< New market survey report >

FO-WLP and RDL dielectric material

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Subjects and Focal points of survey

<Subjects of survey>

◆ FO-WLP (Fan-out Wafer Level Package):

- Chip-First type, RDL-First type

  * But RDL-first type FO-WLP not using photolithography for semiconductor is not included.

◆ Dielectric material:

- Liquid type, Film type
- Photosensitive (positive/negative) and non-photosensitive

<Companies surveyed>

▼ FO-WLP assembler

- ASE, SPIL, TSMC, Amkor, STATS ChipPAC, Nanium, J Devices, Infineon, Freescale, Toshiba, Fujitsu laboratories, Others

▼ Dielectric material supplier

- Sumitomo Bakelite, HD Microsystems, Toray, Asahi Kasei E-Materials, Fujifilm EM, JSR, Asahi Glass, Shin-Etsu Chemical, Ajinomoto FT, Dow Chemical, Others

Focal points of survey

▼ FO-WLP

1. Main driver of Market growth
   - By application IC: AP, BB/RF, PMIC, Substitute PKG of 2.5D IC,
   - By needs: miniaturized wiring, low-profile PKG, cost reduction…

2. Technical issues for cost reduction and market expansion
   - Shift from wafer based assembly to panel based assembly, and Enlargement of assembly work size
   - Technologies and issues to realize panel based assembly and multi-RDL

▼ Dielectric material

1. Market growth of dielectric material
   - By usage（Buffer coat, FC bump, RDL, Others)
   - By form (liquid and film) of RDL materials for FO-WLP

2. Technical demands of RDL dielectric materials for FO-WLP:
   - Required characteristics for FO-WLP and the assembly process

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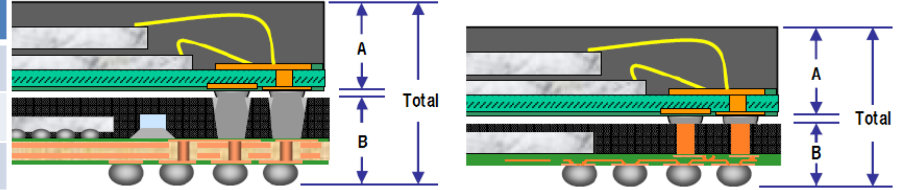
Samples of contents (from Chapter 2)

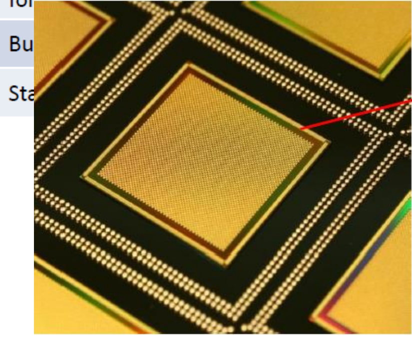
【Types of FO-WLP and the comparisons】

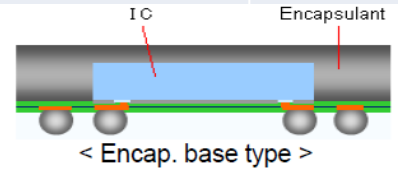
	Encapsulated base	PCB technology	RDL-First
Process type	Chip-First	Chip-First	RDL-First
Wafer/Panel	Wafer/Panel	Panel	Wafer/Panel
Work size (at present)	~ 300mm wafer	~ 400 x 500mm panel	300mm wafer
Su for			
Bu			
Sta			

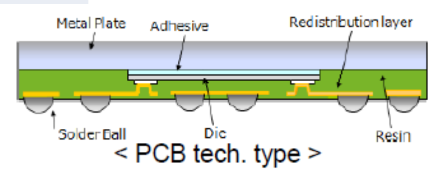
【Comparison of PKG height of AP by type (Left: FC-CSP based PoP, right: FO-WLP based PoP) 】

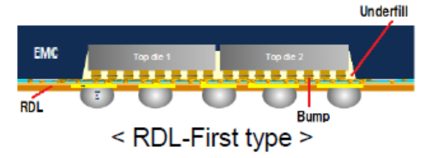


【Structure of TSMC's InFO-WLP】

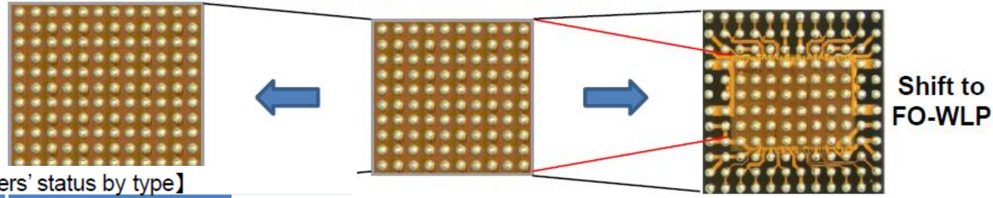




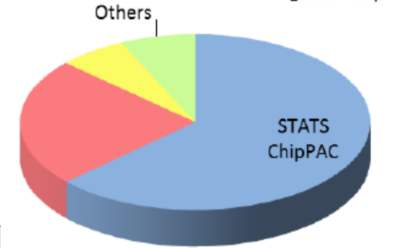




【Technical comparison for the increase of IO number in WL-CSP】



【Multi chip PKG】



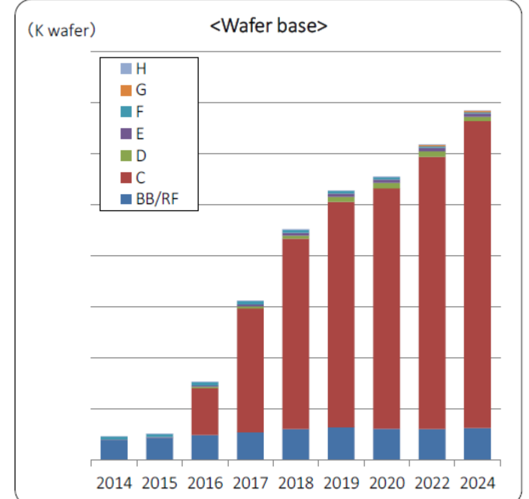
【List of FO-WLP assemblers' status by type】

Assembler	Name	Type of FO-W	
		Encap. Base*1	PCB tech.
		✓	
Amkor Technology	WLFO		
	SWIFT/SLIM		
ASE	aWLP		

【Market size forecast of FO-WLP by application and assembly work base

		2014	2015	2016	2017	2018
BB/RF for Mobile	Wafer base	143				
	Panel base	0				
AP	Wafer base	0				
	Panel base	0				
	Wafer base	0				
		0				

【Market size forecast of the assembled FO-WLP on wafer base 】



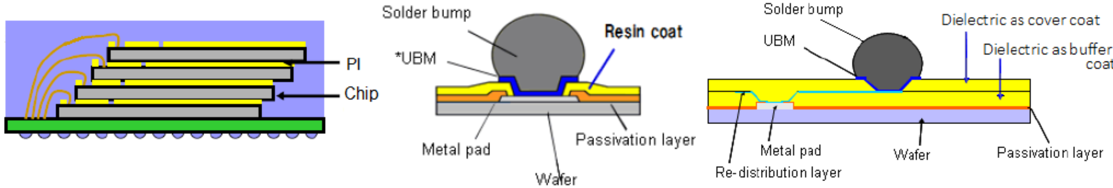
【Production status of FO-WLP assemblers by # of RDL in 2014 (in volume)】

	# of RDL layer				
	1-layer	2-layer	3-layer	4-layer & more	Total
STATS ChipPAC					
Others					
Total (K pieces)					

【Adoption possibility of FO-WLP type by application IC】

IC type and the combination of ICs	The present PKG type	Encap. base		P T
		Wafer	Panel	
AP for Smartphone	PoP, FC-CSP			
...	2.5D (+3D) PKG			
...	FC-CSP, FO-WLP	✓	P	

Samples of contents (from Chapter 3)



【Comparison of Spin-less coating methods】

	Slit coater	Spray coater	Ink-jet coater
	Stage		
Coating speed	~200mm/s	40mm/s	10～100mm/s
Film thickness uniformity *	±3 ~ 5%	±5%	±3 ~ 5%
Material utilization ratio	approximately %	approximately %	approximately %
Range of the liquid viscosity that coaters can apply			
RDL dielectric material application to a panel			

【 Types and usage of dielectric materials 】

Type of dielectric material		Usage
Photosensitivity	Polymeric material	
Photosensitive (Positive/Negative), Non-photosensitive	Polyimide (PI), Polybenzoxazole (PBO), Benzocyclobutene (BCB), Phenol, Epoxy, Others	Stress buffer coat, Passivation for bump, Interlayer dielectrics, Adhesive

【 Market size forecast of RDL dielectric materials for FO-WLP by form of material 】

		2014	2015	2016	2017	2018	2019
Liquid	Volume (t)						
	Amount (K USD)						
	Average (USD/kg)						
Film	Volume (m^2)						
	Amount (K USD)						
	Average (USD/m^2)						
Total	Amount (K US						

【 General status of manufacturers of dielectric material for semiconductor coat by type 】

	Form of material		Photosensitive/Non-photo			Polymeric type		
	Liquid	Film	Posi	Nega	Non-photo	PI/PBO	Others	
Ajinomoto Fine-Techno	✓	✓						
	✓							
Asahi Kasei E-Materials	✓							
Dow Chemical	✓							
	✓							

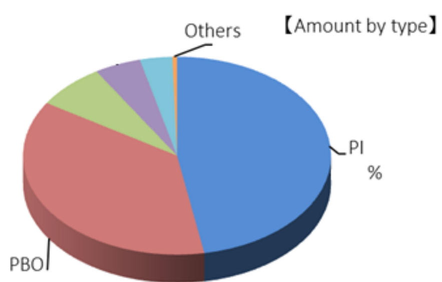
【 Required characteristics of RDL dielectric material for FI-WLP

		WL-CSP	FO-WLP	
Number of layers of RDL dielectric material		1 ~ 2-Layer	2-L and more (mainly 2~3)	· 1 l abo · 2 forı
Thickness of a dielectric	As buffer coat layer	Approximately 5μm		
	As cover coat layer	~ μm		
Chemical resistance				
…				

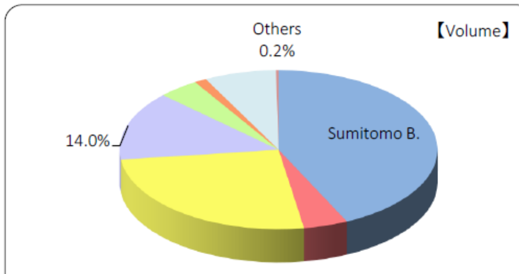
【 Sales status of dielectric material manufacturers by usa

	Volume (kg)			
	Buffer C.	FC bump	RDL	
HD MicroSystems				
Toray Industries				
Others				
Total				

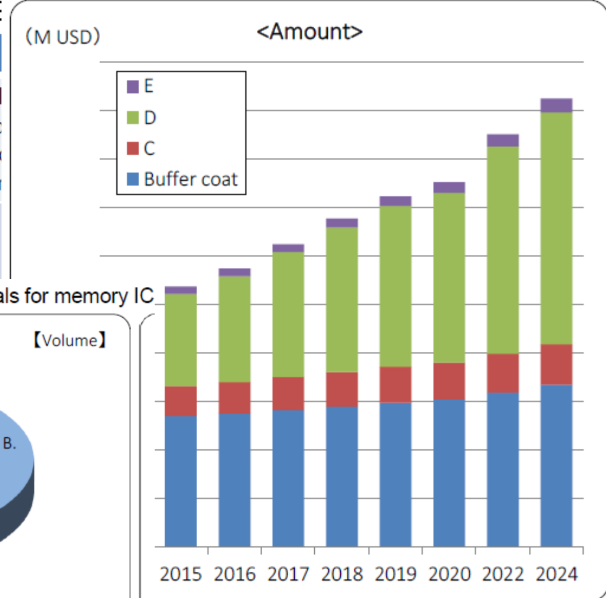
【 Market ratio of dielectric materials by type of polymer 】



【 Market share of buffer coat dielectric materials for memory IC



【 Market size forecast of liquid dielectric materials by usage 】



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