Park Electrochemical Corp

Nelco® 射频与微波材料
Nelco® 高科技 数字电子材
Nelcote® 先进复合材料
Nova™ 航空构件

Park Electrochemical Corp.

- 成立于 1954
- 全球性供应:
  - Nelco® 数字与射频/微波 线路板用材料
  - Nelcote® 结构复合材料 – 主要航空业用途
- 品牌: Nelco® 和 Nelcote™
- 2008财务年 净营业额 2.42 亿 美金
- 纽约股市 (PKE)
- ~950 员工

Park Electrochemical Corp.

先进复合材料

- 民用航空业用途

Park Electrochemical
(先进材料）

核心技术:
聚合物化学技术
研发配方 / 上胶技术

数字线路板
基材

- 通讯
- 网路系统基础设备
- 高端计算机

射频与微波线路板
基材

- 无线通讯

不断探讨未来的
新技术和方向

航空构件生产
民用航空用途

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

公司成长过程

- 成立于1954
  - 1960 年上市
  - 1984 年 纽约股市上市(PKE)
- 1962 年 发明多层线路板材料
- 1969 年 业务全球化
- 1986 年设立亚太区业务单位
- 1988 年收购 FiberCote (现在 Nelcote®) 先进复合材料
- 1992 年收购 Metclad (现在Nelco®) 射频材料
- 2004 年三月庆祝50周年
- 2006 年第二季 Nelco 珠海珠海厂完整设立
- 2008 年新加坡复合材料厂完整设立
- 2008 年收购Nova Composite Structures, 今称 Park Aerospace Structures

Global Operations全球化业务

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

全球Park工厂

Nelcote, Inc.
Waterbury, CT

Nelco New York
Newburgh, NY

Neltec, Inc.
Tempe, AZ

Nelco California
Fullerton, CA

Neltec SA
France

Neltec Europe
France

Nelco
Singapore

Nelco Zhuhai
China

NEW! Pioneer Rd
Singapore

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

Nelco Products Pte Ltd

配合新一代
全自动化系统

PARK ELECTROCHEMICAL CORP.

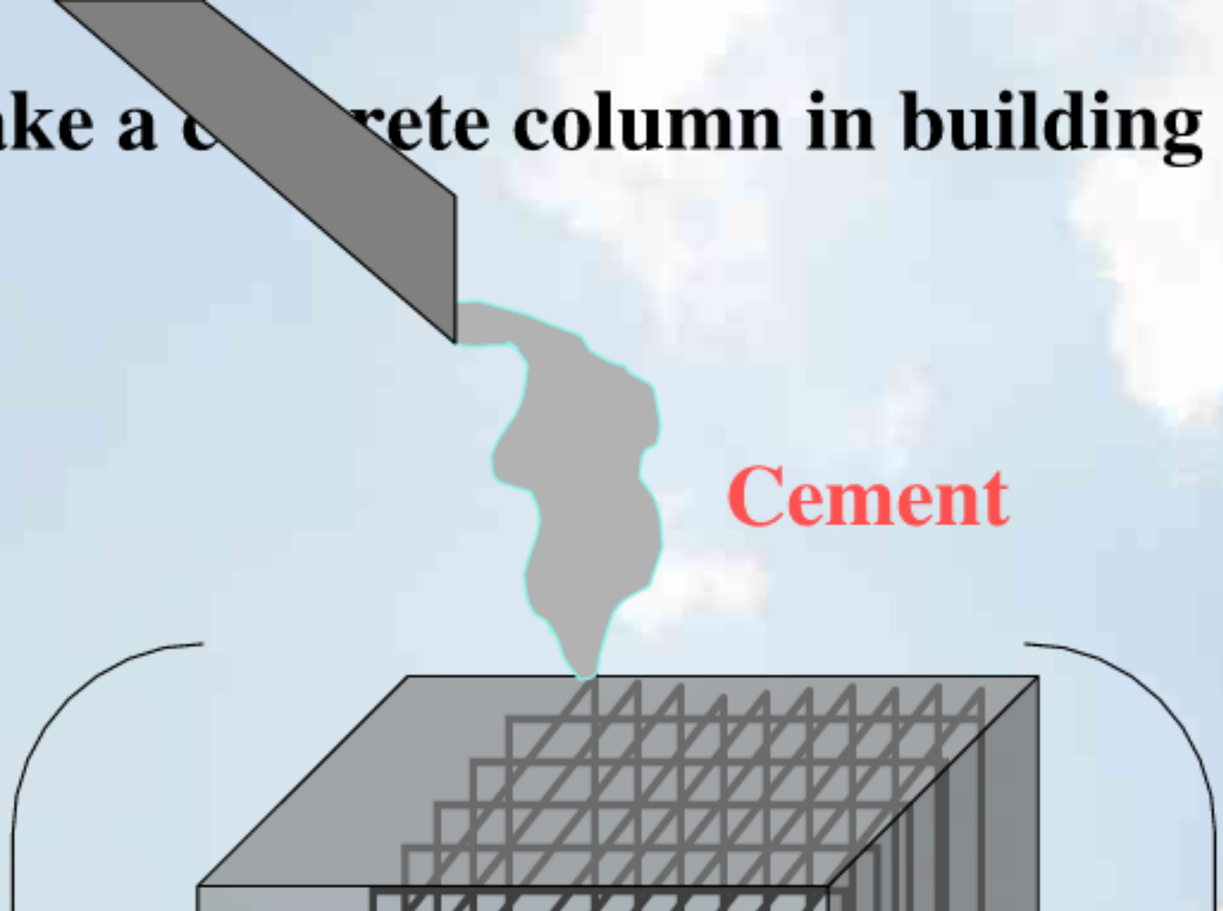
Nelco® and Nelcote™
Advanced Material Technologies

What are Laminates and Prepregs?

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

How to make a c rete column in building ?

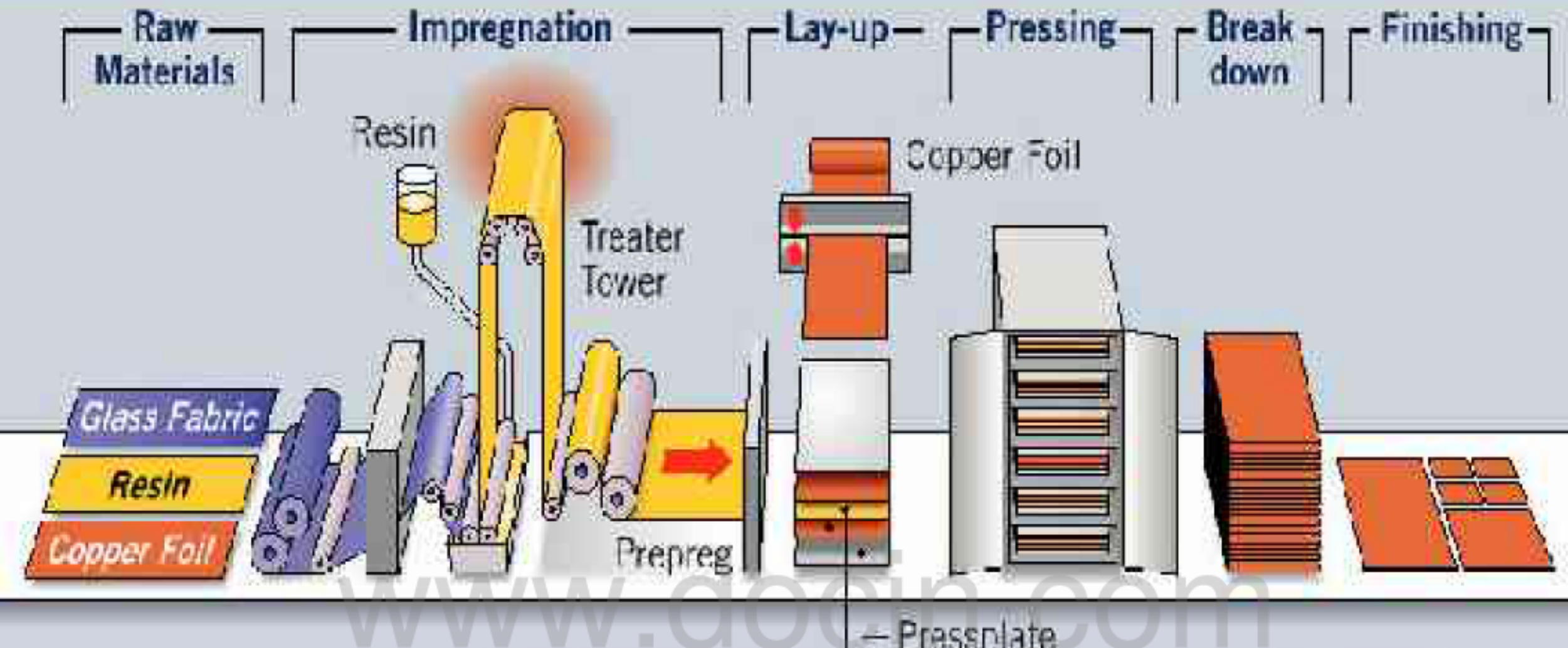


PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

	Concrete	Laminates
Reinforcement	Steel frame	Glass cloth (FR4)
Body/ filler	Cement	Epoxy, BT, CE, Polyimide, PTFE resin
Surface	Paint / epoxy coat	Copper foil

Base Material Manufacturing Process



IMPREGNATION

Processing

TREATER CAVITEC
I.R. heating

VARNISH

ACETONE

Norcross
Viscosity
regulator

Glass
Cloth

Prepreg in
rolls

Prepreg in
formats

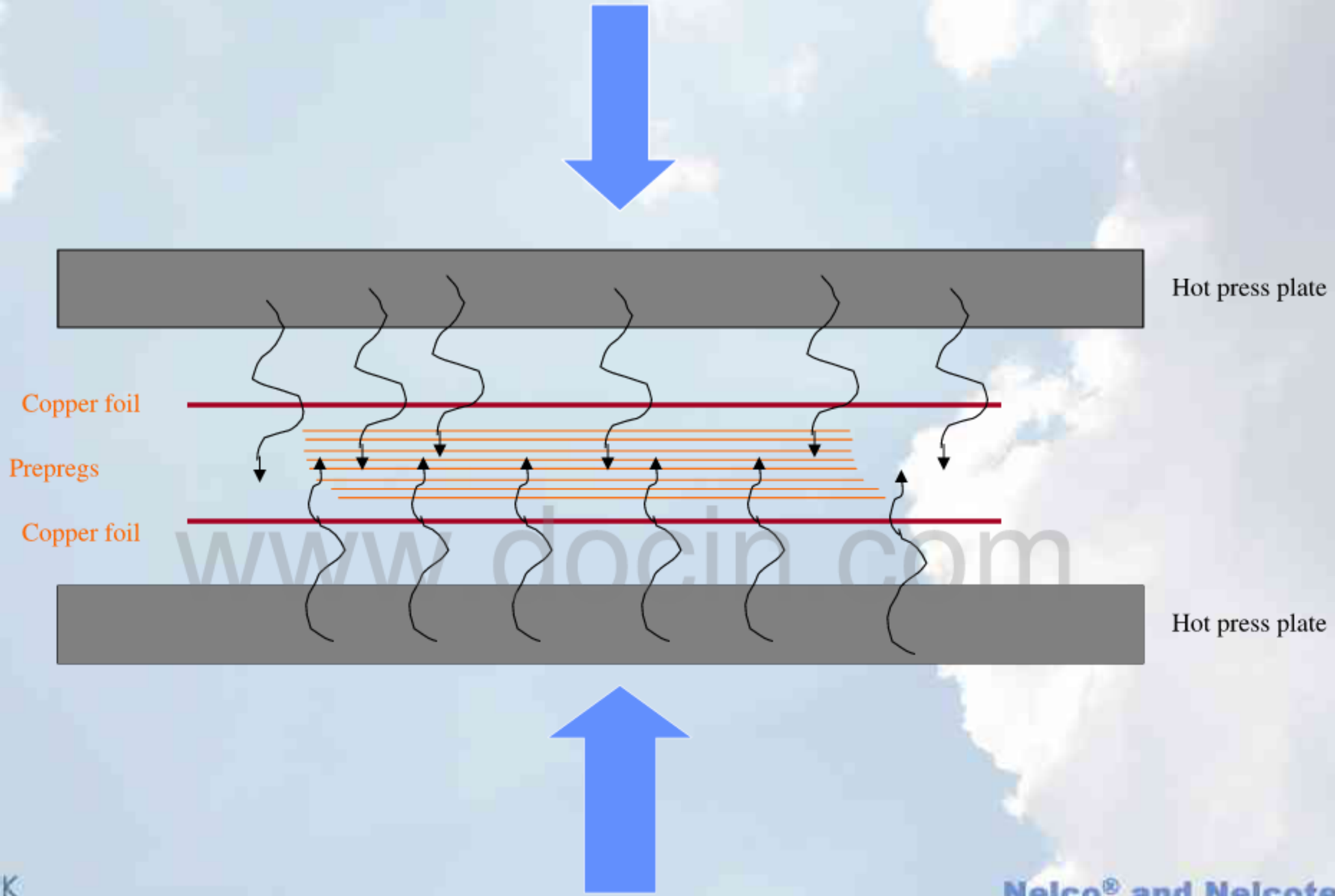
Gap
regulation

Unwinders | Splicer | Accumulator | Varnish pans | Ovens | Mahlo | Accum. | Rewinder | Sheeter | Stacker

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

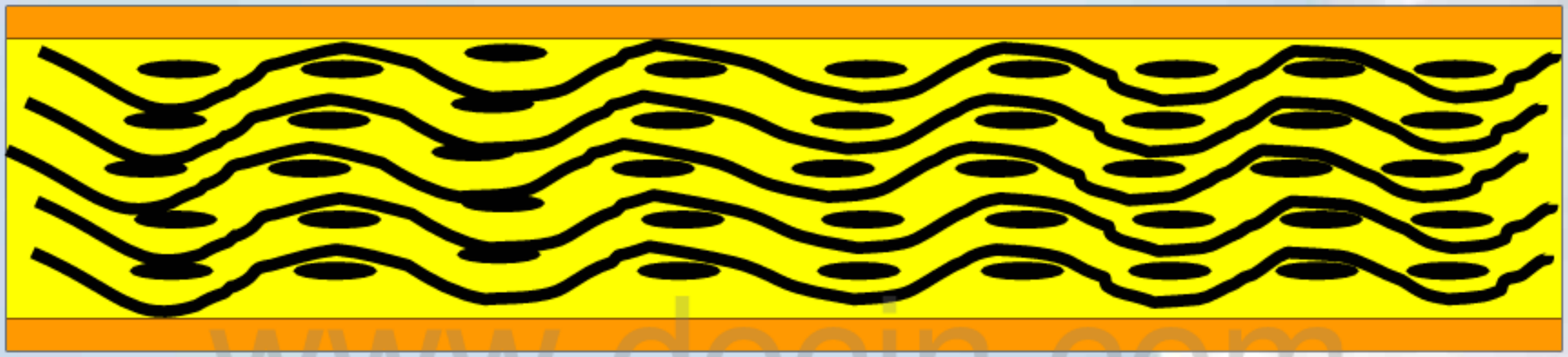
Press



PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

Laminate



Thin Laminates

Thin Laminates are copper clad glass-resin laminates generally less than 1.0mm thick.

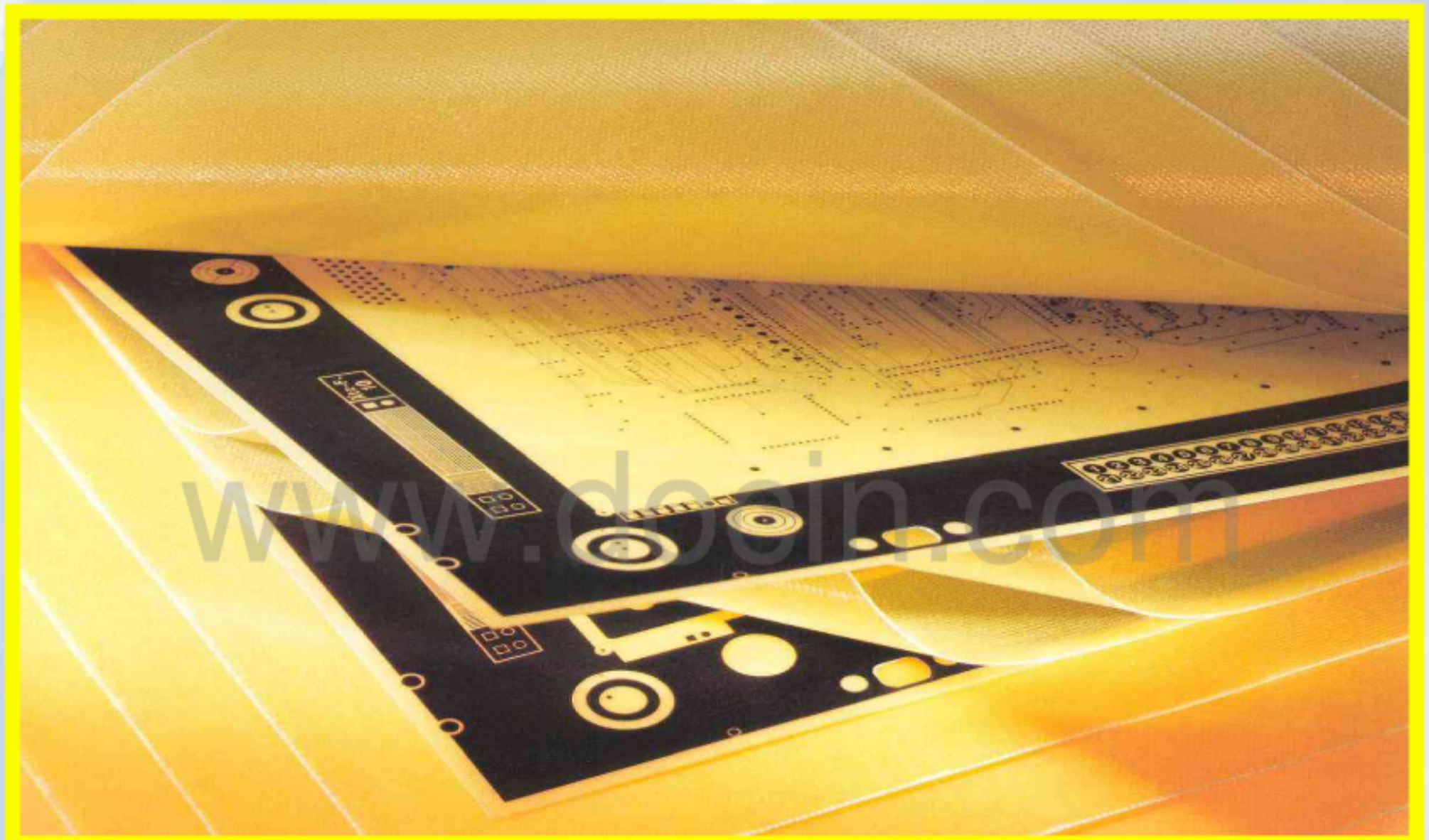
No logo.

Prepregs

Prepregs are glass fabrics treated and coated with semi-cure resin.

The resin melt, fill up gaps, bond layers together when heated in the press.

Multi-layer Printed Circuit Board manufacturing process



PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

Base Material Manufacturing Process 半固化片及覆铜板生产过程

Raw Materials 原料

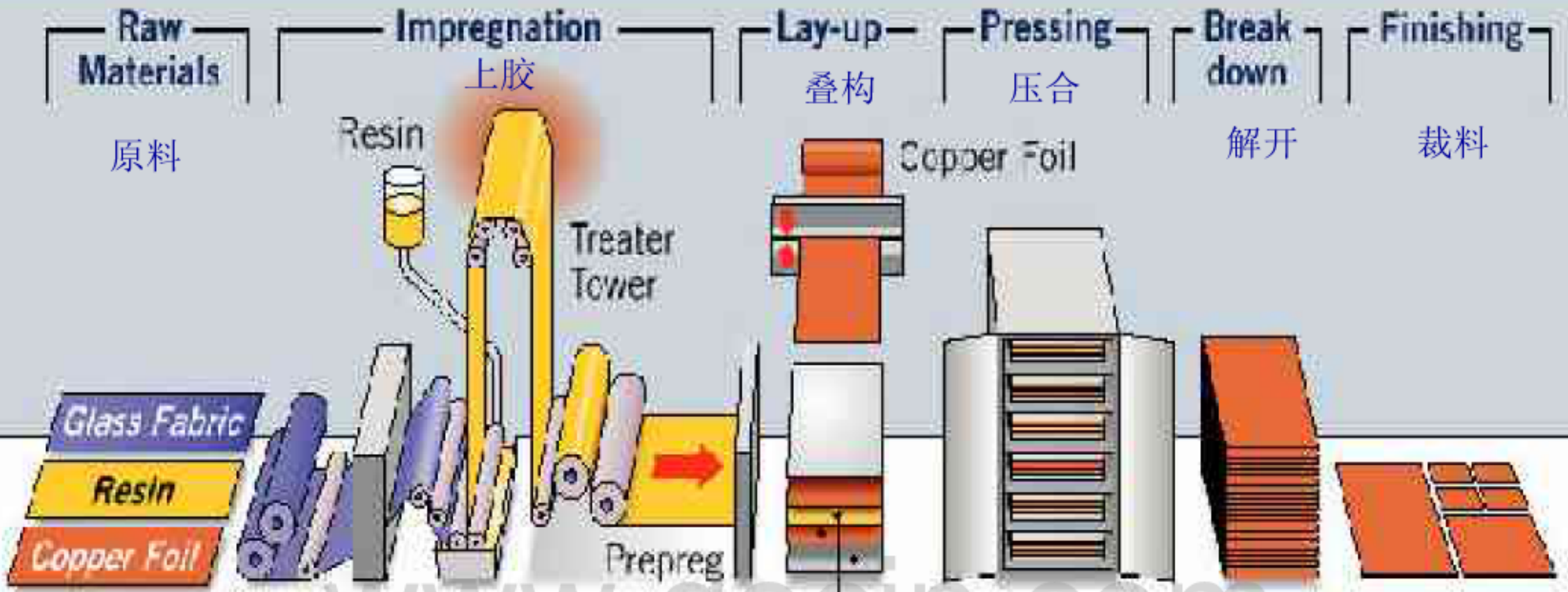
Impregnation 上胶

Lay-up 叠构

Pressing 压合

Break down 解开

Finishing 裁料



Pressplate

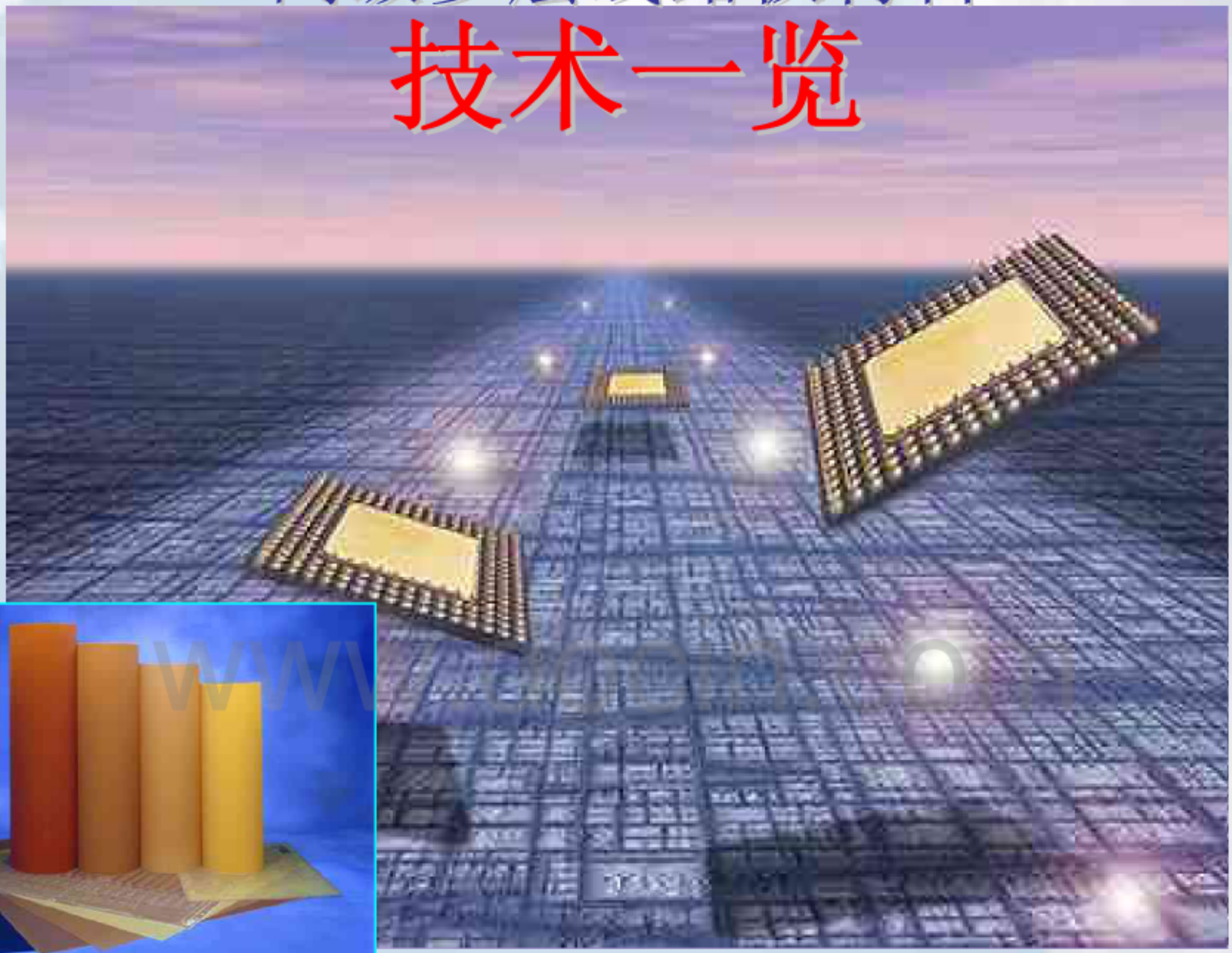
Nelco® 数字 与 射频/微波材料

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

高级多层线路板材料

技术一览



PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

Inside multi-layer PCBs……..

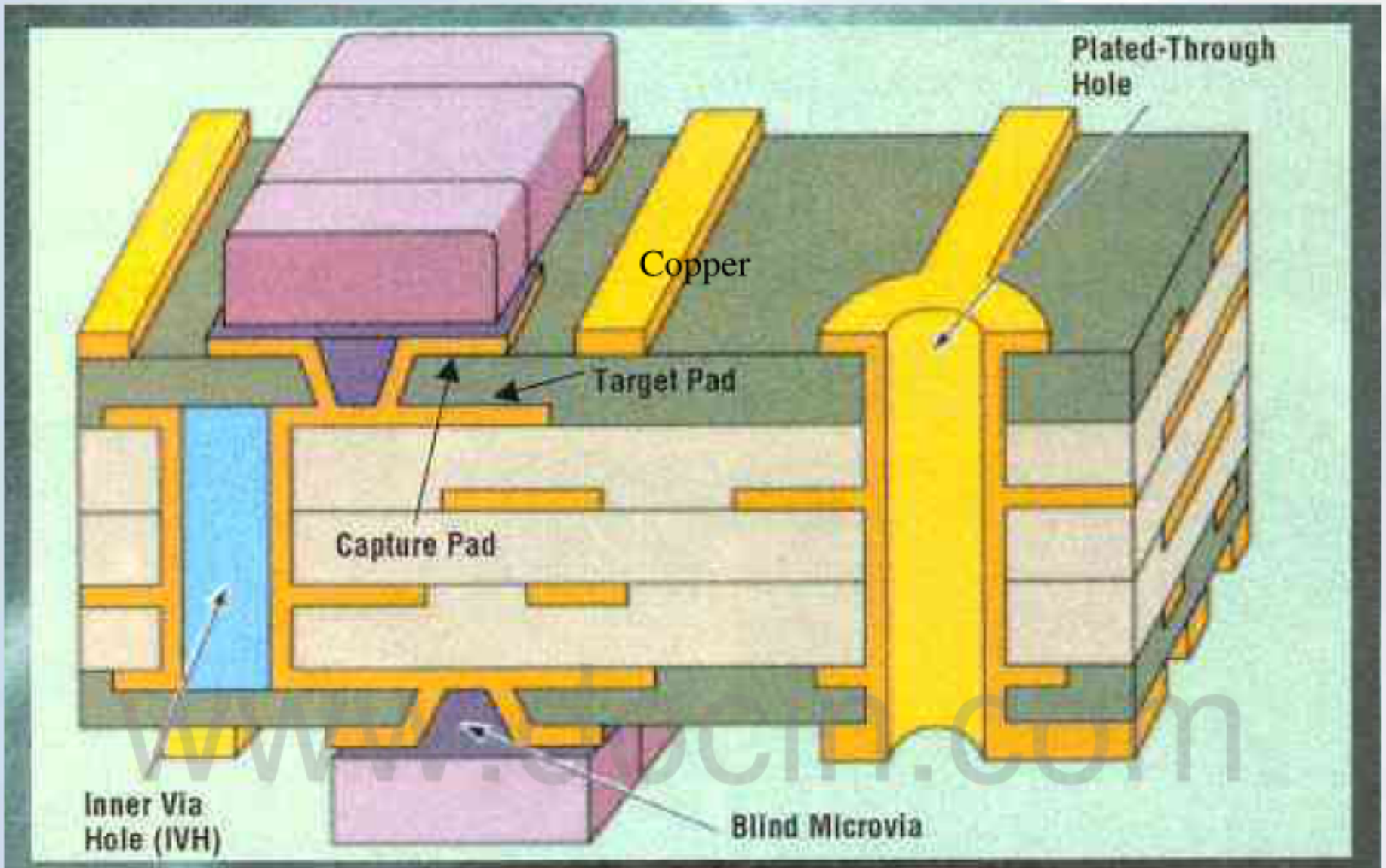
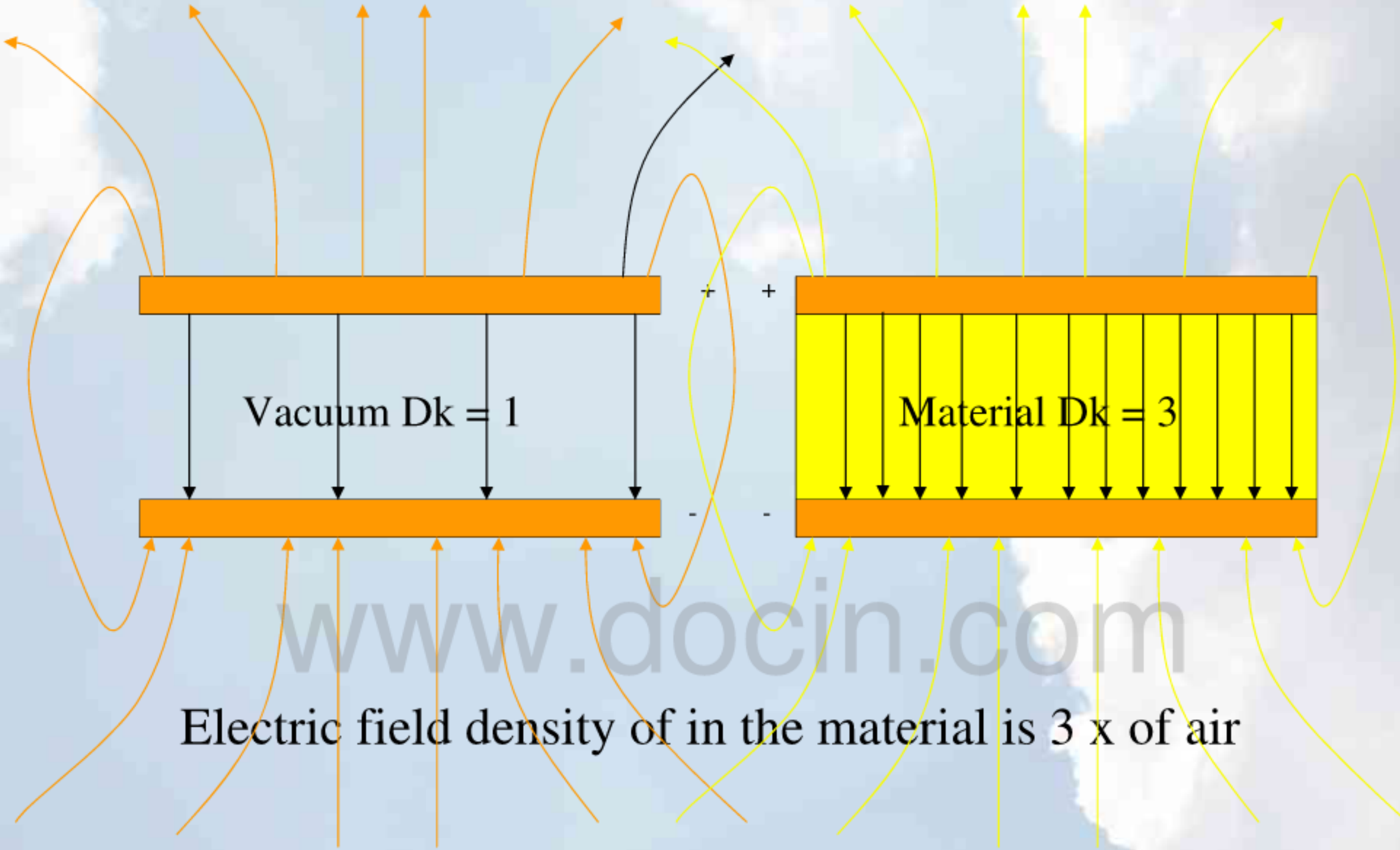
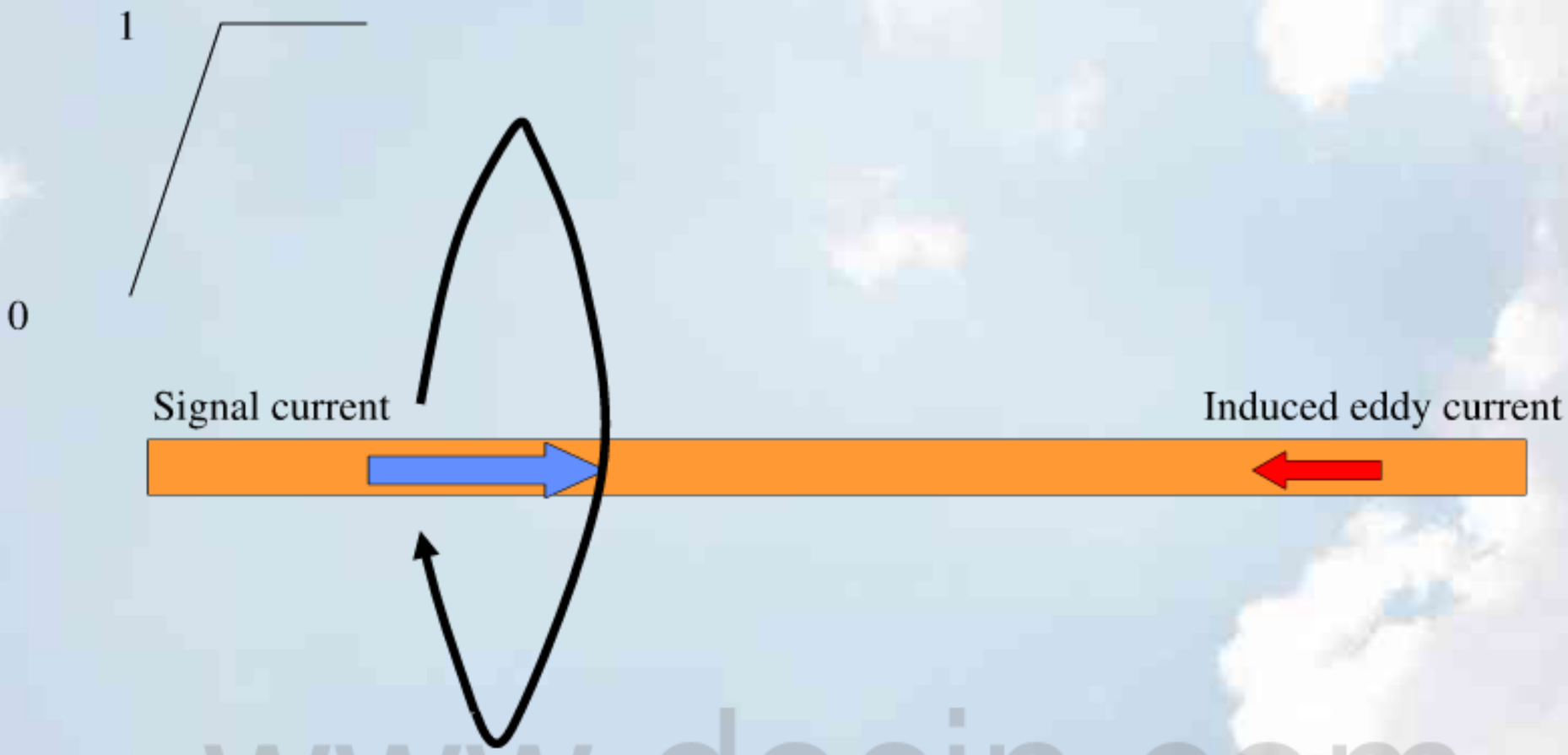


Figure 2. Cross-section of a general HDI/microvia PWB.

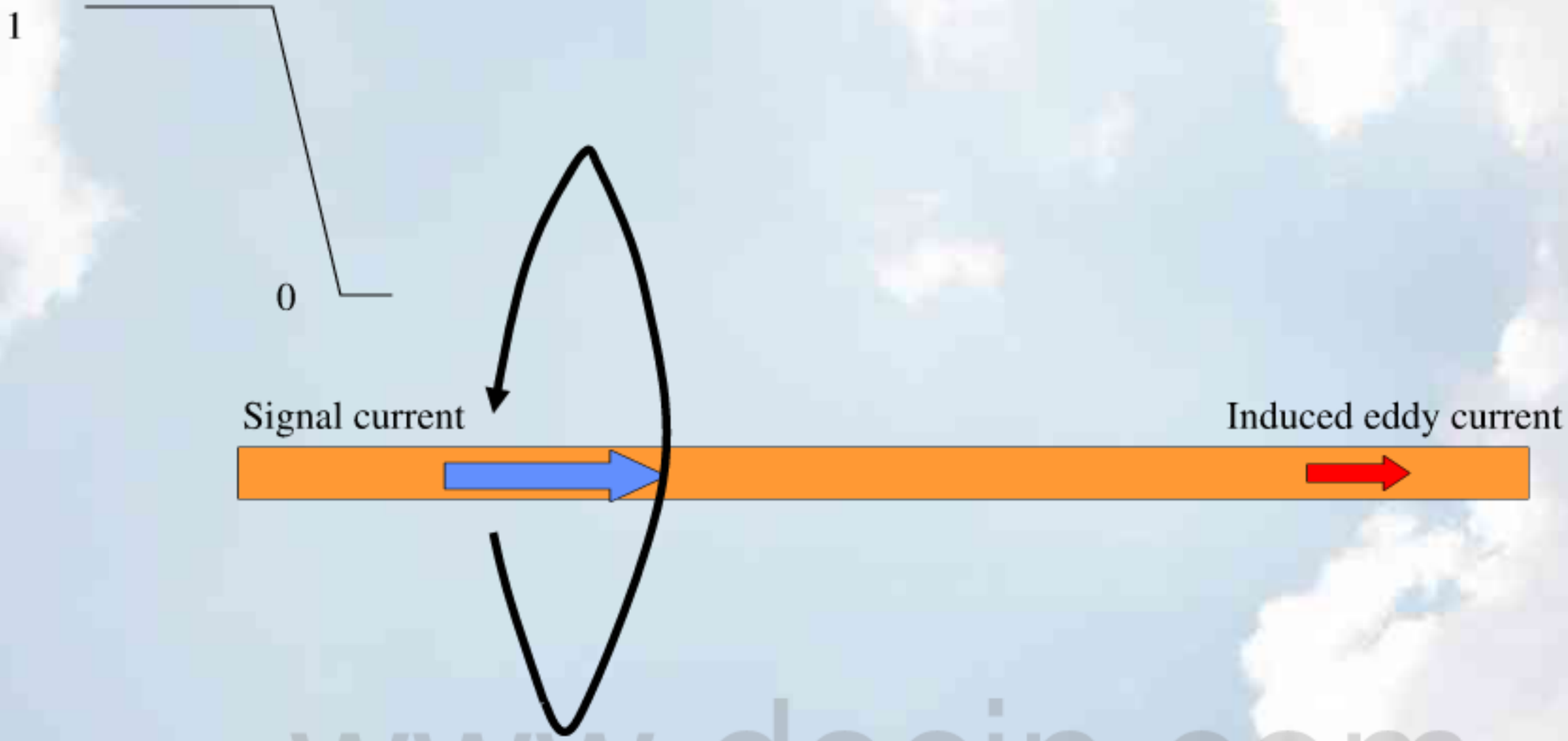
Meaning of Dielectric Constant, Dk, or Er



Electric field density of in the material is 3 x of air



Increasing magnetic field B induced ⇒ Opposite eddy current induced



Decreasing magnetic field B induced ⟹ Opposite eddy current induced

Signal Propagation Speed in Copper Clad Laminates

$$V = k \cdot \frac{c}{\sqrt{\varepsilon r}}$$

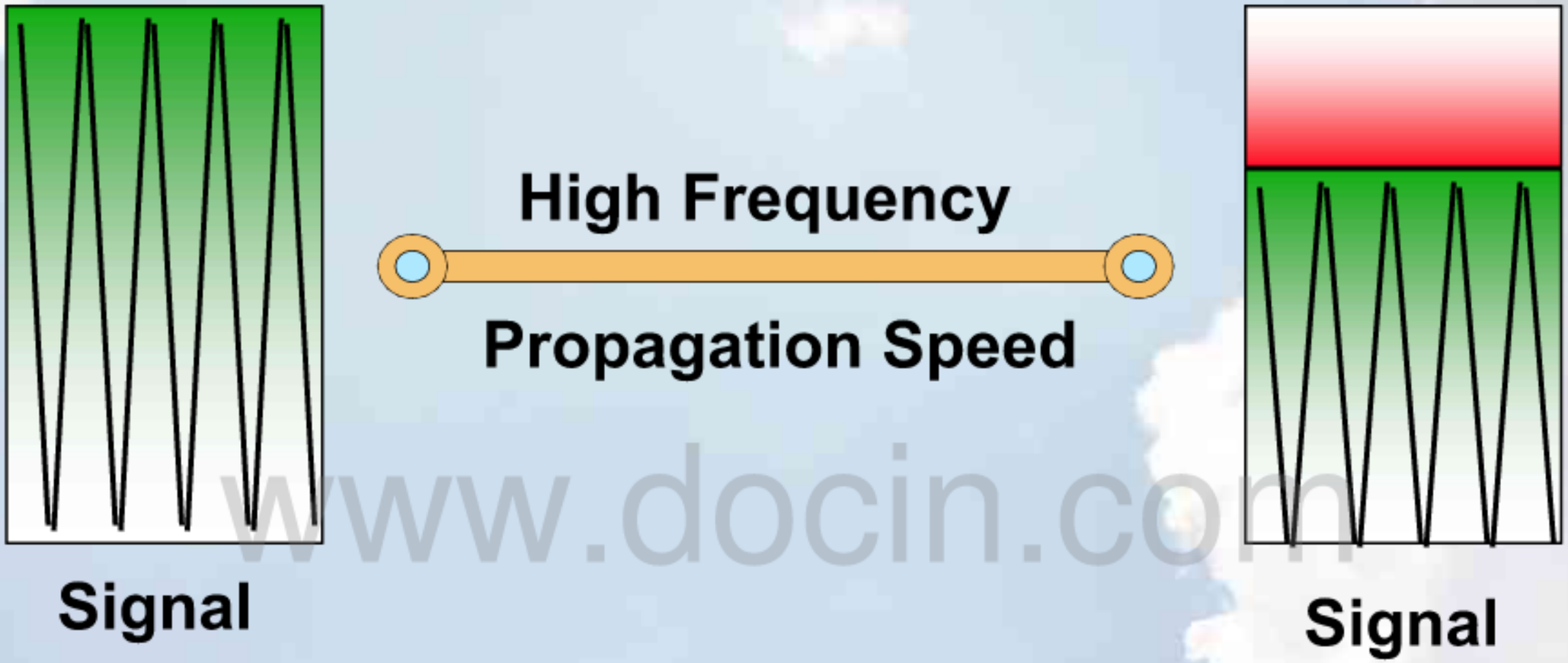
V: Signal propagation speed

c:speed of light in vacuum

k : constant

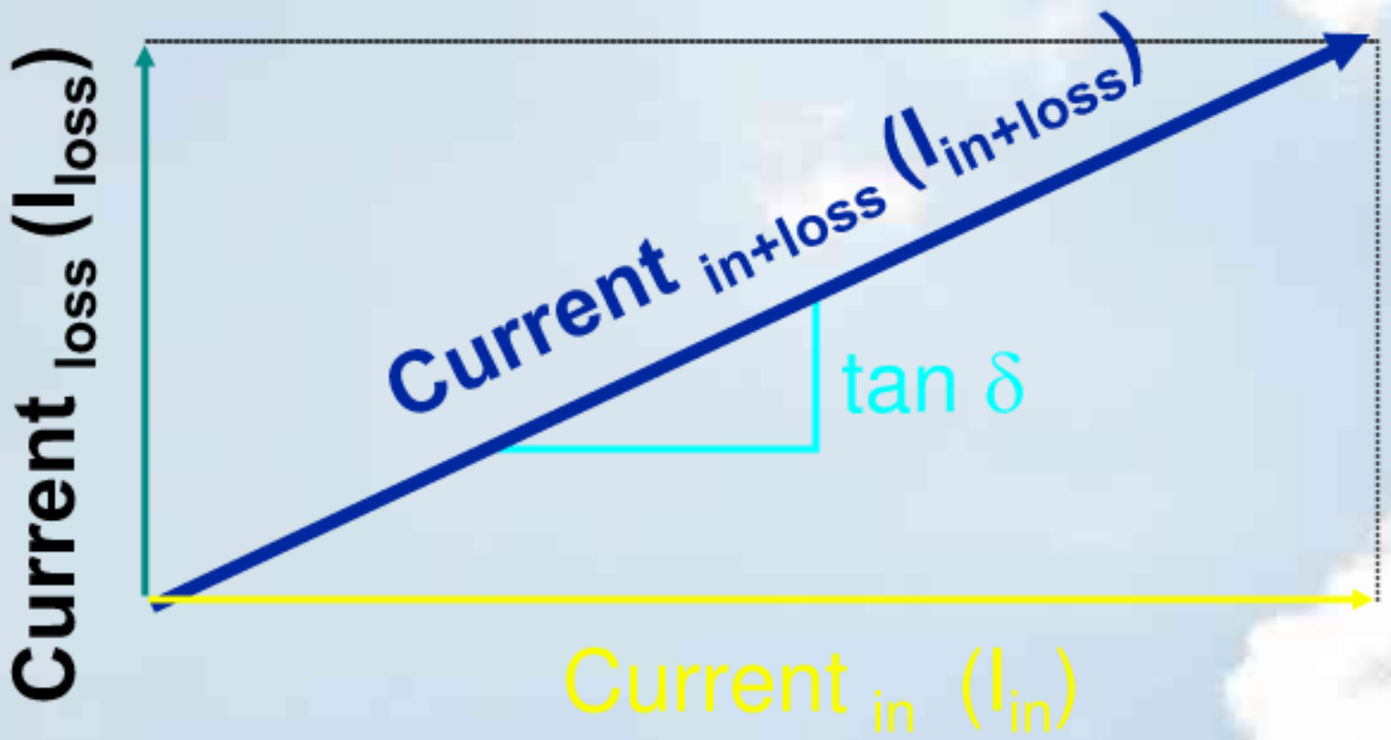
ε : dielectric constant

Signal loss (Df)



To solve the problem, material with low signal loss is required !

Losses inside of Cu-lines



If $I_{in+loss} = I_{in}$ than is $I_{loss} = 0$

and $\tan \delta = 0$ (best case)

Skin effect

At high frequencies the transport of current is also in the dielectric layer around the Cu-lines.

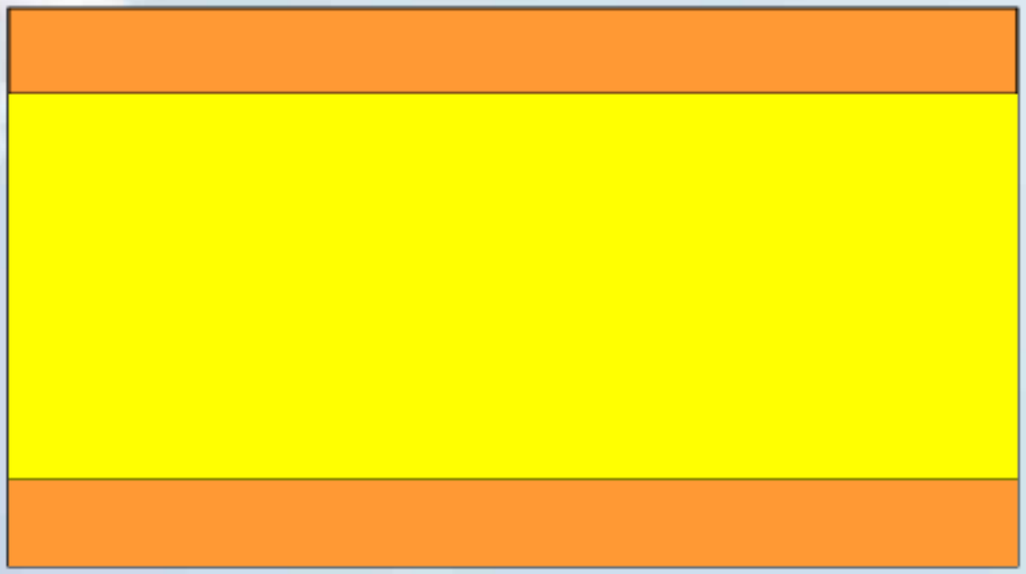
good **poor**

Signal loss

60%	**Losses inside of Cu-lines due to R; I; C** TAN δ
30%	**Skin effect**
10%	**Others**

PCB design roadmaps - High speed signal

Capacitor-like structure between layers of coppers



Main concern is IMPEDANCE (resistance to electric flux breakdown) must be maintained

IMPEDANCE is directly proportional to dielectric thickness

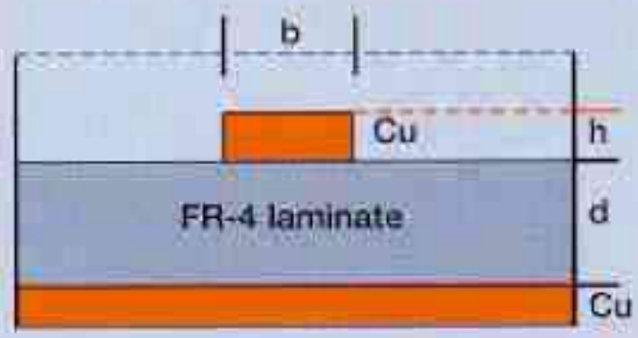
IMPEDANCE is INVERSELY proportional to dielectric constants (Dk)

Material with low Dk can reduce thickness of dielectric while increasing impedance.

Controlled impedance requires controlled thickness tolerance.

Impedance

Microstripline

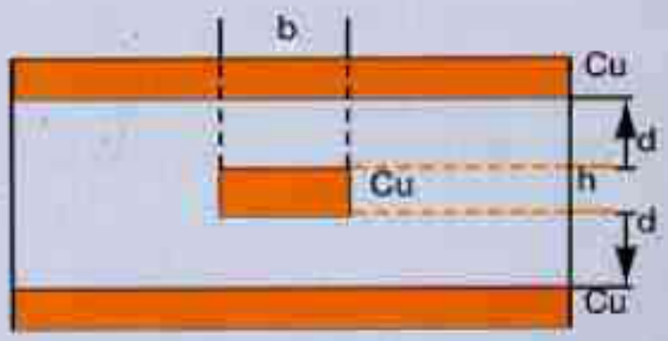


$$ZL = \frac{87}{\sqrt{\varepsilon_r + 1{,}41}} \cdot \ln\left(\frac{5{,}98 \cdot d}{0{,}8\ b + h}\right) \cdot (\Omega)$$

$$ZL_{min} = \frac{87}{\sqrt{4{,}95 + 1{,}41}} \cdot \ln\left(\frac{5{,}98 \cdot 0{,}082}{0{,}8 \cdot 0{,}220 + 0{,}0198}\right) \cdot (\Omega) = 31{,}7\ \Omega$$

$$ZL_{max} = \frac{87}{\sqrt{4{,}65 + 1{,}41}} \cdot \ln\left(\frac{5{,}98 \cdot 0{,}118}{0{,}8 \cdot 0{,}180 + 0{,}0162}\right) \cdot (\Omega) = 52{,}4\ \Omega$$

Stripline



$$ZL = \frac{60}{\sqrt{\varepsilon_r}} \cdot \ln\left(\frac{8 \cdot d}{1{,}68 \cdot b + 2{,}1 \cdot h}\right)$$

$$ZL_{min} = \frac{60}{\sqrt{4{,}95}} \cdot \ln\left(\frac{8 \cdot 0{,}082}{1{,}68 \cdot 0{,}22 + 2{,}1 \cdot 0{,}0198}\right) = 12{,}6\ \Omega$$

$$ZL_{max} = \frac{60}{\sqrt{4{,}65}} \cdot \ln\left(\frac{8 \cdot 0{,}118}{1{,}68 \cdot 0{,}18 + 2{,}1 \cdot 0{,}0162}\right) = 28{,}7\ \Omega$$

Resistor : V, I, R

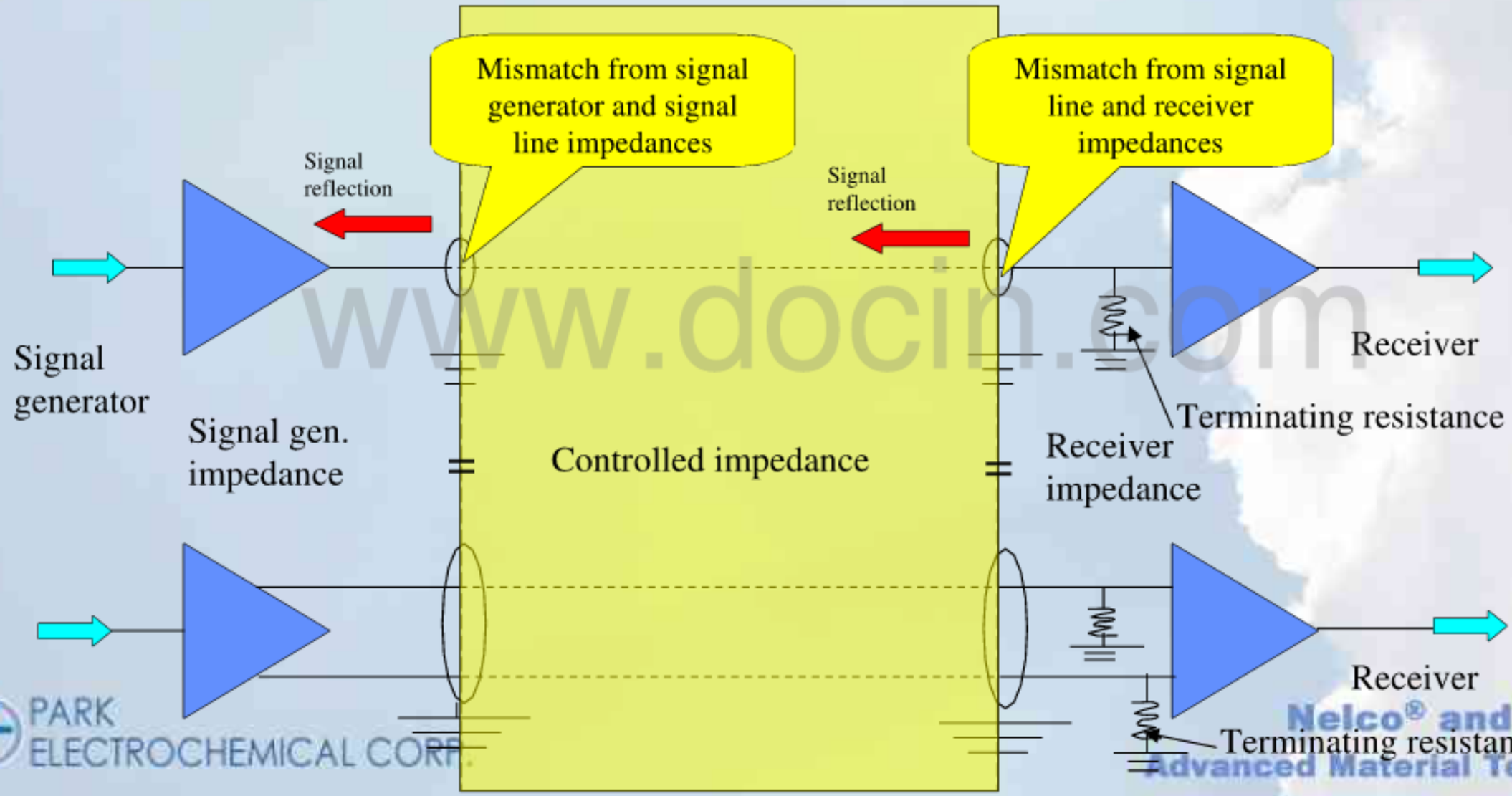
$$V = V1 + V2 + V3$$

Capacitor : C, I, Z (impedance)

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$$

Why is Controlled impedance so important ?

1. When there is a mismatched of impedance at any place along signal line, the maximum power transfer does not occur. Reflection of signal power from impedance mismatch, results in signal attenuation.



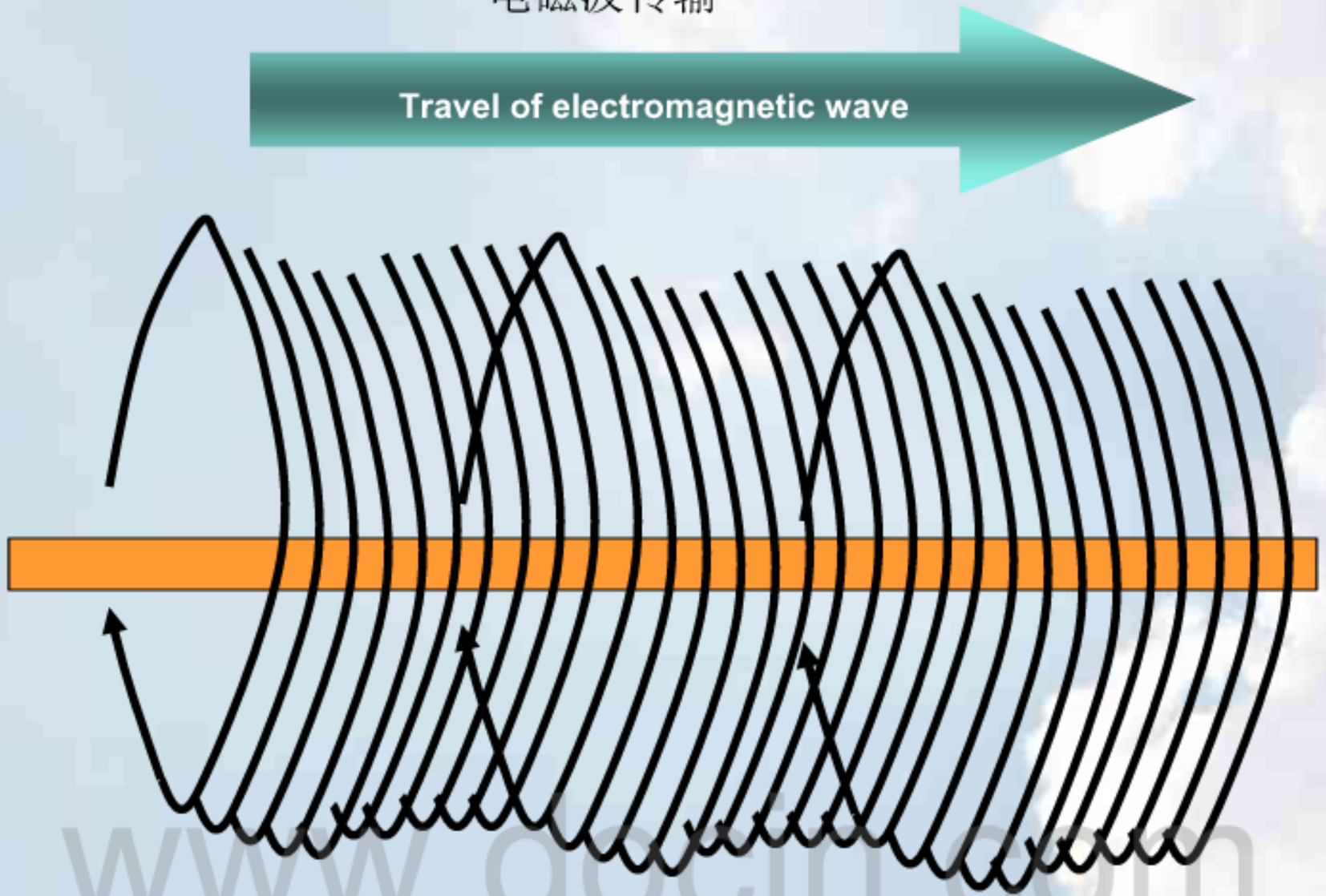
高速数字用途

宽带系统, 路由器, 导向器, 背板, 通讯基站

N4000-12	N4000-12SI	N4000-13	N4000-13SI	N4000-13EP®	N4000-13EP®SI®
Dk: 3.7 (1GHz) 3.6 (10GHz) Df : .010 (1GHz) .008(10GHz)	Dk: 3.4 (1GHz) 3.3 (10GHz) Df : .009 (1GHZ) .007 (10GHz)	Dk: 3.7 (1GHz) 3.6 (10GHz) Df : .008 (1GHz) .008(10GHz)	Dk: 3.3 (1GHz) 3.2 (10GHz) Df : .008 (1GHz) .007(10GHz)	Dk: 3.7 (1GHz) 3.6 (10GHz) Df : .008 (1GHz) .008(10GHz)	Dk: 3.3 (1GHz) 3.2 (10GHz) Df : .008 (1GHz) .007(10GHz)
Tg – 190°C T260 – 113 mins Td – 360°C		Tg – 210°C T260 – 58 mins Td – 350°C			
应用： 宽带系统, 3G, 蓝牙, 导向器 路由器, 背板	应用： 宽带系统, 3G, 蓝牙, 导向器 路由器, 背板，通讯基站	应用： 宽带系统, 3G, 蓝牙, 导向器 路由器, 背 板，通讯基站			

可通过 **6x 288°C**飘锡，可用于无铅装配

电磁波传输



Signal loss must be very low –
Requires very low Df !!!

需要非常低的损耗常数！！

高速数字用途

宽带系统, 路由器, 导向器, 背板, 通讯基站

N4000-12	N4000-12SI	N4000-13	N4000-13SI	N4000-13EP®	N4000-13EP®SI®
Dk: 3.7 (1GHz) 3.6 (10GHz) Df : .010 (1GHz) .008(10GHz)	Dk: 3.4 (1GHz) 3.3 (10GHz) Df : .009 (1GHZ) .007 (10GHz)	Dk: 3.7 (1GHz) 3.6 (10GHz) Df : .008 (1GHz) .008(10GHz)	Dk: 3.3 (1GHz) 3.2 (10GHz) Df : .008 (1GHz) .007(10GHz)	Dk: 3.7 (1GHz) 3.6 (10GHz) Df : .008 (1GHz) .008(10GHz)	Dk: 3.3 (1GHz) 3.2 (10GHz) Df : .008 (1GHz) .007(10GHz)
Tg – 19[illegible] T260 – 11[illegible]ns Td – 3[illegible]		g – 10[illegible] 60[illegible] Td – 50[illegible]			
应用： 宽带系统, 3G, 蓝牙, 导向器 路由器, 背板	应用： 宽带系统, 蓝牙, 导向器, 路由器, 背板 通讯基站	应用： 宽带系统, 3G, 蓝牙, 导向器 路由器, 背 板, 通讯基站			

可通过 **6x 288°C**飘锡，可用于无铅装配

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

射频 / 微波用途

无线通讯, 机站天线, 功放器, 无源双频带高功率线路板,
交通工具通讯, 微米波器件

N4000-13RF	N9000-13RF	NH9000	NX9000	NY9000	Mercurywave™ 9350
改良环氧树脂, 玻纤布增强	聚四氟乙烯 混压覆铜板,玻纤布增强	陶瓷填充聚四氟乙烯,玻纤布增强	陶瓷填充聚四氟乙烯,玻纤布增强（含胶量中）	陶瓷填充聚四氟乙烯,玻纤布增强 （低含胶量）	热固化树脂 玻纤布增强
Dk: 3.5 -3.8 (1GHz) Df : .0065 (10GHz)	Dk: 3.0 -3.5 (1GHz) Df : .004 – .005 (10GHz)	Dk: 2.94 -4.50 (10GHz) Df : .0022– .0030 (10GHz)	Dk: 2.70 -3.20 (10GHz) Df : .0020– .0024 (10GHz)	Dk: 2.08 -2.33 (10GHz) Df : .0016– .0019 (10GHz)	Dk: 3.50 (10GHz) Df : 0.004 (10GHz)
	易于加工。不含磨损高的陶瓷填充剂. 铜箔覆贴在热固性树脂上	热膨系数低, 加强热稳定性	热膨系数中等, 增加了机械强度	非常低损耗用途	低损耗,高耐热性能用途

高耐热性能/无铅装配用途/抗电子迁移 FR4

无铅装配，低速服务器，低速背板，汽车控制系统

无铅装配 +低热膨系数+抗CAF + 低损耗

N4000-11	N4000-29	N4000-12	N4000-13
酚醛固化剂	酚醛固化剂	改良环氧树脂	改良环氧树脂
Tg 175°C	Tg 185°C	Tg 190°C	Tg 210°C
CAF resistant	CAF resistant	CAF resistant	CAF resistant
CTE – 3.2% (50 – 260°C)	CTE – 3.0% (50 – 260°C)	CTE – 3.6% (50 – 260°C)	CTE – 3.5% (50 – 260°C)
Td – 345°C	Td – 350°C	Td – 370°C	Td – 365°C
T260 > 30min	T260 > 60min	T260 > 60min	T260 > 30min

特别用途耐热材料

用途： **Burn-in** 线路板, 集体线路基材, 无线通讯, 汽车, 细线/多层线路板背板

N5000	**N8000**	**N7000-1/ N7000-2HT / N7000ULV0**
双马来酰亚胺-三嗪- 环氧树脂	氢酸酯树脂 **Cyanate Ester**	无-**MDA** 聚酰胺 / **UL-V0** 等级
BT-Epoxy		
热性能	热性能	热性能
Tg - 180°C (by DSC method)	**Tg - 250°C (DSC)**	**Tg - 250°C to 260oC**
Td - 334°C	**Td - 376°C**	**Td - 375°C - 390oC**
T260 – >12 mins	**T260 – >12 mins**	**T260 – 12 to 30 mins**
热膨系数	热膨系数	热膨系数
x/y 轴 : 10 – 14 ppm/°C	**x/y 轴 : 10 – 13 ppm/°C**	**x/y 轴 : 9 – 15 ppm/°C**
Z 轴 : 3.4% **(50°C – 260°C)**	**Z 轴 : 2.5%** **(50°C – 260°C)**	**Z 轴 : 1.7 - 2.5%** **(50°C – 260°C)**
电性能	电性能	电性能
Dk : 3.7 (RC 50% **@ 1GHz)**	**Dk : 3.8 (RC 50%** **@ 1GHz)**	**Dk : 3.8 (RC 50%** **@ 1GHz)**
Df : 0.014 (RC 50% **@ 2.5GHz)**	**Df : 0.011 (RC 50%** **@ 2.5GHz)**	**Df : 0.015 (RC 50%** **@ 2.5GHz)**
应用	应用	应用
Burn-in 线路板, 集成线路基材， **FCP,CSP** 等	**Burn-in** 线路板 , 无线通讯, 高速计算机, 汽车	**Burn-in** 线路板 , 无线通讯, 高速计算机, 汽车

多功能 FR4

计算机外设, 电源, 计算机 打印机, 手机, 多层线路板

N4000-2	N4000-6	N4000-7
热性能	热性能	热性能
Tg - 140°C (by DSC method)	Tg - 175°C (by DSC method)	Tg - 150°C (by DSC method)
Td - 300°C	Td - 325°C	Td - 330°C
T260 – 8 to 12 mins	T260 – 4 to 8 mins	T260 – 16 mins
热膨系数	热膨系数	热膨系数
x/y 轴 : 12 – 16 ppm/°C	x/y 轴 : 12 – 15 ppm/°C	x/y 轴 : 12 – 15 ppm/°C
Z 轴 : 4.5% (50°C – 260°C)	Z 轴 : 3.8% (50°C – 260°C)	Z 轴 : 3.7% (50°C – 260°C)
电性能	电性能	电性能
Dk : 4.1 (RC 50% @ 1MHz)	Dk : 4.1 (RC 50% @ 1MHz)	Dk : 4.1 (RC 50% @ 1MHz)
Df : 0.023 (RC 50% @ 1MHz)	Df : 0.023 (RC 50% @ 1MHz)	Df : 0.010 (RC 50% @ 1MHz)

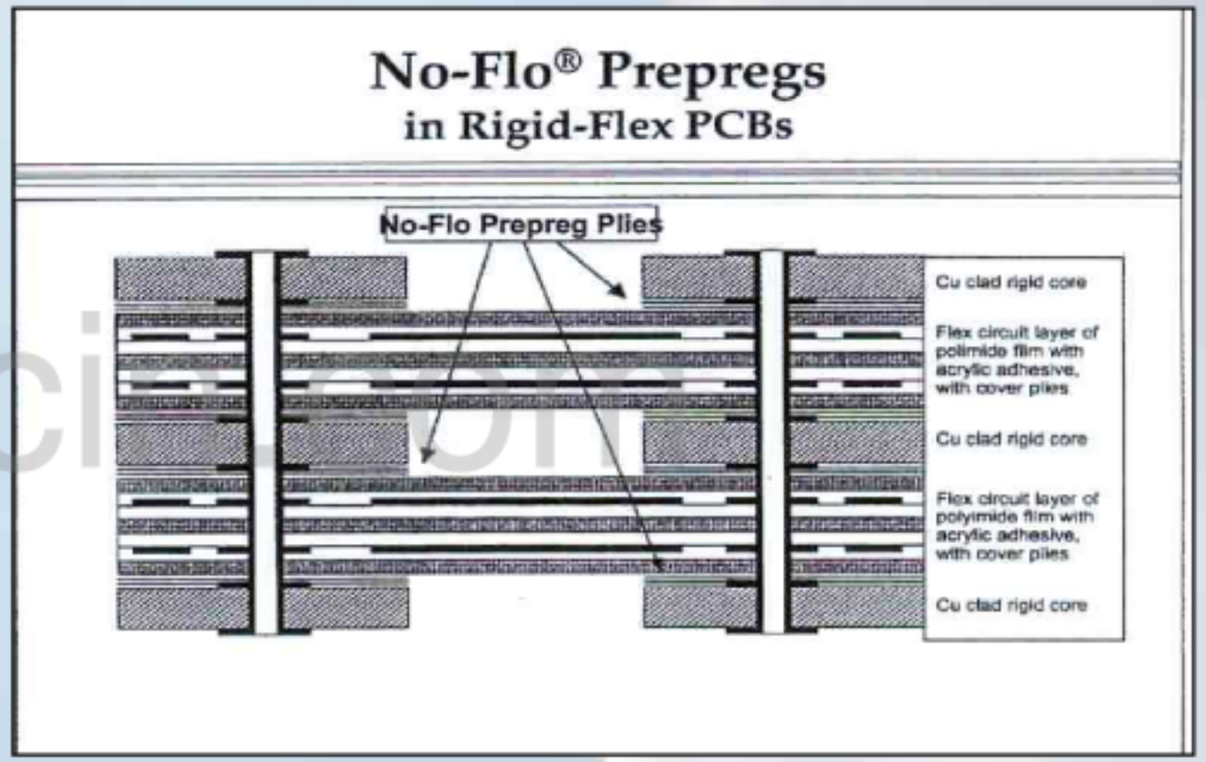
低流胶半固化片

应用: 散热片粘结, 硬软混合板

N4000-2 NF
Tg 125°C

N4000-6 NF
Tg 175°C

N4000-7 NF
Tg 155°C



环保，无铅装配用途

N4000-7EF

- 中与高 **Tg** 间(最低**160°C - DSC) FR-4**
- 无卤素
- 可用于无铅装配
- 阻抗电子迁移
- **Dk** 如同 **FR-4 (4.0 – 4.1 @ 1MHz)**
- **Df** 低于**FR-4 (0.013 @ 1MHz)**
- **UL 94-V0** 耐燃等级

Derivative Products:

N4000-2 NF
N4000-6 NF — **1080 No Flow (NF) prepreg for Rigid-Flex, Heat Sink bonding applications.**

LD™ Prepregs - **Spreading glass yarn 106, 1080 prepreg for Laser Drilling**

SI™ Glass - **106, 1080 and 2116 for better Signal Integrity**

BC ™ - **Available with N4000-6, N4000-11**

高性能材料

Tg 增加

N9000/NY9000
Woven glass reinforced PTFE

NH9000
Woven glass, Ceramic Loaded PTFE

N7000-1/N7000-2HT/N7000-2V0 — Tg260°C/ Tg250°C
Non-MDA Polyimide/ Toughened/ UL94V0

N8000 — Tg 250°C
Cyanate Ester

N9000-13RF — Tg 220°C
PTFE Blended Laminate

N4000-13/N4000-13SI/N4000-RF — Tg 210°C
High Speed, Low Loss Epoxy

N4000-12/N4000-12SI — Tg 190°C
High Speed, Low Loss CAF resistant System

N5000 — Tg 185°C
BT Epoxy

N4000-29 — Tg 185°C
High Thermal reliability Epoxy

N4000-11 — Tg 175°C
Low CTE Hi Tg Multifunctional Epoxy

N4000-6/N4000-6FC — Tg 175°C
Hi Tg Multifunctional Epoxy

N4000-7EF — Tg 165°C
165oC Tg Halogen Free Epoxy

N4000-7/N4000-7SI — Tg 155°C
Low CTE ultifunctional Epoxy

N4000-2 — Tg 140°C
Multifunctional Epoxy

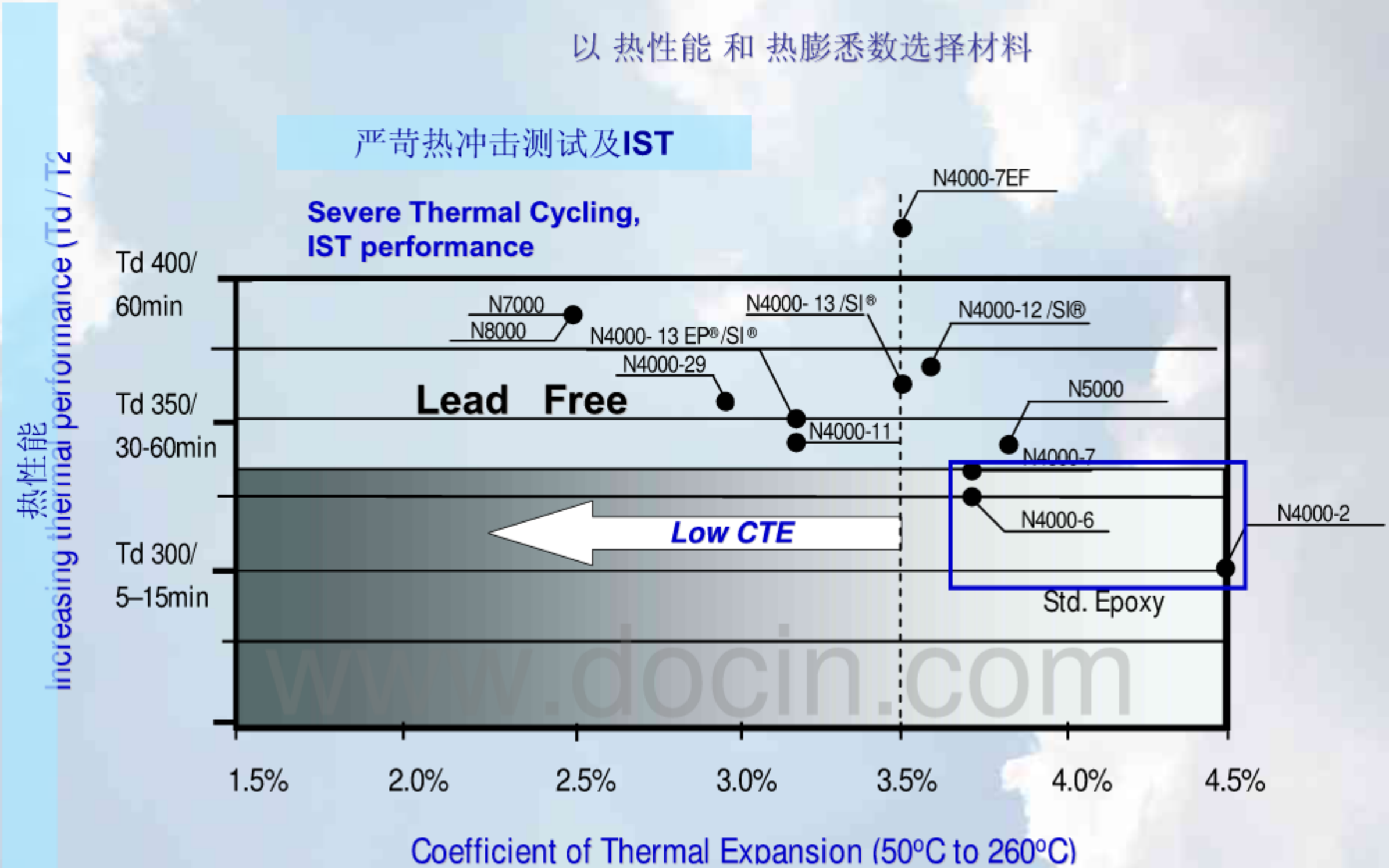
FR-4 环氧树脂

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

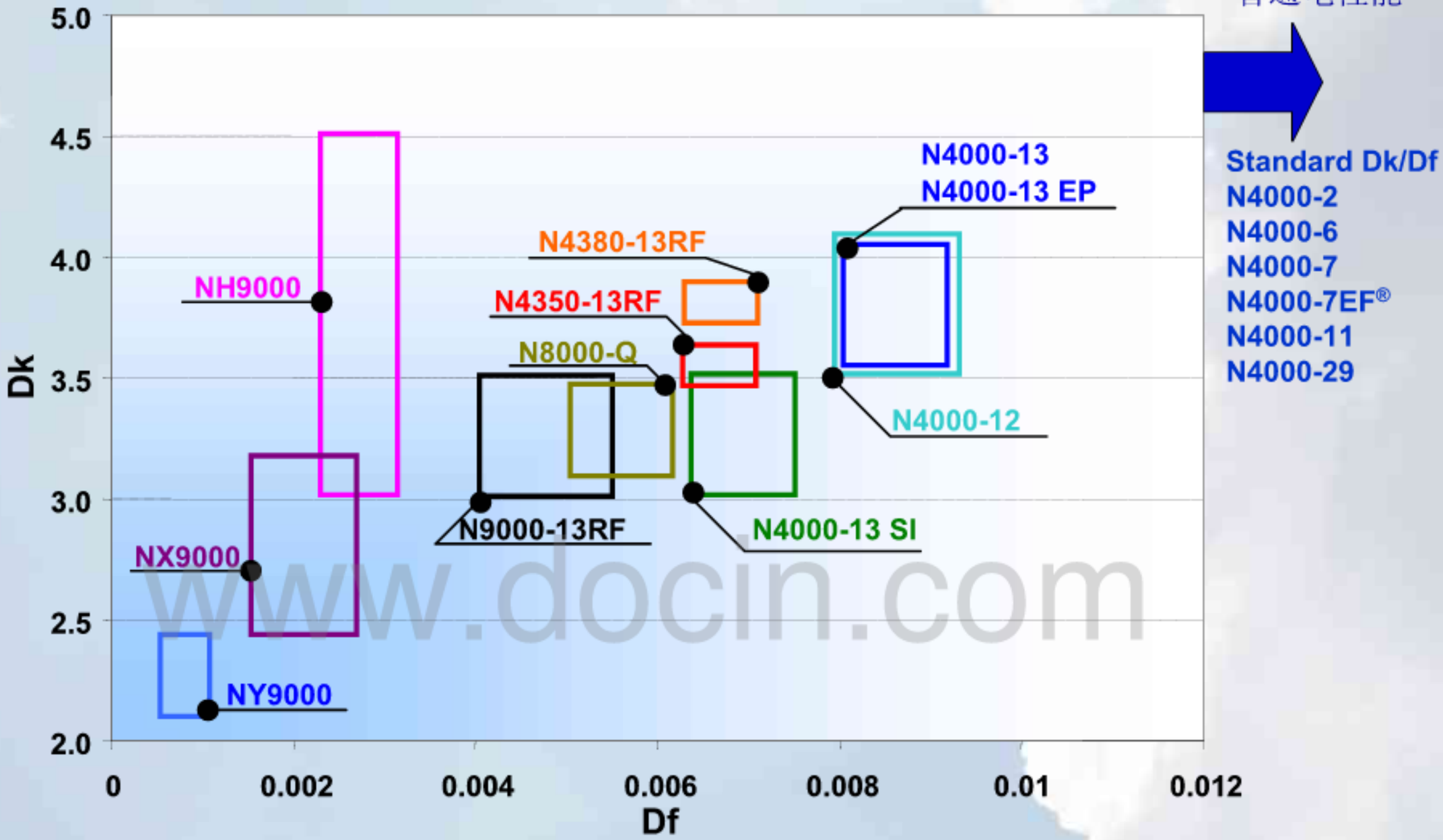
以 热性能 和 热膨悉数选择材料

严苛热冲击测试及IST



以 电性能 选择材料

普通电性能



Standard Dk/Df
N4000-2
N4000-6
N4000-7
N4000-7EF®
N4000-11
N4000-29

SI® = Signal Integrity Reinforcement

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies

谢谢

PARK ELECTROCHEMICAL CORP.

Nelco® and Nelcote™
Advanced Material Technologies