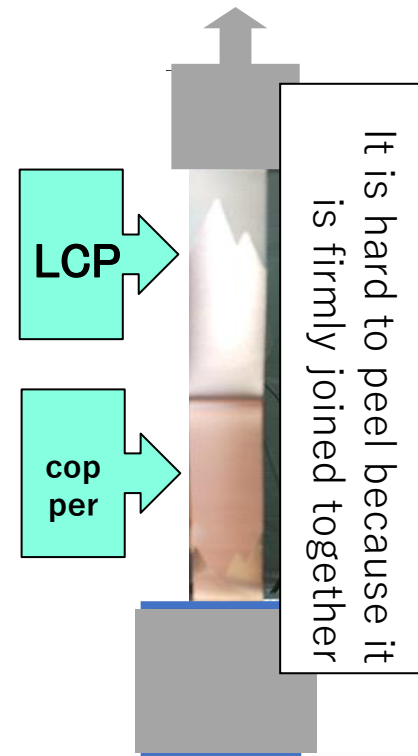
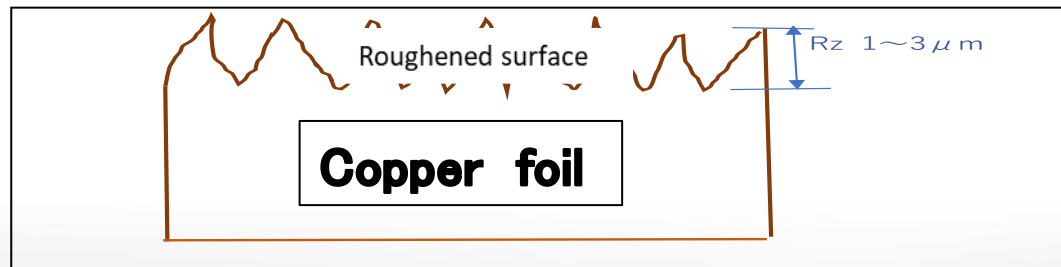


Liquid crystal polymer film (LCP), copper foil laminate (FCCL)

<Original direct cast film forming method>

- (1) A strong integral bond can be obtained without an epoxy adhesive during LCP-copper interface.
- (2) Since there is no uneven semiconductor (roughened surface) on the copper foil surface, dielectric loss can be avoided.

Previous: Roughening required → KGK: Roughening unnecessary



Can be thinned by KGK's original manufacturing method

Item	Unit	Method	Conditions	SAR25C12 (KGK)	Other's
Cu	μm	-	-	12	12
LCP	μm	-	-	25	100
Solder heat resistance	-	-	270°C, 30sec.	○	○
Dk (20GHz)	-	Split post dielectric resonator method	20GHz	3.63	3.58
Df (20GHz)	-	Split post dielectric resonator method	20GHz	0.0057	0.0020
Dk (10GHz)	-	Cavity resonance method	10GHz	3.39	3.50
Df (10GHz)	-	Cavity resonance method	10GHz	0.0039	0.0018
Tensile Modulus	GPa	ASTM D882	23°C	0.087GPa	0.16GPa
Volume Resistivity	Ωcm	JIS-C-2151		E+17	E+16
Moisture Absorption	%	-	85 °C × 85% RH × 168h	<0.1	<0.1
Peel Strength	N/mm	JIS C 6471		> 1.4	0.8
Chemical resistance	-	-	(HCl, NaOH, IPA) 23°C 5min.	No abnormality	No abnormality
Linear expansion (MD)	ppm/K	TMA	50-150°C	36	52
Linear expansion (TD)	ppm/K	TMA	50-150°C	36	34
Flame retardance	-	UL94		V-0	V-0

No anisotropy (strength difference depending on direction) due to direct coating method

Firmly adhered by direct coating method



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Since the dielectric constant (relative dielectric constant, dielectric loss tangent) depends on the type of material (PI, LCP, PTFE, etc.), no significant difference is seen with other companies, but studies were conducted to reduce and improve the dielectric constant. By examining the film conditions, an improvement of relative permittivity of -3.1% was seen (additional verification required).

	Item	Method	SAR25C12 (KGK)
Consider conditions	Dk (10GHz)	Cavity resonance method	-3.1%



Liquid crystal polymer film (LCP), copper foil laminate (FCCL)

Issues of conventional materials for 5G (autonomous driving, remote medicine, advanced IoT factory etc.)



"Hydrophilicity" in the composition of epoxy-polyimide
"Hydrophilicity" of copper foil roughening treatment (surface chemical treatment)



Solved by LCP cast film FCCL



End of presentation

User is responsible for determining whether the KGK product is fit for a particular purpose and suitable for user's method of application. Please remember that many factors can affect the use and performance of a KGK product in a particular application. The materials to be bonded with the product, the surface preparation of those materials, the product selected for use, the conditions in which the product is used, and the time and environmental conditions in which the product is expected to perform are among the many factors that can affect the use and performance of a KGK product. Given the variety of factors that can affect the use and performance of a KGK product, some of which are uniquely within the user's knowledge and control,

It is essential that the user evaluate the KGK product to determine whether it is fit for a particular purpose and suitable for the user's method of application.

KGK make no warranties on above data.

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