고분자 전자재료 기술동향

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ORGANIC ELECTRONIC MATERIALS FOR IC PACKAGE

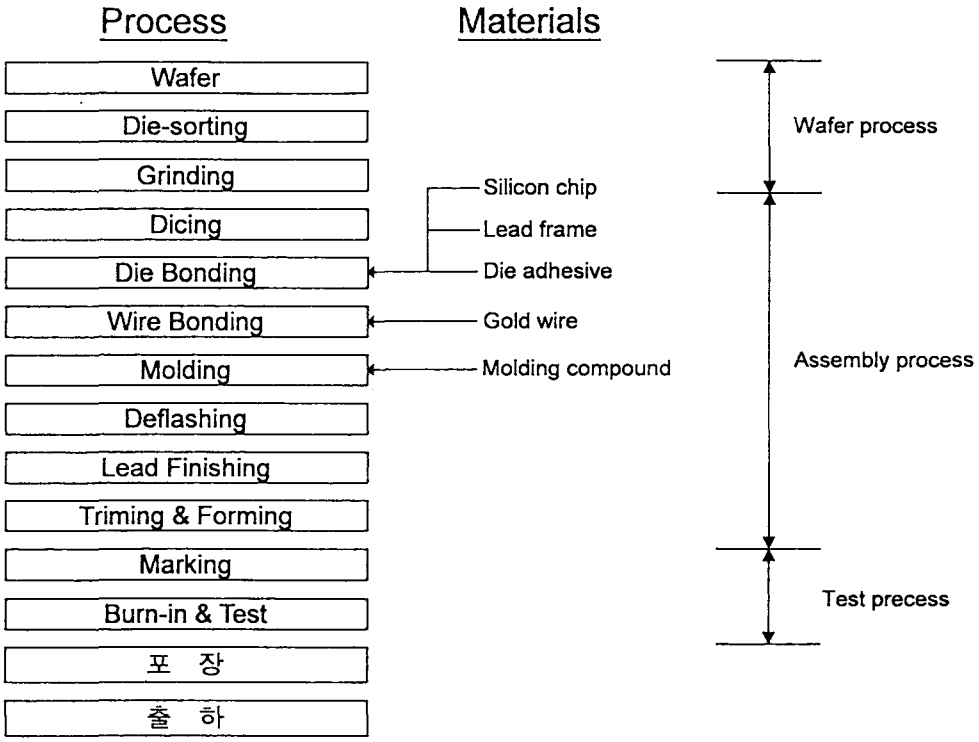
- Epoxy Molding Compound (EMC)
- Photoresist (PR)
- Polyimide Buffer Coating
- Process Chemicals

재료의 국산화 현황 및 구성비

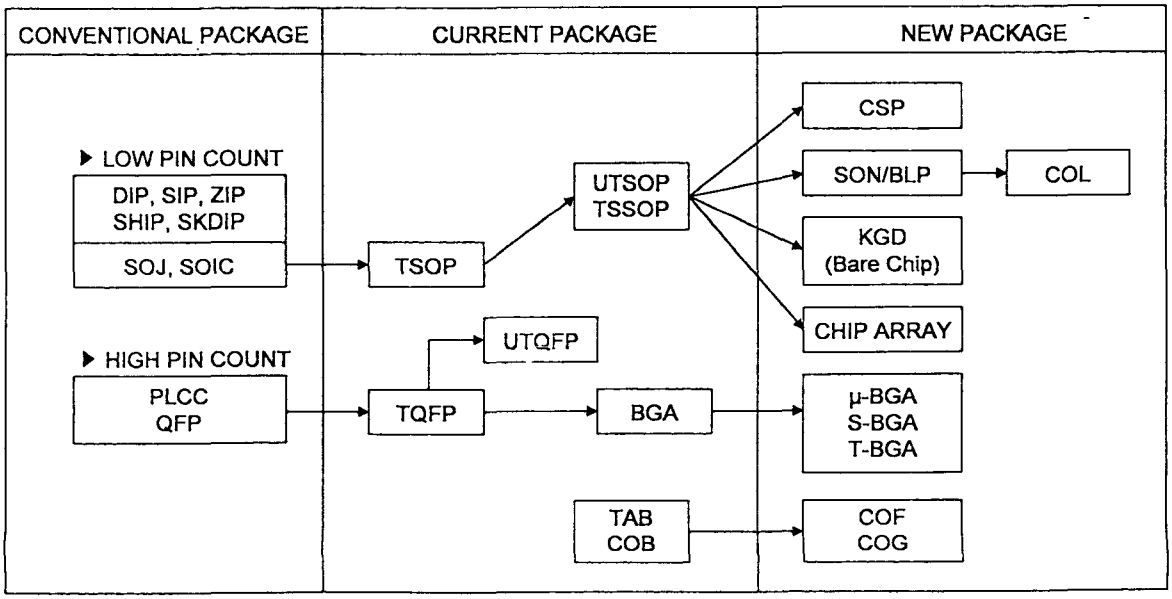
(단위 : 백만불, %)

구분	1996			1997		
	수요	구성비	국산화율	수요	구성비	국산화율
재료총수요	2,005	100	43	2,349	100	46
Wafer	661	33	49	720	31	54
Leadframe	526	26	44	614	26	46
Photoresist	176	9	14	213	9	21
EMC	124	6	18	139	6	24
Bonding Wire	108	5	88	135	6	87
Process Chemicals	100	5	55	111	5	59

Assembly Process Flow Chart of Plastic Package



PACKAGE TREND (I)



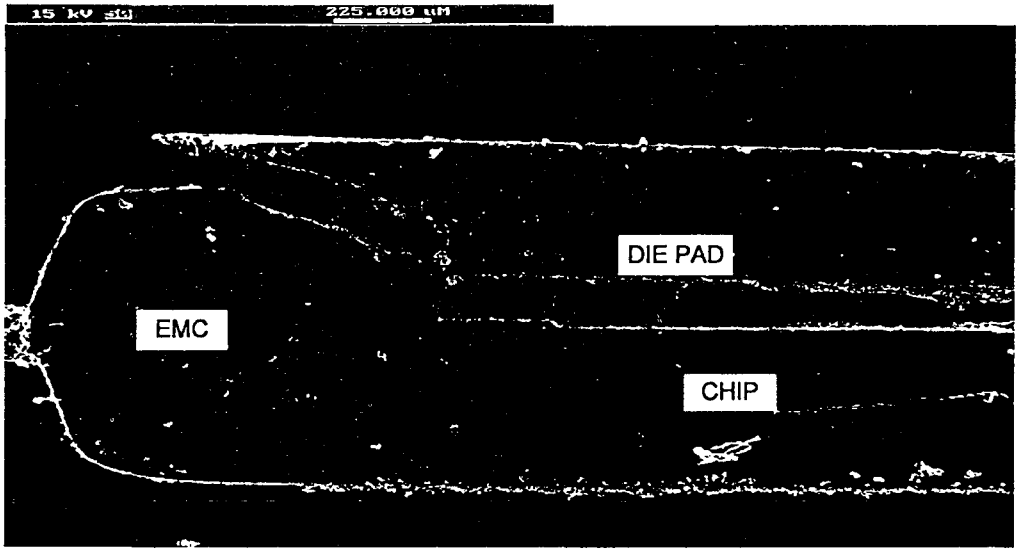
PACKAGE TREND (II)

Package	Items	1996	1997	1998	1999	2000
TSOP	Thickness	1.0 mm (TSOP)			0.5 mm (UTSOP)	
	Ptich	0.8 mm		0.65 mm	0.5 mm (MTSOP)	
QFP	Pin Count	256 (28×28)		304 (40×40)		
	Pad Pitch	100 μm	90 μm		80 μm	
	Thickness	1.4 mm	1.0 mm		0.5 mm (UTQFP)	
	Power	4 W		6 W (HTQFP)	10 ~ 15 W	
BGA	Pin Count	256		352	400	500
	Pad Pitch	100 μm		90 μm	80 μm	50 μm
	Power	2 W		5 W		10 ~ 15 W
CPGA	Pin Count	413		499	588	
	Power	15 W		35 W	75 W	
3D	Density	1.0 mm TSOJ 2 Stack		0.5 mm TSOJ 2/4 Stack		
CSP	Pitch	100 μm	90 μm		80 μm	
	Substrate	-	PCB/PI Tape		Plastic (Low Cost)	
COB	Density	1 Chip (Potting/Mold Type)			Module	
	Interconnection	0.80/0.75 mm		0.65 mm		0.5 mm
COG	Pad Pitch	80 μm		70 μm	60 μm	50 μm

KEY TECHNOLOGY FOR EMC

Trend	Function of chip	1997	1998	1999	2000	2001~
Requirement Of EMC	1. Increase of filler content Improvement of flowability	Filler content (%) 90 90 91 92 Melt viscosity (Poise) 100 100 90 80				
	2. Increase of adhesion to each materials	(1) Chip surface (2) Copper, 42-alloy (3) Silicon surface (4) PI tape (5) Ag plating (6) Pd plating				
	3. Low warpage	(1) Availibility for thin-size and large-size (2) Availibility for BGA and CSP				
	4. Availibility for Cu lead frame	(1) High adhesion to Cu oxide (2) High flowability (3) High thermal cycle stability (4) Low warpage				
	5. Availibility for area array package	Over-mold system : (1) High adhesion (2) High flowability(anti-wire flow) (3) High thermal stability (4) Low warpage Liquid potting system : High reliability(P.C.T.)				
	6. Availibility for new molding system	(1) Granulated molding compound / Molding under decompression (2) Melt tabletting				
	7. Protection of the earth environment	(1) Non-halogen(Br/Sb free) (2) Lead free ⟶ Adhesion to Pd plating				

Example of PKG Crack



반도체 성형재료의 요구 특성 및 중점 개발 항목

저흡습성
저 응 력
고 강 도
고 접 착
고 인 성

고유동성

Base resin의 특성향상

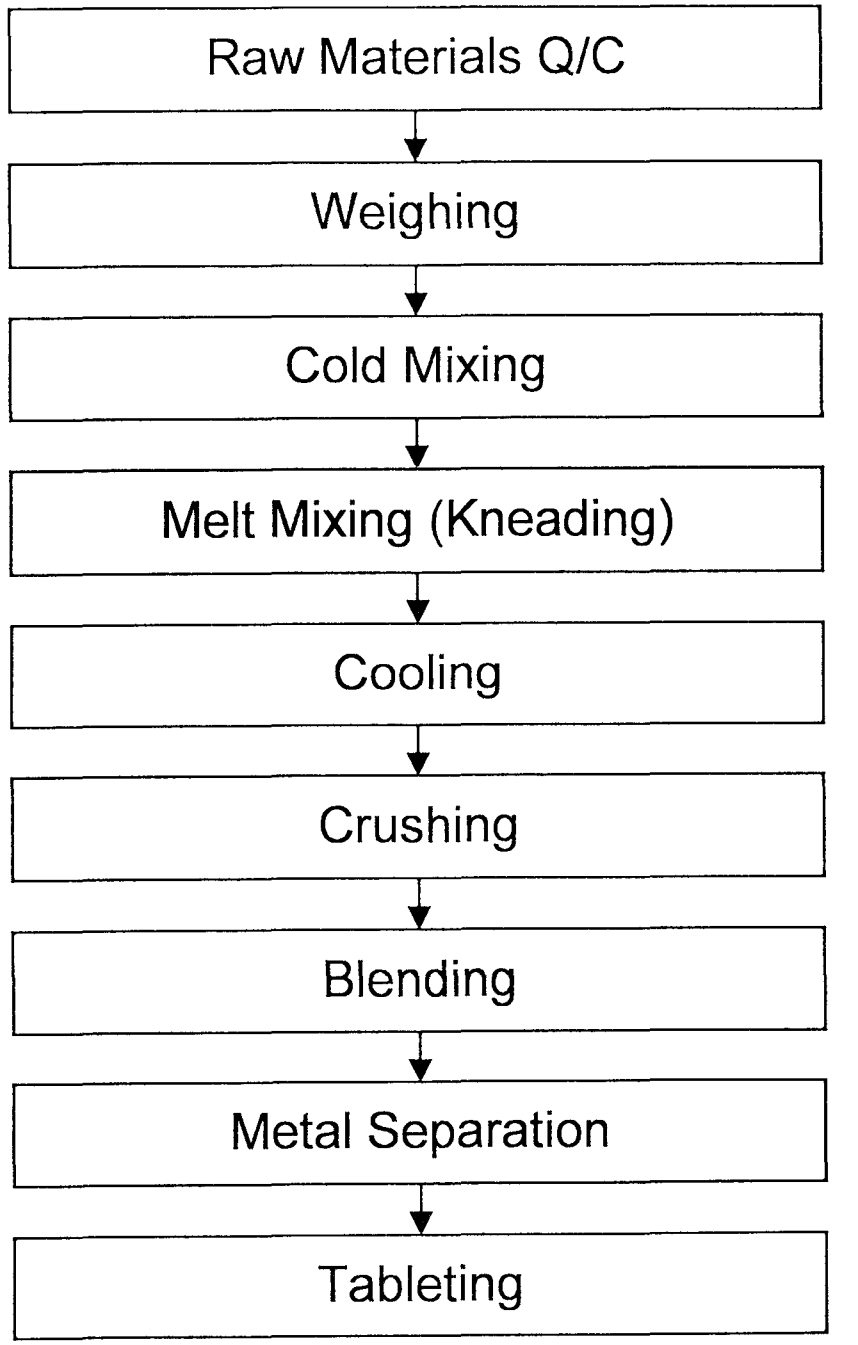
Filler의 고충전화

첨가재의 개발

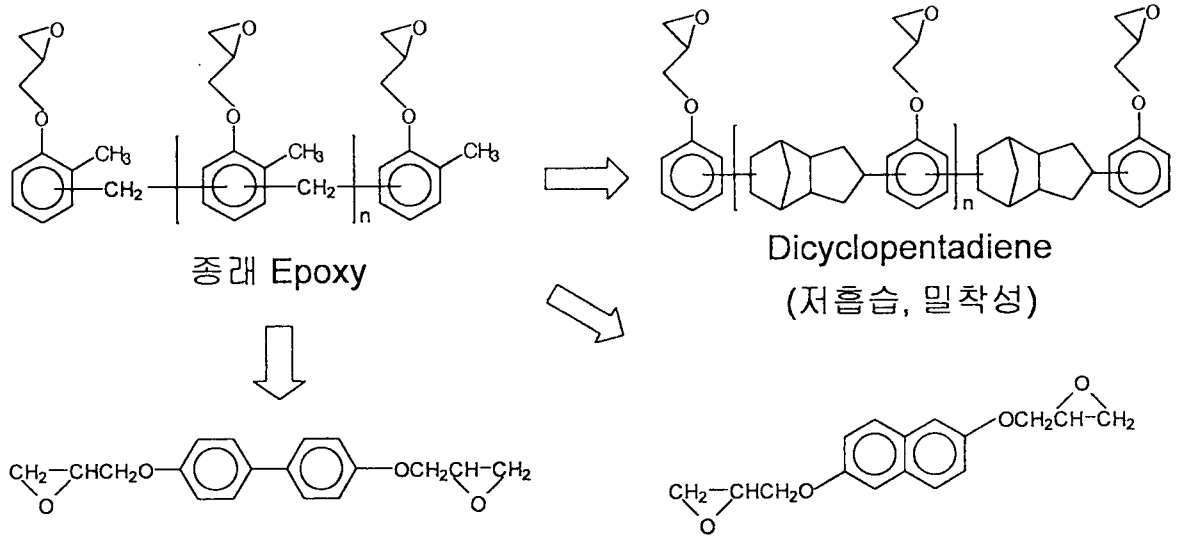
Constitutive Materials of EMC

No	Component	Remarks	Compounding ratio
1	Epoxy	- Binder	4 – 15
2	Hardener	- Curing agent	4 -10
3	Br-Epoxy	- Organic flame retardant	2 >
4	Sb_2O_3	- Inorganic flame retardant	3 >
5	Filler	- Improving strength, thermal conductivity - Lowing thermal expansion coefficient, moisture absorption	70 – 90
6	Coupling agent	- Improving adhesion between filler and organic materials	1 >
7	Accelerator	- Accelerating reaction of epoxy with hardener	1 >
8	Flexibilizer	- Lowering thermal stress	5 >
9	Wax	- Releasing agent for worability - Improving degree of mixing	2 >
10	Colorant	- Coloring	1 >

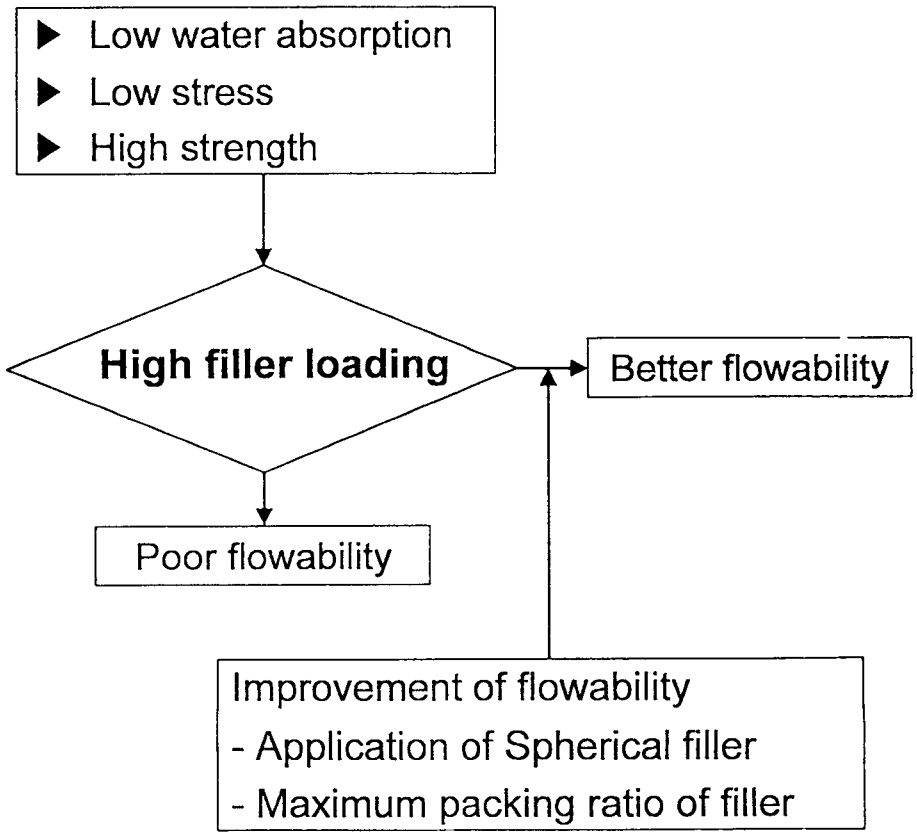
EMC 제조 공정도


Raw Materials Q/C
Weighing
Cold Mixing
Melt Mixing (Kneading)
Cooling
Crushing
Blending
Metal Separation
Tableting

BASE Resin의 특성 연구



High Filler Loading

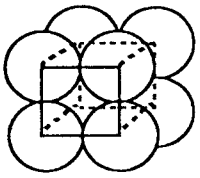


Mooney's Equation

$$\ln\left(\frac{\eta_C}{\eta_0}\right)=\frac{K_E\,\phi_f}{1-\phi_f/\phi_m}$$

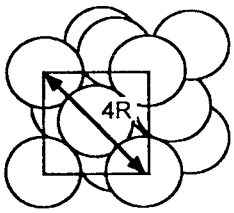
$$\phi_m=\frac{True\ volume\ of\ the\ filler}{Apparent\ volume\ occupied\ by\ the\ filler}$$

1) Simple cubic

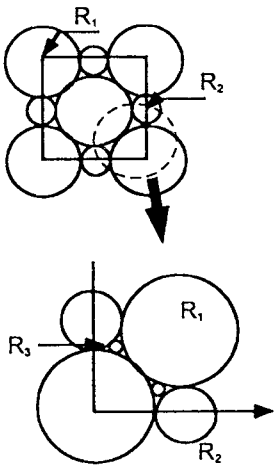


$$\phi_m=\frac{1}{(2R)^3}\left(\frac{4}{3}\pi R^3\times\frac{1}{4}\times 4\right)=0.52$$

2) Face centered cubic



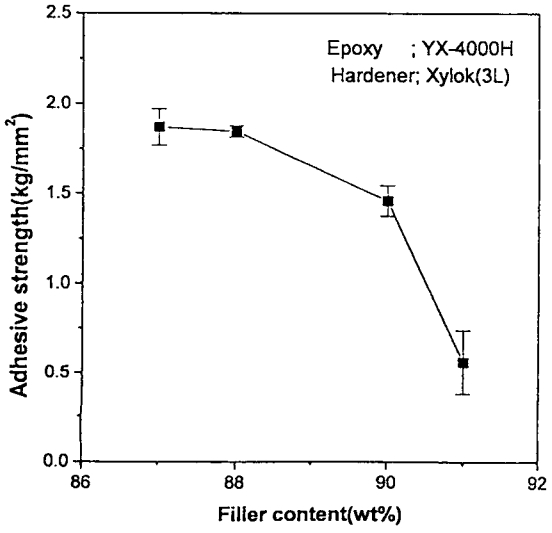
$$\phi_m=\frac{1}{2\sqrt{2}R^3}\left(\frac{4}{3}\pi R^3\times 4\right)=0.74$$

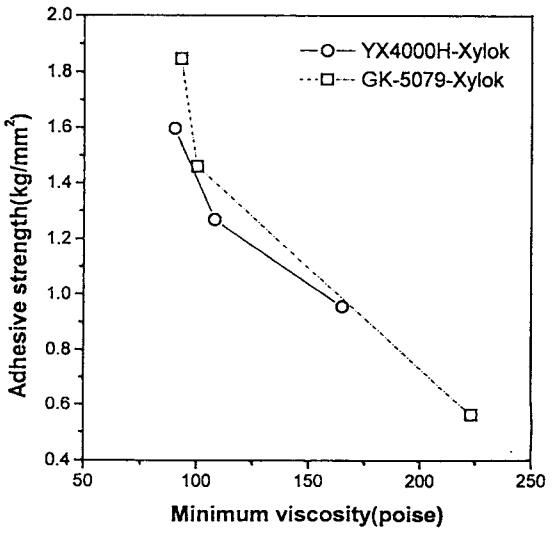


$R_1:R_2:R_3 = 1:0.414:0.114$

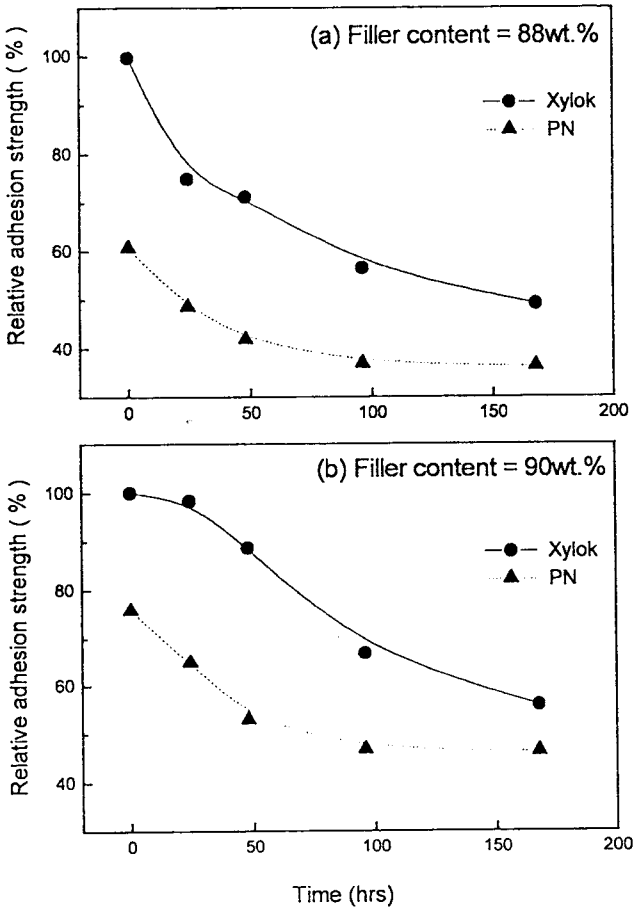
$\phi_m=0.793$

Relation between adhesive strength & filler content

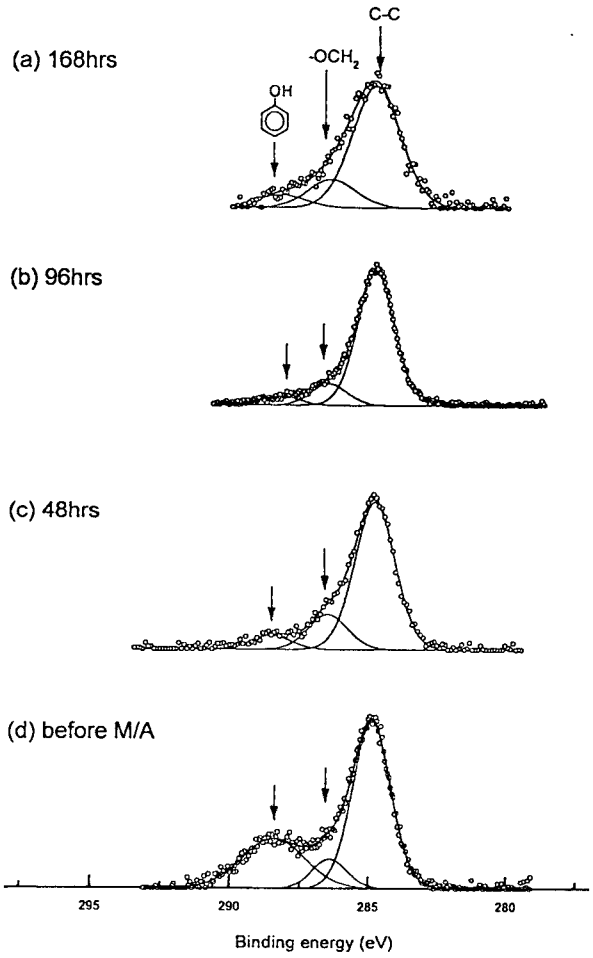




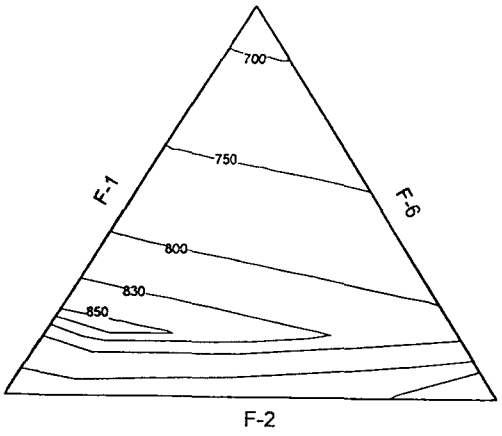
Adhesion strength vs. moisture absorption time

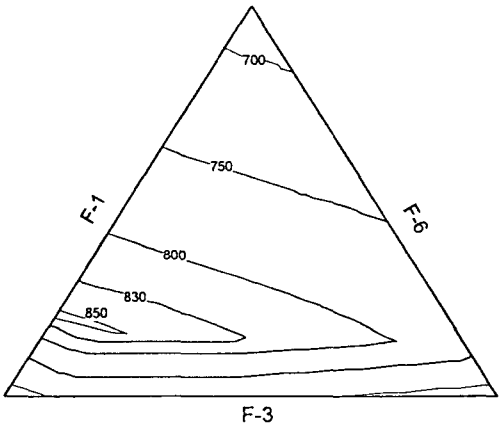


C1s spectra from the no-etched leadframe separated from xylok-cured EMC after pull-tested with moisture absorption (M/A) time

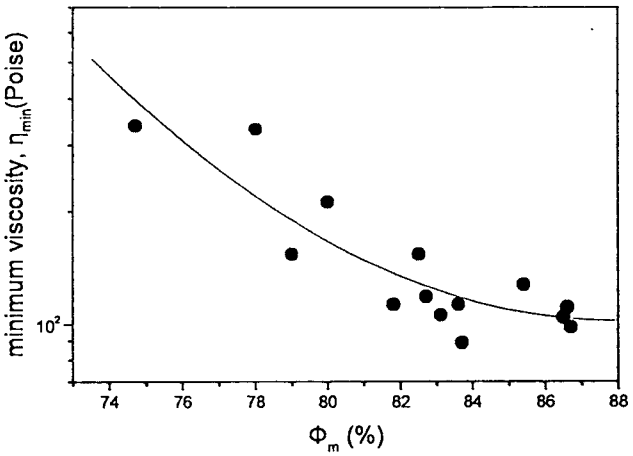


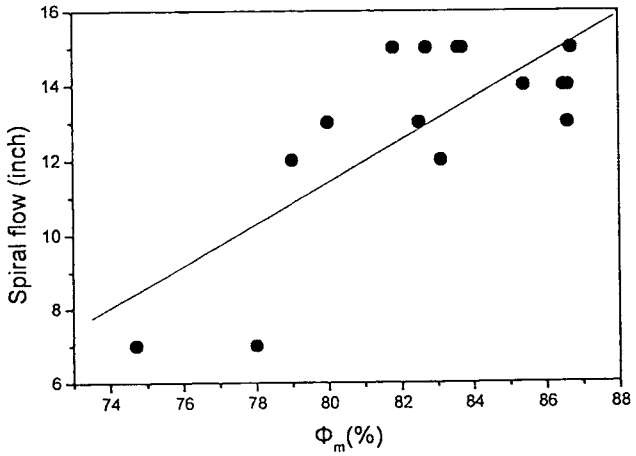
Iso-maximum packing fracion line with 3-component filler combination using simplified hatching model





Minimum melt viscosity and spiral flow





결 론

- 고충전 (92 wt%) 기술 확보를 통한 신뢰성 향상
- Cu Leadframe과의 접착력 향상 기술
  - 첨가제 및 적용기술 개발
- 고열전도 소재 개발
- 박형화, 대형화에 따른 Warpage 대응 기술
- Non-halogen 난연 기술