

ETERNAL MATERIALS



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PCB Applications and Opportunities for 5G

Photoresist Materials Business Division

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2019/11/18



- **Profile**
Overview 、 Development Milestones 、 Core Technology
、 Business Group 、 Global Production Sites 、 Global Service Network 、
R&D Sites 、 Annual Sales Distribution 、 R&D Honor
- **Financial Information**
- **Introduction of the Photoresist Materials Business Division**
- **PCB Applications and Opportunities for 5G**



Profile - Overview

- **Core Business** : Manufacturing, processing and sales
- **Founding** : in 1964, Headquarters in Kaohsiung, Taiwan
- **Year of Listed on Taiwan Stock Exchange** : 1994
- **Chairman** : Allen K. L. Kao
- **Number of Employees** : 4,747 ¹
- **Number of Production Sites** : 24 (3 in Taiwan, 14 in Mainland China, 1 in United States, 1 in Thailand, 3 in Japan, 1 in Malaysia and 1 in Italy)
- **Overall Sales Revenue in 2018** : USD 1,436 million ²
- **Headcounts of Researchers** : 559 (R&D expenditures accounted for 3% of sales revenue)

Eternal is:

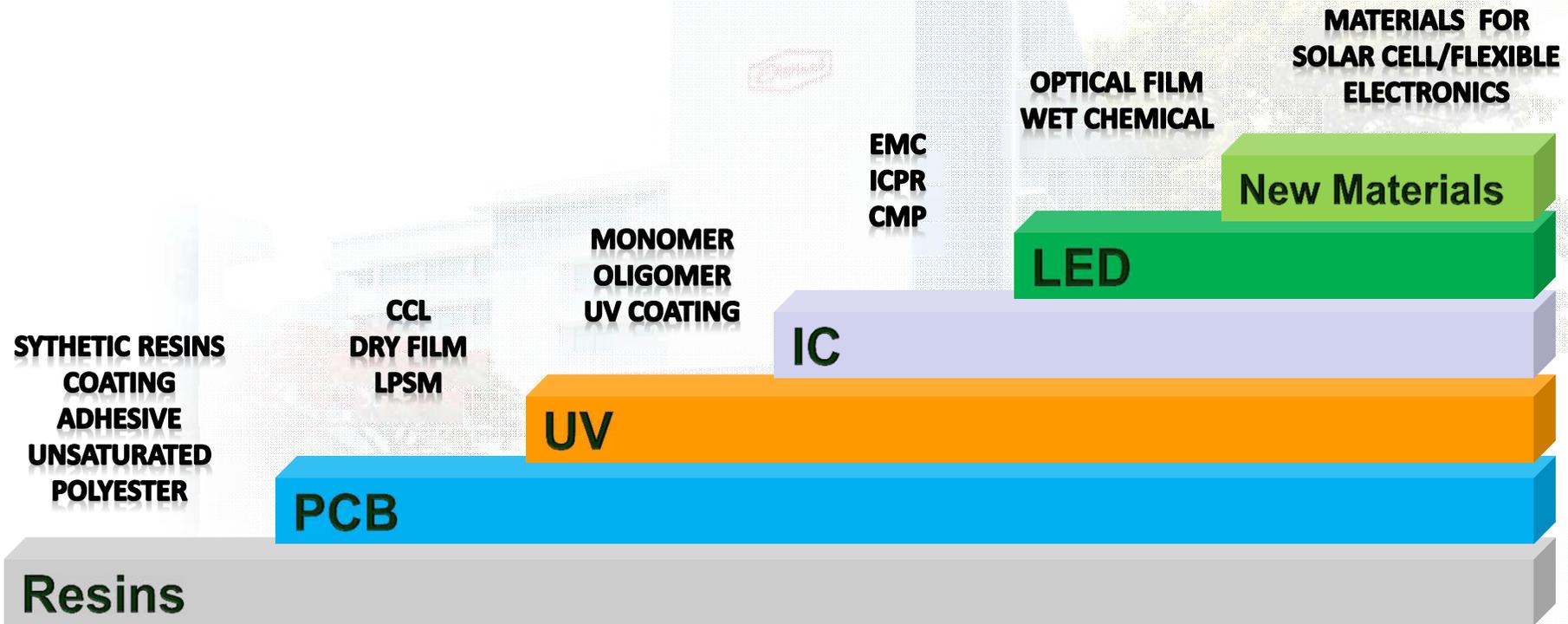
- One of the leading suppliers of Dry film photoresist in the world.
- One of three largest UV curable Monomers & Oligomers material suppliers.
- One of the leading suppliers of synthetic resin in Asian.

1.Number of Employees on September 30,2019

2.refer to year 2018 Consolidated statement

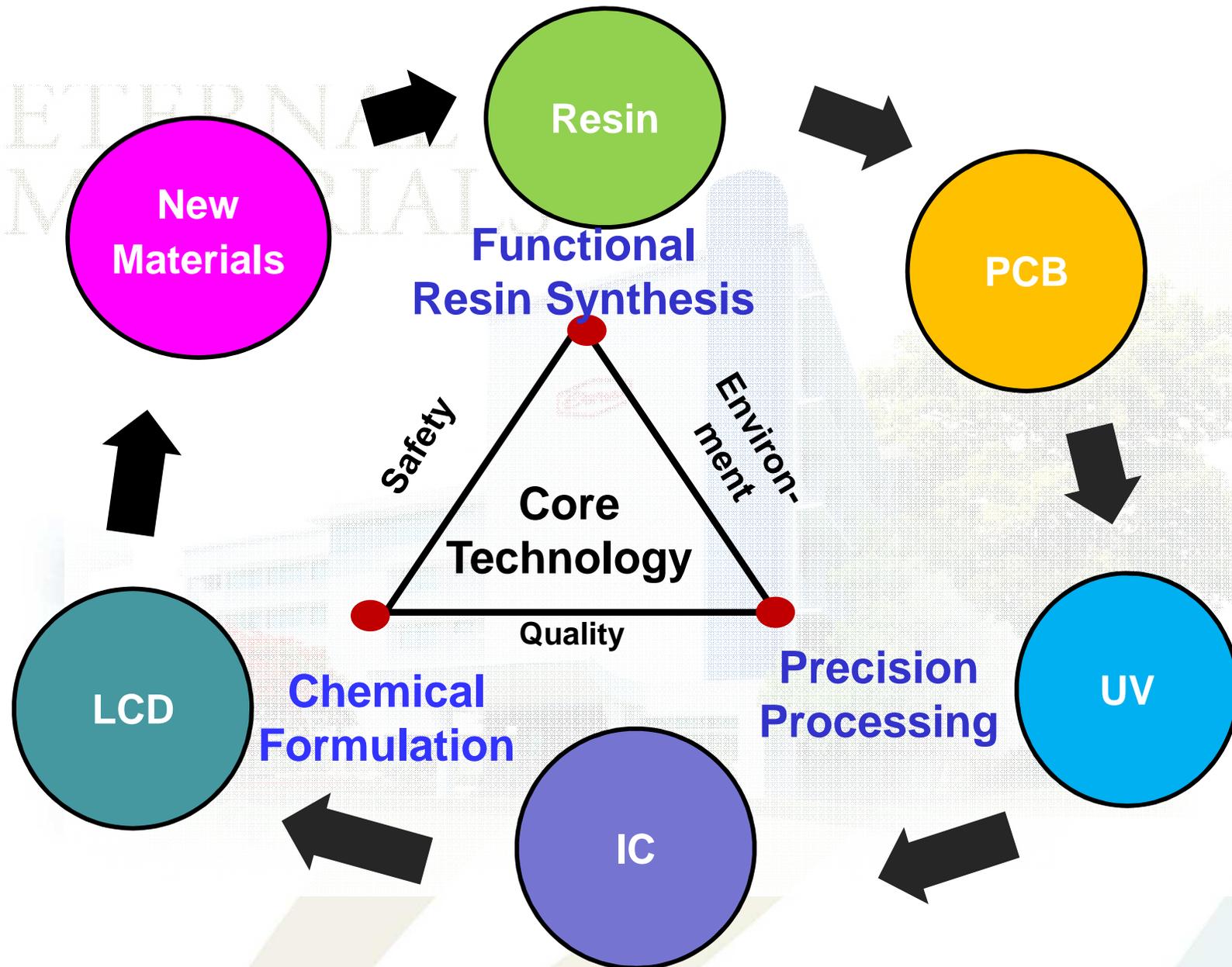


Profile-Development Milestones





Profile-Core Technology





Profile-Business Group

2018Y

Combined revenue NTD43.3 Billion

Resins Materials



- Synthetic Resins Business Division
- Unsaturated Polyester Resins Division

Electronic Materials

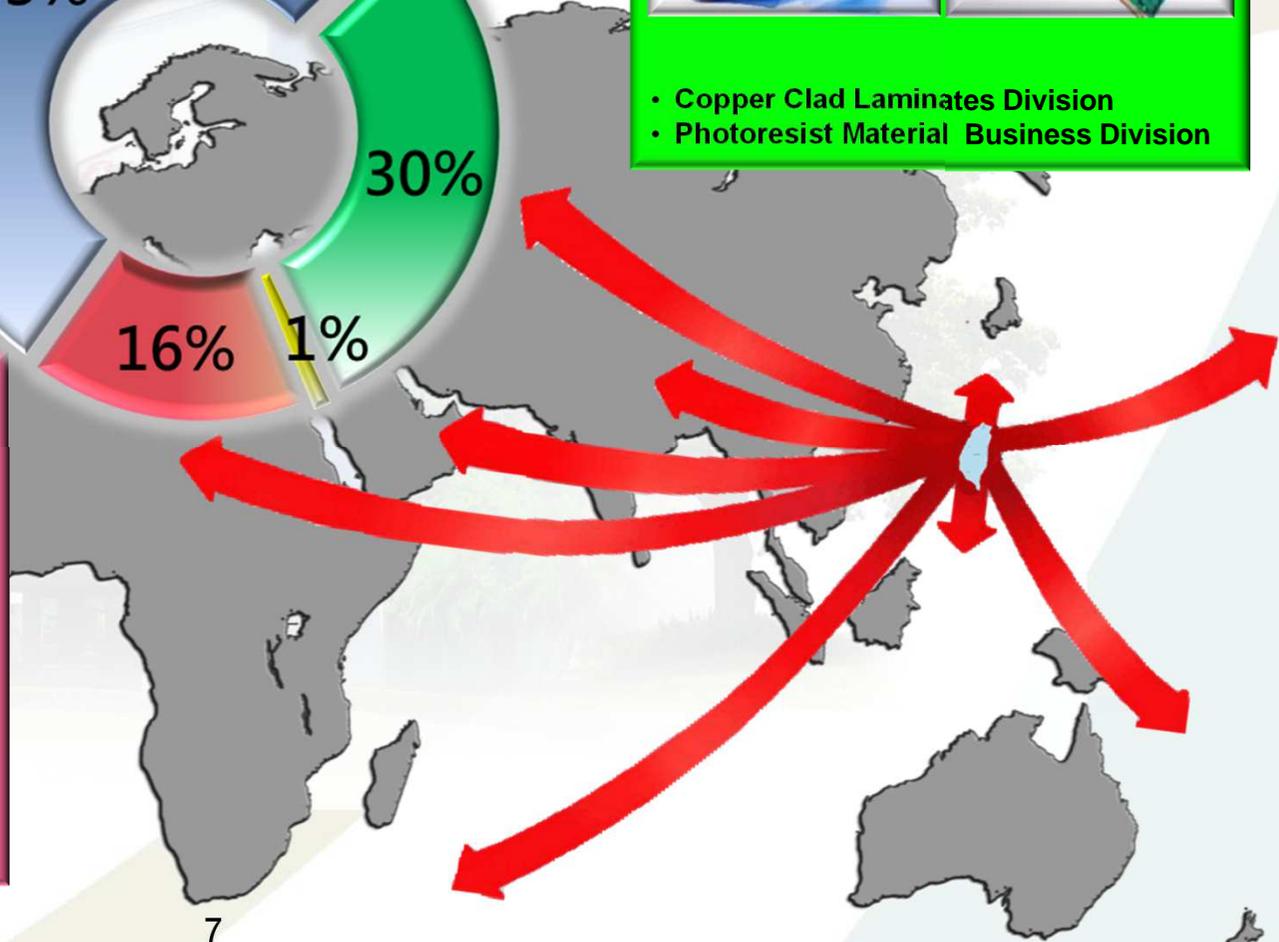
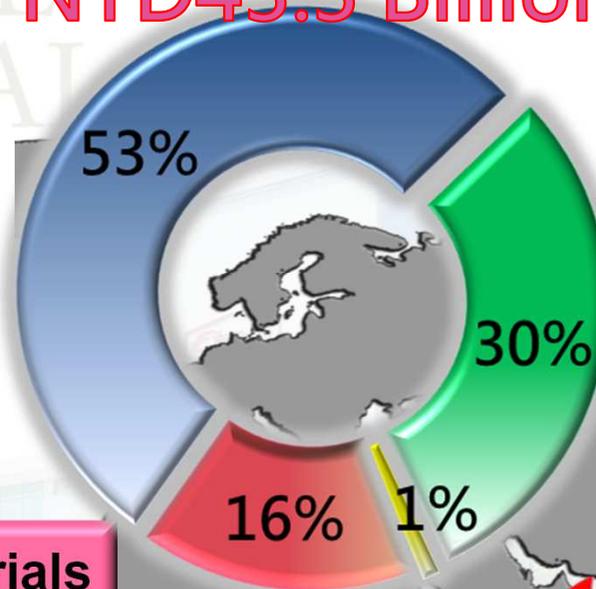


- Copper Clad Laminates Division
- Photoresist Material Business Division

High Performance Materials



- Specialty Material Division





Profile-Global Production Sites

Global Production Sites :24

- Taiwan : 3
- China : 14
- Thailand : 1
- USA : 1
- Japan : 3
- Malaysia : 1
- Italy : 1



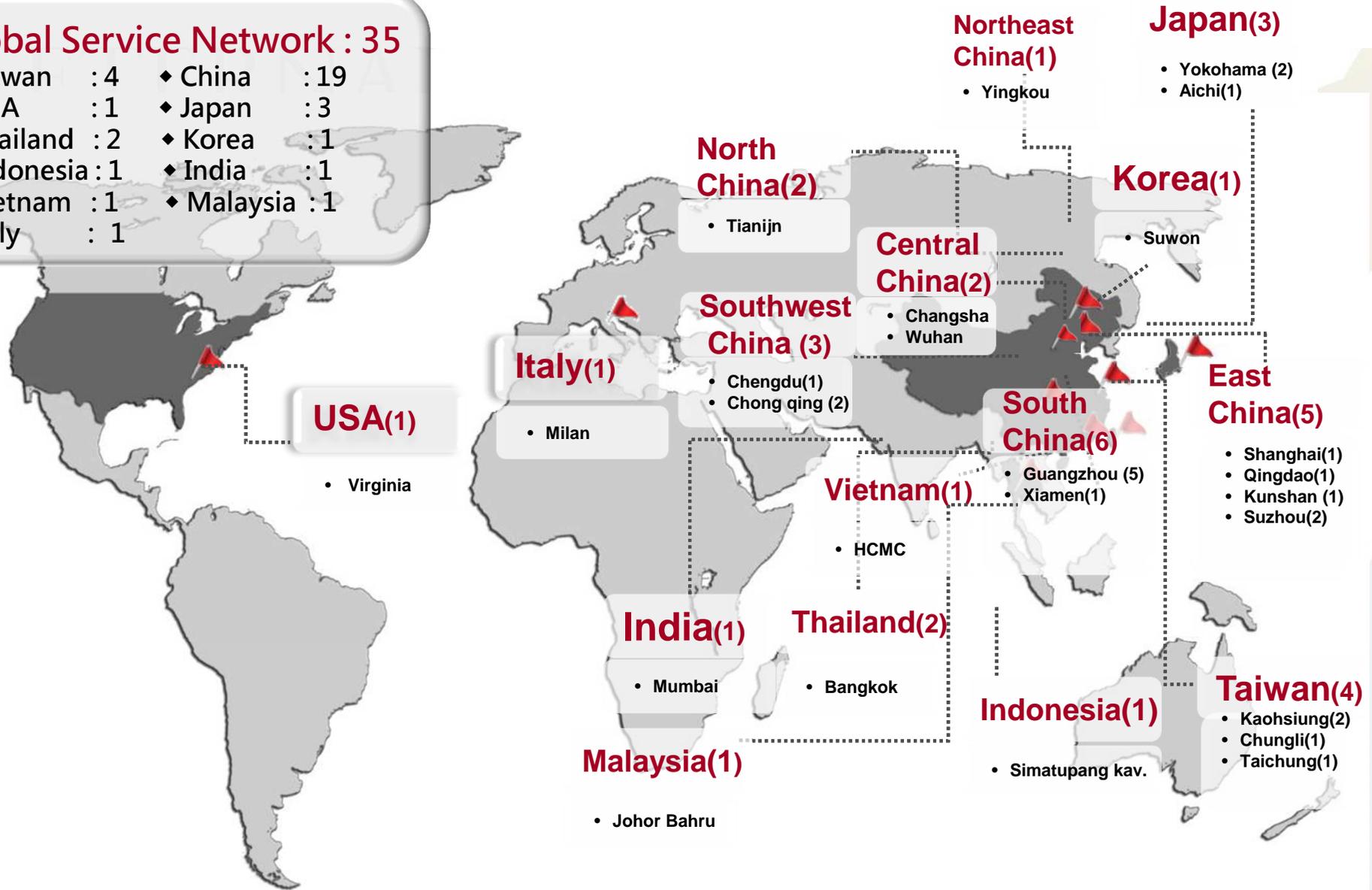
P.S. "Changzhou plant" in preparation



Profile-Global Service Network

Global Service Network : 35

- ◆ Taiwan : 4
- ◆ USA : 1
- ◆ Thailand : 2
- ◆ Indonesia : 1
- ◆ Vietnam : 1
- ◆ Italy : 1
- ◆ China : 19
- ◆ Japan : 3
- ◆ Korea : 1
- ◆ India : 1
- ◆ Malaysia : 1





Profile-R&D Sites



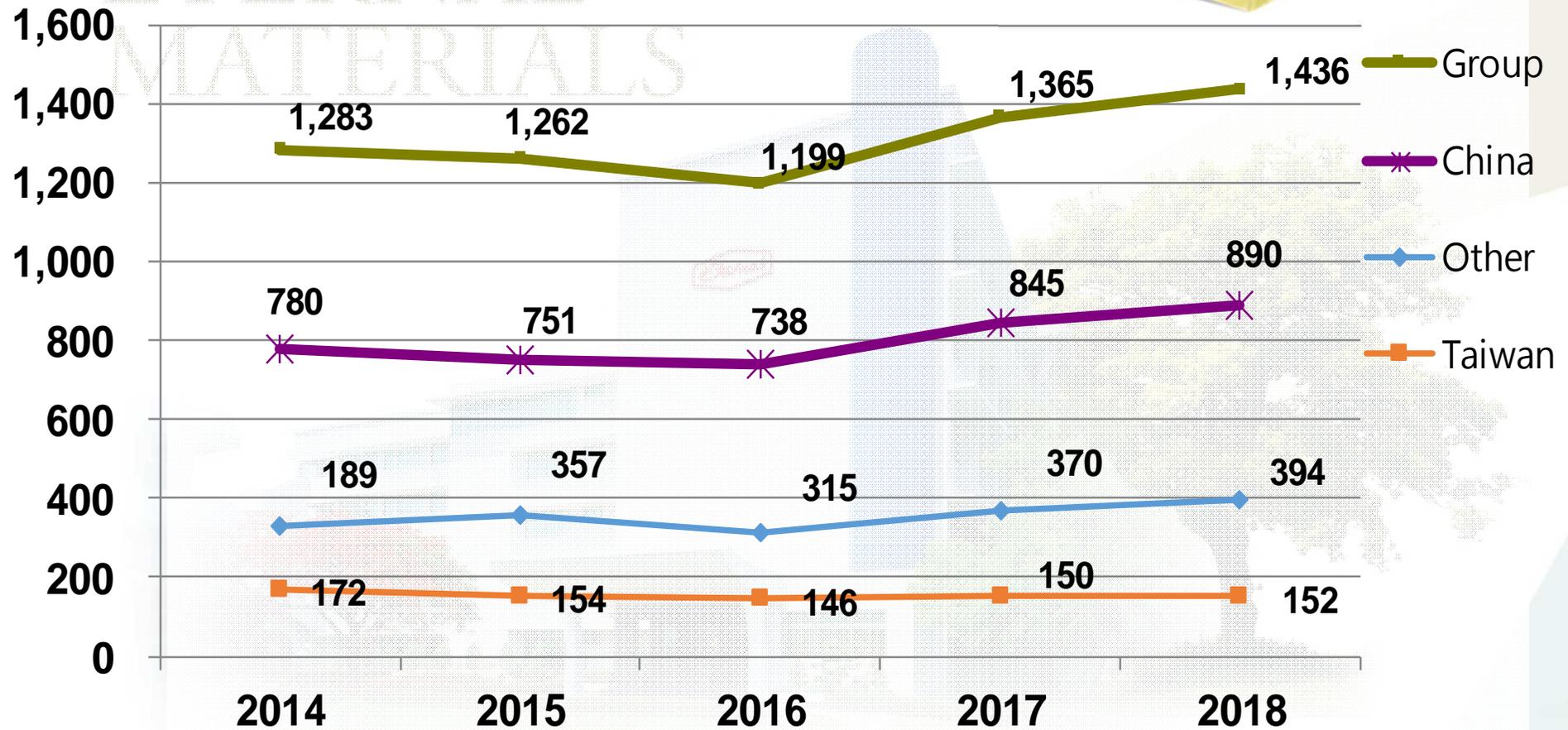
-  1. Taiwan – Research & Development Center
-  2. China – Mainland China R&D Center
-  3. China – Beijing laboratory
-  4. The laboratory of plant (*8)





Profile-Annual Sales Distribution(In the recent 5 years)

Unit : USD million





R&D Honor

- 1990 **Best performance manufacturer on new product R&D for Specialty Monomer products**
- 1992 **Best performance manufacturer on new product R&D for Dry Film products**
- 1993 **Outstanding Award for Industrial Technology Advancement granted by MOEA**
- 1995 **Excellent Award for Industrial Technology Advancement granted by MOEA**
- 1997 **Best performance manufacturer on new product R&D for Image Material**
- 2001 **Distinguished Award for Industry Technology Advancement, the highest honor granted**
- 2005 **Honored NBIA International Incubation Award from Open Laboratory /Incubation Center of ITRI**
- 2007 **Awarded Innovation Elite Prize of Taiwan nanotechnology (Industry Award) by Taiwan Nanotechnology Industry Development Association**
- 2008 **Awarded Industrial Contribution Prize in TCIA Industrial Excellent Award 2008**
- 2010 **Awarded Outstanding Enterprise Innovation Award by Taiwan Nanotechnology**
- 2018 **Awarded Chinese Society for Management of Technology**



Financial Information

Balance Sheet & Main Financial Index

In Millions of New Taiwan Dollars

Items	2019Q3		2018		2017	
	Amount	%	Amount	%	Amount	%
Cash and cash equivalents	6,787	<u>12</u>	6,085	<u>11</u>	7,984	<u>14</u>
Accounts receivable	15,488	<u>29</u>	14,783	<u>27</u>	14,977	<u>27</u>
Inventories	7,312	<u>13</u>	7,918	<u>15</u>	7,803	<u>14</u>
Financial assets	2,954	<u>5</u>	2,820	<u>5</u>	2,791	<u>5</u>
Property, plant and equipment	17,492	<u>32</u>	18,792	<u>35</u>	18,465	<u>33</u>
Total Assets	55,110	<u>100</u>	54,360	<u>100</u>	56,466	<u>100</u>
Current liabilities	18,037	<u>33</u>	14,483	<u>27</u>	18,125	<u>32</u>
Long-term borrowings	11,114	<u>20</u>	14,166	<u>26</u>	12,988	<u>23</u>
Total Liabilities	33,294	<u>60</u>	32,735	<u>60</u>	35,398	<u>63</u>
Total Equity	21,816	<u>40</u>	21,625	<u>40</u>	21,068	<u>37</u>
Key Financial Ratio						
Average cash collection days	140		128		125	
Average days required for sale	87		81		79	
Current ratio	175		212		183	



Financial Information

Statement of Comprehensive Income

In Millions of New Taiwan Dollars

Items	2019Q3		2018		2017	
	Amount	%	Amount	%	Amount	%
Operating revenues	30,192	<u>100</u>	43,300	<u>100</u>	41,551	<u>100</u>
Gross profit	5,750	<u>19</u>	7,280	<u>17</u>	7,438	<u>18</u>
Operating expenses	(4,020)	<u>(13)</u>	(5,467)	<u>(13)</u>	(5,576)	<u>(14)</u>
Profit from operations	1,730	<u>6</u>	1,813	<u>4</u>	1,862	<u>4</u>
Non-operating income and expenses	525	<u>1</u>	51	<u>0</u>	409	<u>1</u>
Net profit attributable to owners of the company	1,914		1,550		1,910	
Net profit margin	6		3		4	
EPS	1.54		1.25		1.54	
ROE	12		7		9	



Financial Information - Cash Flow Statements

In Millions of New Taiwan Dollars

	2019Q3	2018	2017
Cash and cash equivalents at the beginning of the year	6,085	7,984	8,227
Cash flows from operating activities	4,125	2,883	(468)
Acquisition of property, plant and equipment	(1,661)	(2,479)	(3,003)
Increase (decrease) in short-term borrowings	73	(873)	2,873
Increase (decrease) in long-term borrowings	(1,034)	(1,338)	2,140
Dividends paid	(1,116)	(579)	(1,656)
Other items	646	627	204
Effects of exchange rate changes on cash and cash equivalents	(331)	(140)	(372)
Cash and cash equivalents at the end of the period	6,787	6,085	7,945*
Free cash flow	2,464	404	(3,471)

Note: Free cash flow=

Cash flows from operating activities - Acquisition of property, plant and equipment

* Cash and cash equivalents at the end of the year	7,945
Other items that meet the International Accounting Standards No. 7 Cash and Cash Equivalents Definitions	39
Cash and cash equivalents in the consolidated balance sheets	7,984



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Introduction of the Photoresist Materials Business Division

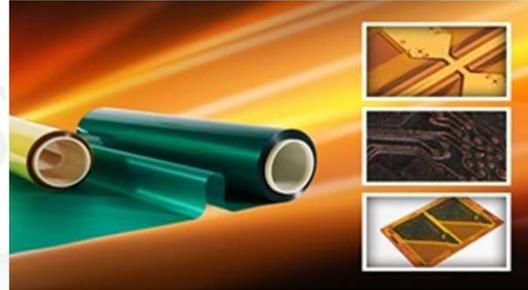


PM Division-Product Category

Dry Film Photoresist



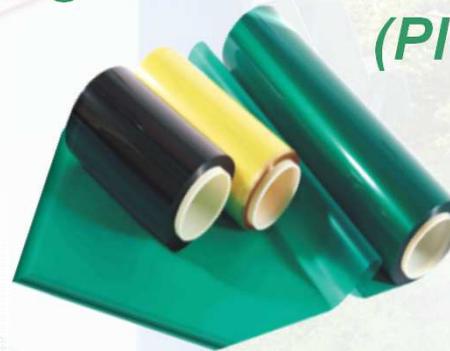
Photosensitive Dry Film Solder Mask



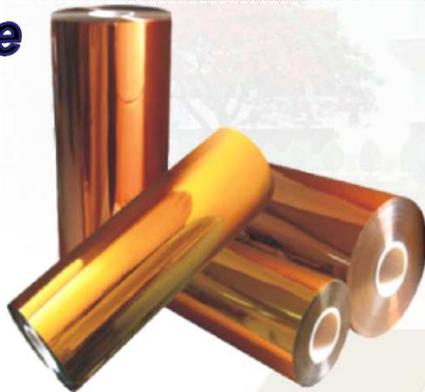
Vacuum Laminator



Photo-Imageable Coverlay (PIC)



Dry Film Photosensitive Polyimide



Liquid UV Curable Marking Ink



Toll Coating Service

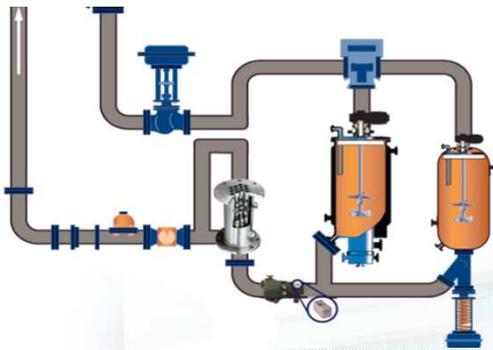


PM Division-One-Stop Service



For Better Quality and Higher Efficiency

Varnishing



Coating



Slitting



Logistics

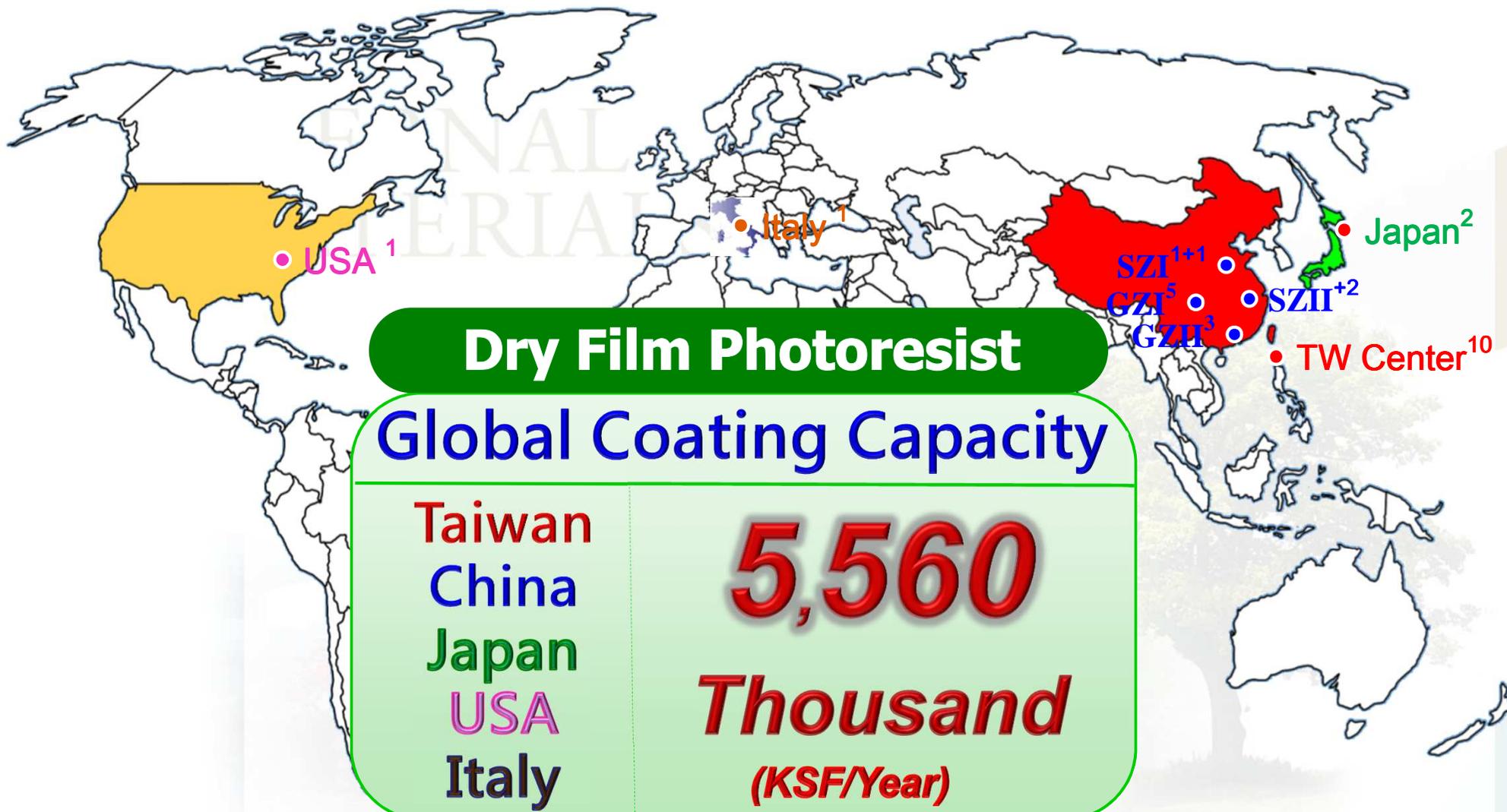


- ① $22\pm 2^{\circ}\text{C}$, $<60\% \text{RH}$
- ② $5\pm 3^{\circ}\text{C}$
- ③ $-20\pm 2^{\circ}\text{C}$



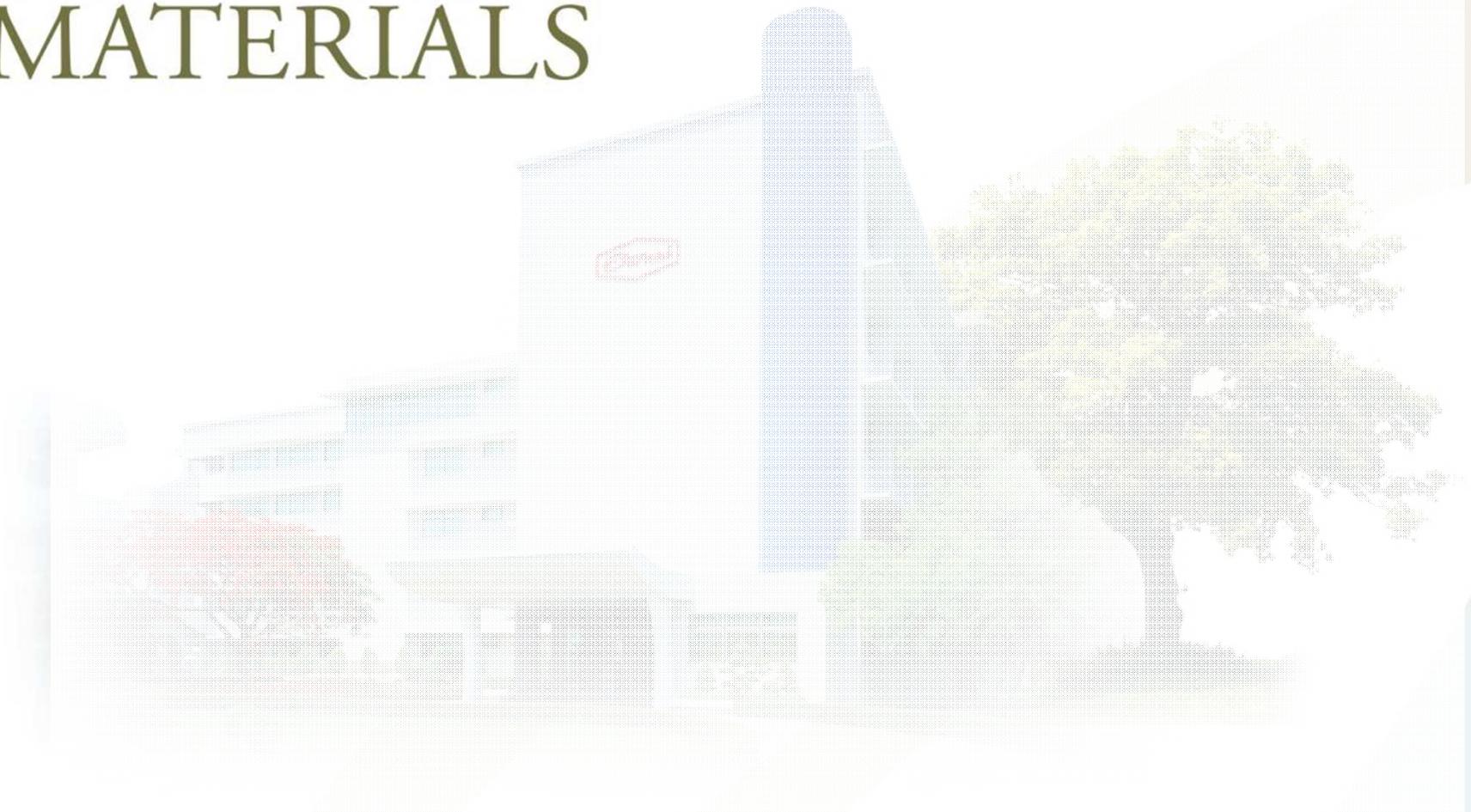


PM Division-Global Coating Capacity



Coating Process Capability Thickness
50nm ~ 300um

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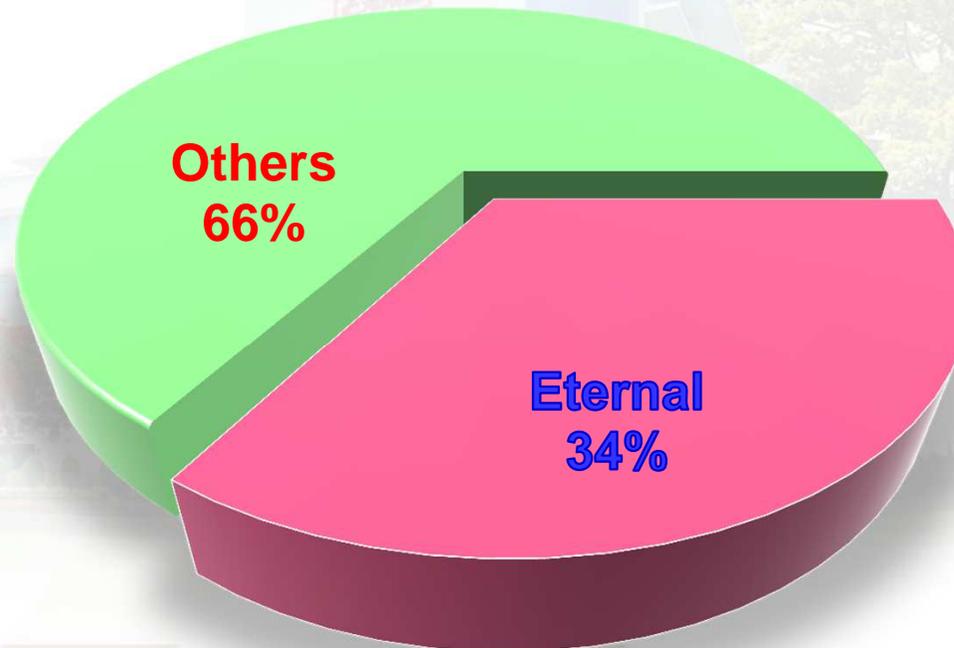
PM Division-Dry Film Market Share

Global Dry Film Market Size Update (2016~2020)

■ Global DRF Market Size (2016 ~ 2020)

Ten Thousand KSF	2016	2017	2018	2019(F)	2020(F)
Dry film Market Size	1,020	1,122	1,206	1,170	1,225

Eternal's Dry Film Market Share 34%

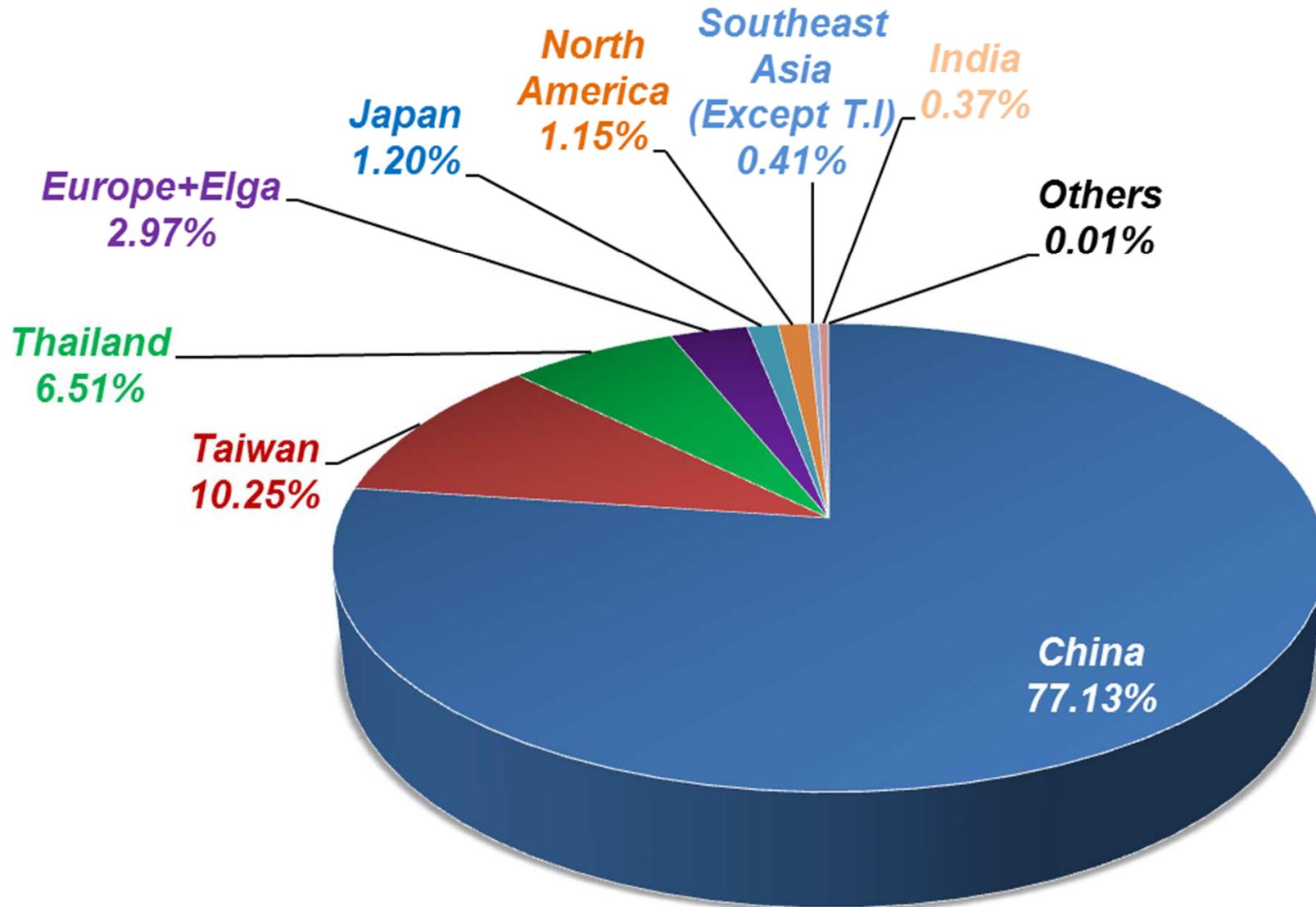


Source: Analysis and update by Eternal Market Report



PM Division-Dry Film Market Share

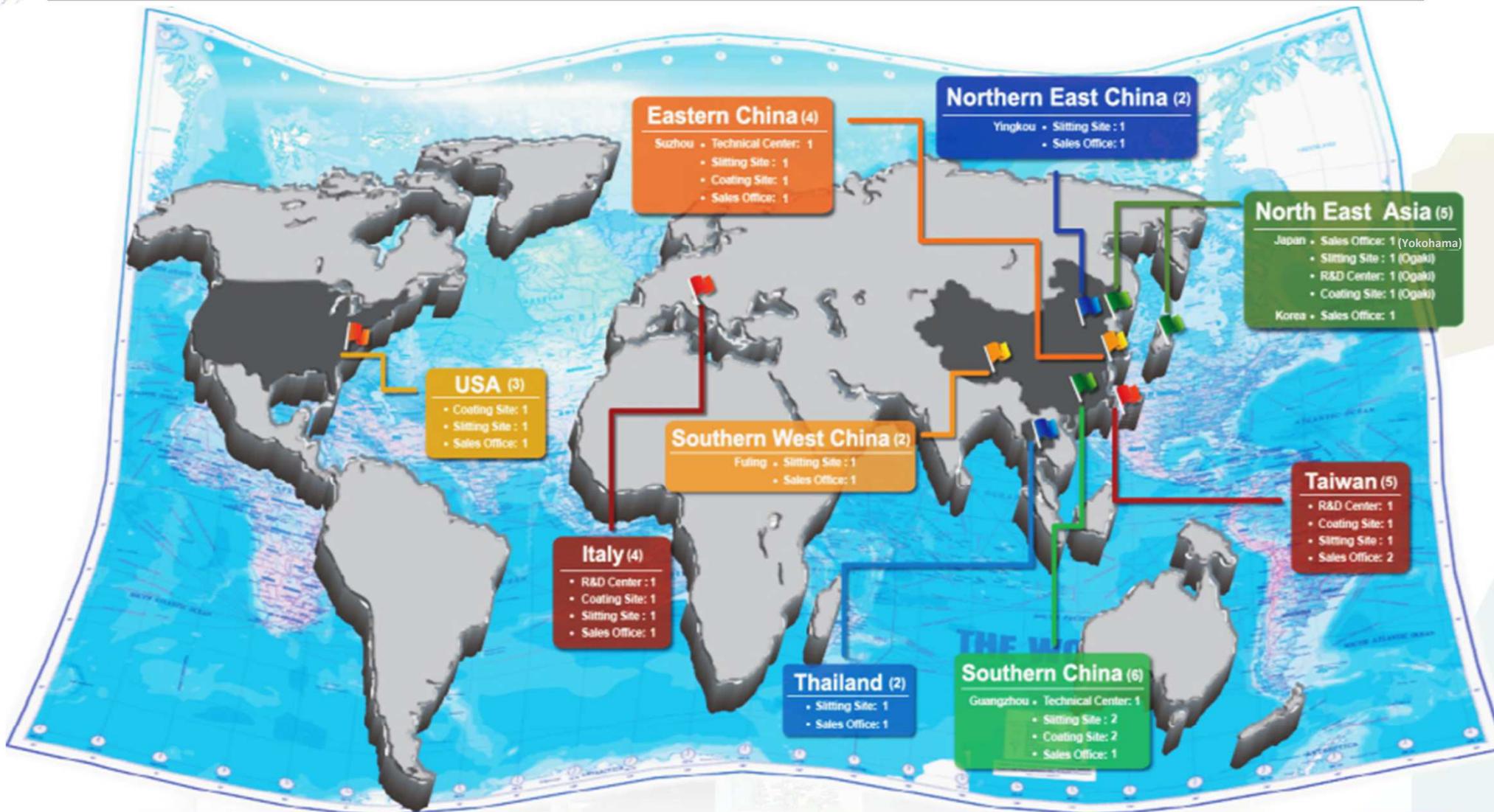
Eternal's Dry Film Market Share



Statistical period: 2019Y Jan~Aug



PM Division-Global Layout



Worldwide Locations

- R&D Center: 3
- Coating Site: 7
- Technical Center: 2
- Slitting Site: 10
- Sales Office: 11
- Taiwan: 5
- Japan: 4
- Korea: 1
- China: 14
- Thailand: 2
- USA: 3
- Italy: 4



PM Division-Coating Sites

USA –Virginia (1)



Europe –Italy (1)



Eastern China
Suzhou (1)



Taiwan – Kaohsiung
Coating Research Center (1)



7 Coating Plants

Japan – Ogaki (1)



Southern China
Guangzhou (2)





PM Division-Coating Sites

2 Coating Lines for Metal Foils

South China Guangzhou

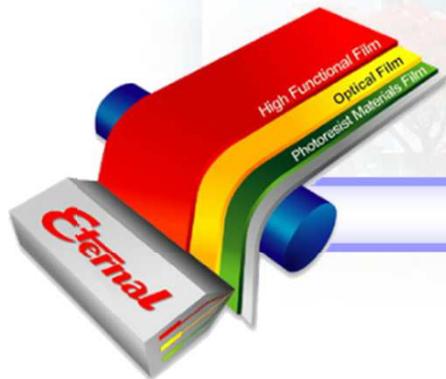


China: 1 Coating Line

Taiwan – Kaohsiung Coating Research Center



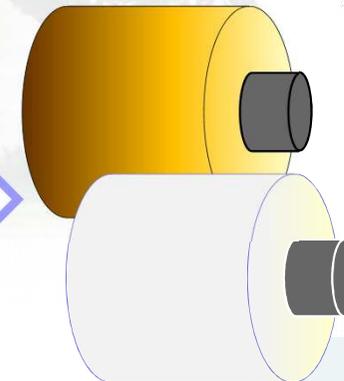
Taiwan: 1 Coating Line



Copper Foil



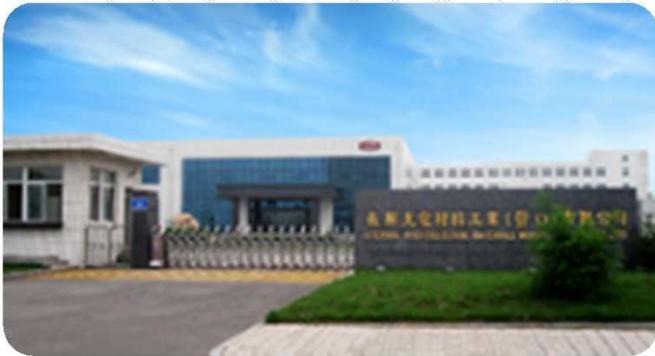
Aluminum Foil





PM Division-Slitting Site/Sales Office

Northern East China



Yingkou (Slitting:1 / Sales:1)

Eastern China



Suzhou (Slitting:1 / Sales:1)

Southern West China



Fuling (Slitting:1 / Sales:1)



China
Slitting:5
Sales:4

Southern China



Guangzhou (Slitting:2 / Sales:1)



PM Division-Slitting Site/Sales Office

 USA : 2	 Japan : 2
 Italy : 2	 Korea : 1
 Thailand : 2	 Taiwan : 3

Japan



Ogaki
(Slitting:1)



Yokohama
(Sales:1)

Taiwan



Ta-Fa Plant
(Slitting:1 / Sales:1)



Zhongli Office
(Sales:1)

Italy



Milan
(Slitting:1 / Sales:1)

Korea



Gyeonggi-do
(Sales:1)

Thailand



Bangkok
(Slitting:1 / Sales:1)

USA



Virginia
(Slitting:1 / Sales:1)



PM Division-Related Certificates





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PCB Applications and Opportunities for 5G



What is 5G

On June 22, 2015, the International Telecommunication Union (ITU) announced that IMT-2020 (International Mobile Telecommunication-2020) will be the technical standard for the future 5G. The development forecast is as follows:

- Enhanced Mobile Broadband:
Mobile broadband rate 10 Gbps (LTE 100 times)

eMBB

8K · AR · VR · Holography



- Ultra-reliable and Low Latency Communications:
End-to-end delay will be reduced (LTE 1/10 times)

URLLC

Autonomous vehicle · Industrial automation



- Massive Machine Type Communications:
Number of mobile connections 1000K/Km2 (LTE 100 times)

mMTC

Smart Home

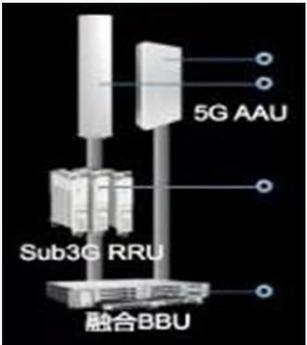
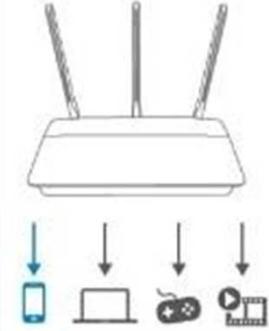


- 5G requires four to five times the number of 4G Base Station and a large number of small Small Cell.



5G market and application

Early stage

	Infrastructure		Mobile terminal	User terminal Equipment	5G Application
	Macrocell	Small Cell	SmartPhones	Router/Switch	Network Equipment
Application Equipment					
Critical module	Antenna、Power amplifier、Communication backplane	High Speed Multilayer PCB、High frequency microwave PCB	Upper/Lower Antenna、RF Related	Antenna、Communication high-speed multilayer PCB	Network module
Related require	Large Size、Multi-layer、High Frequency/High Speed	High Frequency/High Speed、Material mixing	Flexible Antenna	High Frequency/High Speed、Material mixing	Large size、Multi-layer、High Frequency/High Speed、Metal PCB
Potential Market Start time	big 2018	big 2019	bigger 2020~	medium 2020~	bigger 2021~

Source : ITRI

Overall 5G market

In the early stage, the business opportunity was started with the base station hardware, followed by the 5G smart phone, and the long-term includes the car, industrial control, agriculture....

PCB Materials

Relying on low signal loss materials

- The Rigid PCB material is mainly Teflon.
- FPC materials are based on LCP and modified PI.

PCB Maker

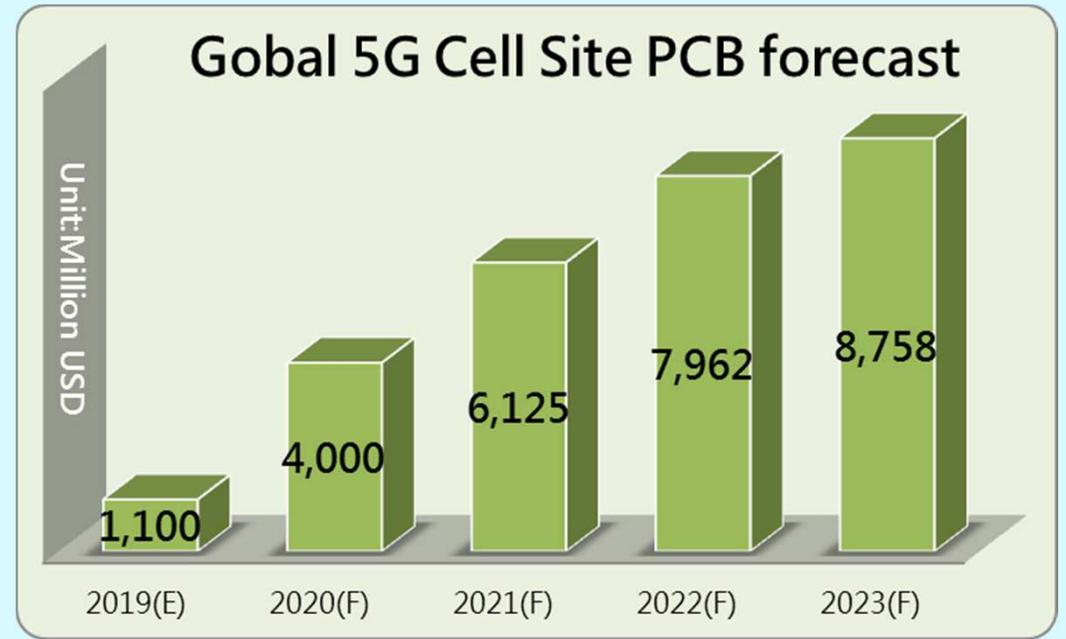
- The base station antenna, power amplifier, communication backplane, and IC carrier board are mainly required.
- After 2020, 5G mobile phones will drive demand for FPC.
- PCB factory - In addition to 5G high frequency / high speed board requirements, there are also heat dissipation design, thin board precision thin road and high impedance matching.



5G Base Station PCB market analysis

Gobal 5G Cell Site PCB forecast

- The 5G base station is about 4 to 5 times more than the 4G base station . Each Cell Site has about 6 to 10 high-speed multilayer PCB.
- In 2019, there were about 500,000 5G base station in the world, and in 2020, it has increased to more than 2 million.



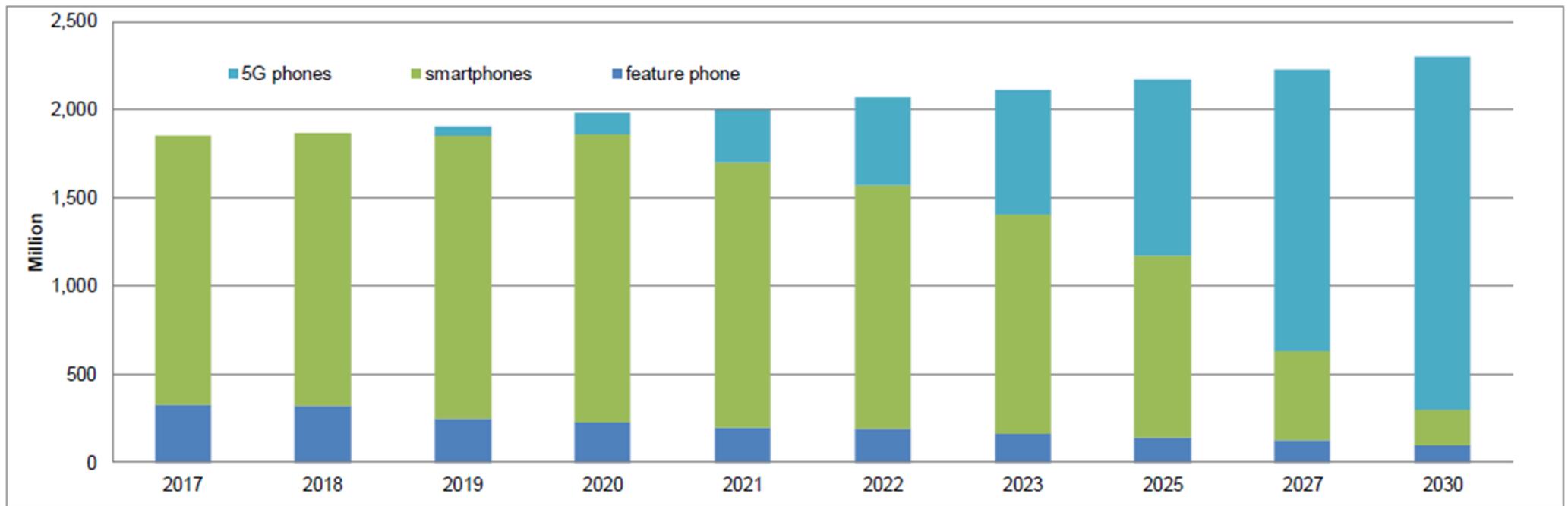
Source : ITRI

■ Taiwan's PCB makers still mainly supply European and American cell site PCB maker

	European	Korea	China
Cell site maker	Ericsson/NOKIA	Samsung	華為、中興
5G Cell site market share	44%	21%	37%
PCB suppliers and potential vendors	BoardTek、GCE、WUS、SCC、SYTECH、First Hi、New Era、Allied Circuit	SEMCO(IC Substrate)、Ibiden(IC Substrate)	Fonder、SYTECH、WUS、Unimicron(IC Substrate)、kinsus (IC Substrate)、Nan Ya(IC Substrate)、SCC



5G Smart phones market analysis



Source: Compiled by JMS using Gartner's data

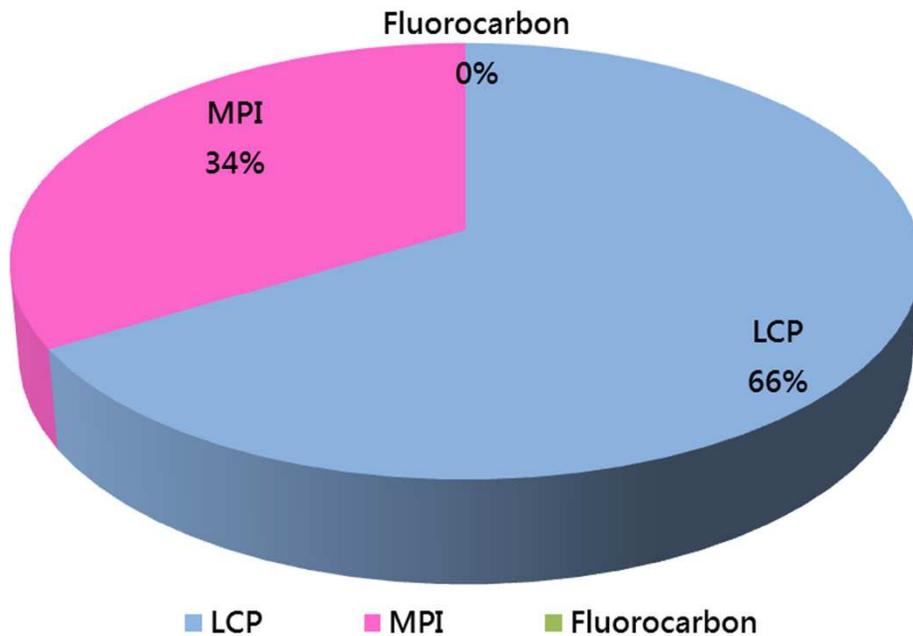
- In 2019, global smart phone shipments were estimated at 1.9 billion, of which 5G smart phones were only about 5 million, accounting for only 0.26%.
- It is estimated that the shipment of 5G smart phones will reach 700 million in 2021, accounting for 33% of the total. The 5G smart phone is still the growth and replacement power of smart phones in the future.
- 5G is expected to go up to 2 antenna design, and the cost of RF front-end components is relatively higher, 3 times more than the average 4G.
- Because high frequency transmission requirements, FPC substrate uses modified PI and LCP.



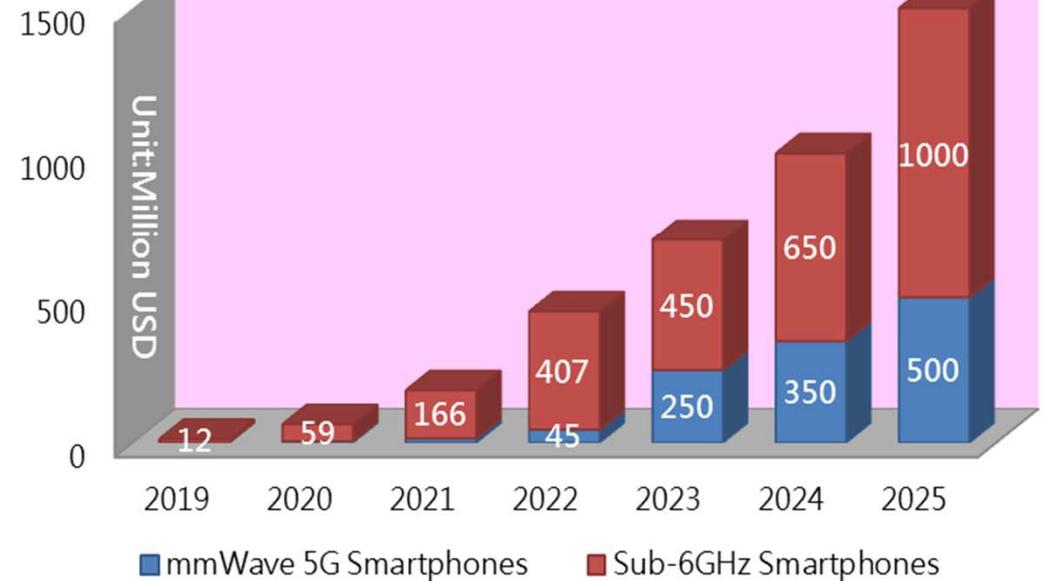
5G FPC market analysis

- The main impact of 5G on the FPC market is that smart phone antenna modules must be designed with high-frequency materials and require a large number of FPC.

2020Y Market Share -Volume



5G Smartphones(M)



Source : (Estimated by JMS)

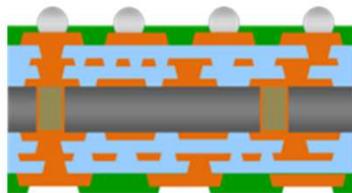
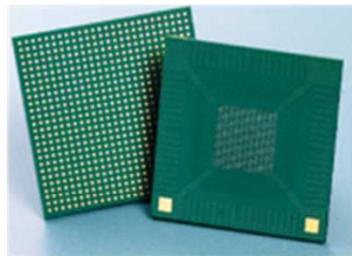
- The traditional FPC substrate is mainly based on PI, and the modified PI and LCP FPC are used in response to high frequency transmission requirements. °



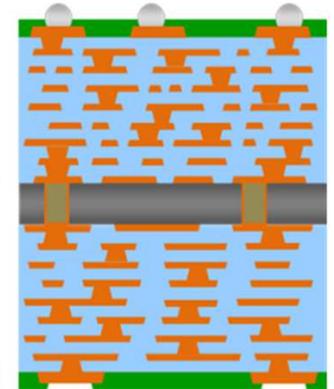
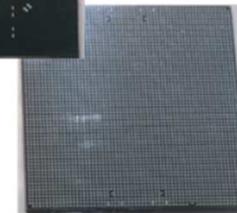
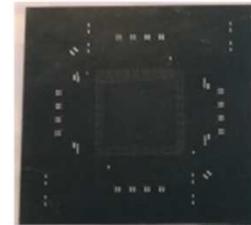
5G IC Substrate market analysis

- The demand for 5G Netcom, IOT, AI, and high-performance computing (HPC) has increased, driving the growth of servers and large-scale multi-layer high-end IC substrate, and the number of FCBGA IC substrate or line density of Netcom equipment is increasing under the technical specifications of high-speed transmission ICs. Both have significantly improved, and the IC carrier is expected to grow 4.9% in the next five years.
- Due to the increased number of FCBGA layers and line density, high-resolution dry film photoresist (L/S<10/10um) and high-performance ABF vacuum lamination equipment will be more important.

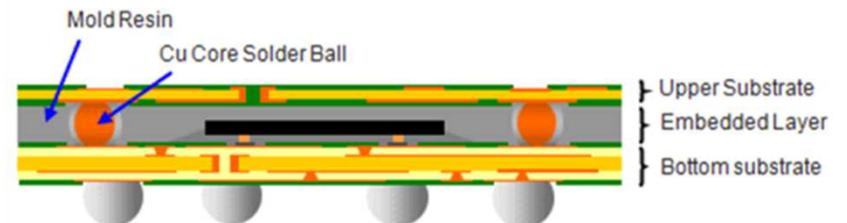
Future Trend of FCBGA



Normal FCBGA · Application for CPU, Graphic.....



Large Size · Multilayer · Application for Networking

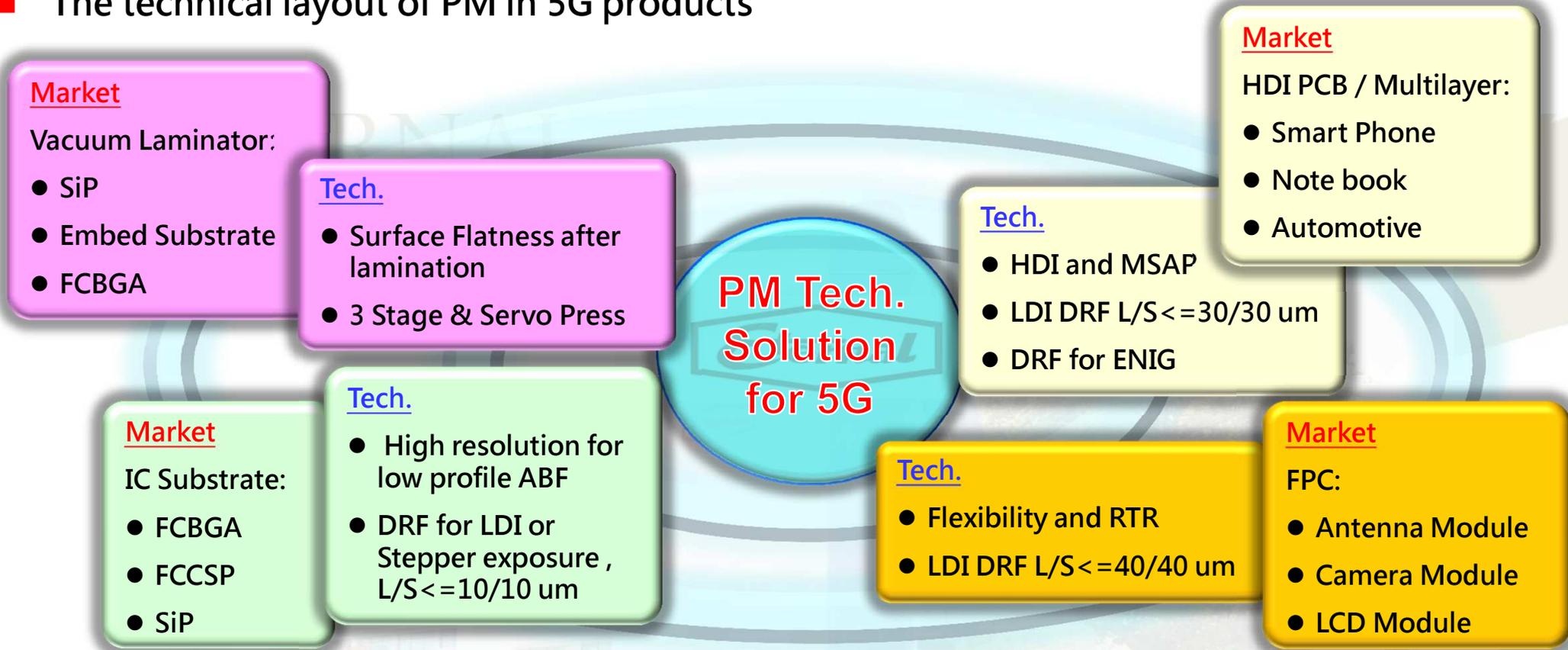


Heterogeneous Integration · Application for consumer.....



Opportunities of PM in 5G products

■ The technical layout of PM in 5G products



■ PCB Opportunities by Products

	2000	2017	2018E	2023E	2018-2023F CAAGR	2018/2017	2018-2023F CAAGR
Multilayer	22,217	22,392	24,564	30,297	0.6%	9.7%	4.3%
HDI	2,074	8,968	9,222	10,661	8.6%	2.8%	2.90%
Package Substrate	3,505	6,696	7,554	9,606	4.4%	12.8%	4.90%
Flex	3,450	12,523	12,395	14,231	7.4%	-1.0%	2.80%

Unit : Million USD

Source: Prismark 2019

■ In the next 5 years, PCB drive products will come from IC Substrate > Multilayer > HDI and FPC. In response to the growth of IC Substrate and ABF FCBGA, in addition to the demand for dry film photoresist, Eternal vacuum laminator is expected to have grow up more than 10% next year.



Conclusion

1. Dry film photoresist is mainly used in the PCB industry. In addition to driving PCB basic materials, chemicals and process equipment, the future 5G applications will directly drive the overall number of PCBs.
2. The demand for 5G base stations will drive the overall demand for PCB hard boards. The PCB area used by a single 5G base stations is about 50% larger than that of 4G base stations. Since 5G uses high-frequency channels, the ability of signals to bypass obstacles is reduced, and more base stations must be built to increase signal coverage, which is about 4 to 5 times larger than that of 4G base stations.
3. 5G Smart phones: because the demand for high-frequency transmission, the overall demand for the FPC has increased, mainly using modified PI and LCP on the antenna module.
4. Applications such as 5G communication, AI artificial intelligence, and high-performance computing (HPC) drive demand in various industries in the market. The 5G communication chip uses FC-BGA IC substrate with ABF material, and the number of layers is increased from 6~10 to 8~20. The IC substrate area will be expanded from 37.5x37.5 mm to 67.5x67.5 mm, and the overall quantity and unit area will increase. In response to the growth of ABF FCBGA, in addition to the demand for dry film photoresist, it will also drive the growth of Eternal ABF vacuum laminator.



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Thank you