Polyimide product portfolio overview:
Non-photosensitive materials and Permanent glue materials

November 5, 2024

FUJIFILM Electronic Materials (Europe) N.V.

Business Department

FUJIFILM
Value from Innovation

ELECTRONIC MATERIALS

FFEM PI/PBO product portfolio

Non-photosensitive polyimides

- Pre-imidized polyimides
  - Patterning by RIE etch
  - Low temperature cure, low shrinkage
- Polyamic acid polyimides
  - Patterning with photoresist. Pattern transfer during TMAH develop step
- Low temperature cure polyimides
  - Patterning with RIE etch
  - EHS friendlier

Negative tone, solvent developable polyimides

- Standard cure material (350ºC)
- Buffercoat for WB/FC packages
- Core product with medium Tg and medium CTE values
- High Tg, low CTE material
- Large film thickness range
- EHS friendlier solution

Negative tone, Low temperature cure polyimides, solvent developable

- Low temperature cure material (350ºC down to 180ºC)
- RDL dielectric or buffercoat for Wafer Level Packages
- Low residual stress material
- Large cured film thickness ranges
- Mask, stepper or LDI patternable
- Available in several coating techniques
- EHS friendlier solution

Positive tone TMAH developable polybenzoxazole

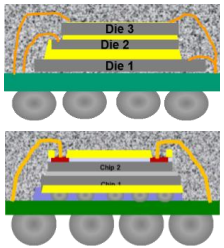
- High photospeed material
- Advanced resolution
- EHS friendlier solution

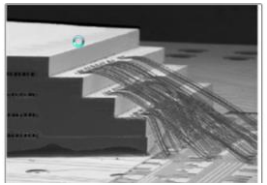
Polyimide & PBO ancillaries

- Developer & rinse solvents
- Cup rinse, edge bead remover solvents
- Rework stripper for exposed and non-exposed polyimide
- Special adhesion promotors

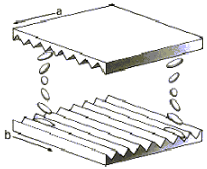
Typical applications of non-photosensitive polyimides

Component adhesive – glue
3D IC stacking

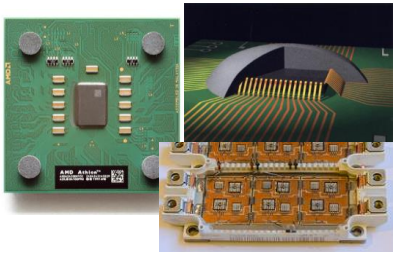


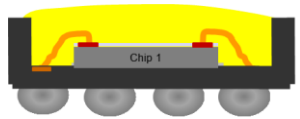


LCD alignment layer

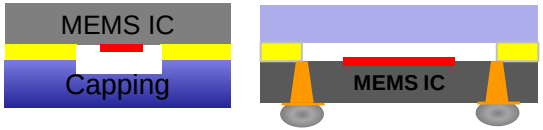


Glob top & underfill encapsulation

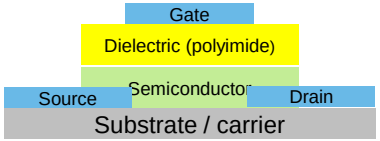




Adhesive – glue
MEMS packages

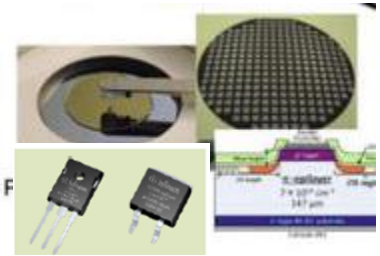


Gate Insulator
Organic electronics



Flexible PI substrate

Dielectrics
Power devices



Non-photosensitive polyimides product portfolio

Technology platform	Available grades	Key material properties
Pre-imidized polyimide-amide system	Durimide® 32A	NMP containing Low shrinkage material Medium cure temperature Patterning by RIE
Polyamic acid system	Durimide® 116A	NMP containing Patterning by photoresist development step Standard temperature cure
Polyamic ester PI precursor	LTG 12-52	EHS friendlier (NMP/NEP-free, halogen-free) Low temperature cure Large cure film thickness range Patterning by RIE
	LTG 12-32*	High Tg and low CTE version of LTG 12-52

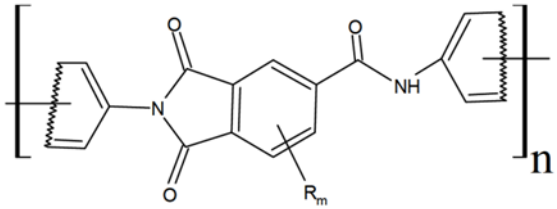
* Ongoing R&D development

Durimide® 32A (Pre-imidized polyimide-amide)

Non-photosensitive, pre-imidized polyamide-imide system

Product	Viscosity	CFT	Patterning
DUR 32A	700 cSt	1 – 11 µm	Dry etch process

- **Chemical structure**



Cured Film Property	275°C	300°C	350°C
Young Modulus (GPa)	2.8	2.8	3.3
Tensile Strength, UTS (MPa)	196	184	184
Elongation (%)	74%	60%	56%
Glass transition, Tg (°C)	283	282	300
Thermal decomposition temperature (°C)	> 480°C	> 480°C	> 480°C
Thermal expansion, CTE (ppm/°C)	52	58	53
Dielectric strength, RT/50%RH (V/µm)	325	325	325

Major applications

- Junction coating for discrete devices
- Glob top applications
- General passivation
- LCD alignment layers

Key features

- Fully imidized polyimide-amide
- Low shrinkage upon bake
- No high temperature cure
- Good mechanical properties
- Patterning using dry etch process
- Reworkable, solvent soluble

Typical Process conditions

Preteatment	Dehydration bake or O_2-flash
Spin coat PI	7 -25 µm CFT
Cure	Oven with N_2 purge
Patterning	Coat wit photoresist or hardmask
Transfer pattern into PI	RIE or O_2 plasma
Remove PR or hardmask	Wet or dry processing

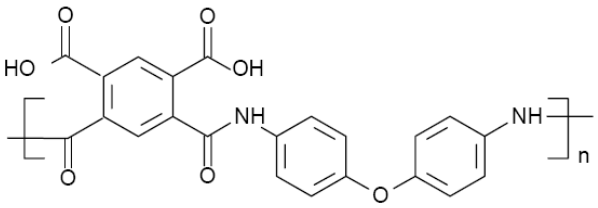
Note: export-restricted material.
Export licence and end-user statement required.

Durimide® 116A (Polyamic-acid system)

Non-photosensitive, polyamic-acid system

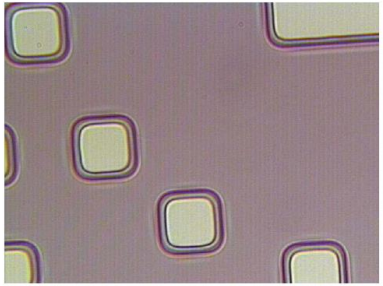
Product	Viscosity	CFT	Patterning
DUR 116A	12,000 cSt	4 – 10 µm	Positive photoresist (TMAH development)

- **Chemical structure**

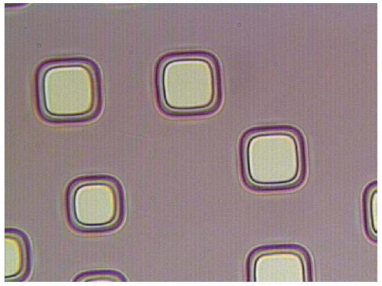


Cured Film Properties (350°C/60 min)	Data
Young Modulus (GPa)	3.3
Tensile Strength, UTS (MPa)	260
Elongation (%)	80%
Glass transition, Tg (°C)	371
Thermal decomposition temperature (°C)	> 590
Thermal expansion, CTE (ppm/°C)	32
Dielectric strength, RT/50%RH (V/µm)	325

- **PI patterning with photoresist. Pattern transfer during TMAH development step**



SBFT: 9.9 µm



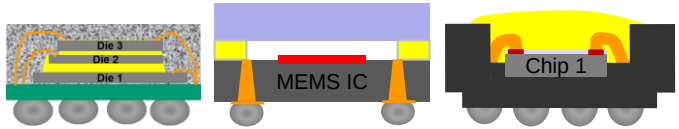
CFT: 5 µm

Typical process conditions

Pretreatment	Dehydration bake and/or O_2-flash
Spin:	4000 rpm / 30 sec (CFT ~ 3.2 µm)
Soft bake	60 sec @ 110°C + 60 sec @ 130°C
Patterning	Coat photoresist. Softbake & exposure photoresist. Typical 1.5 – 2.5 µm PR.
Developing (pattern PI)	Puddle 1 x 60 sec with TMAH 2.38wt%
PR strip	Wet process (solvent)
Cure	1 hour @ 350 to 400°C

Note: Lower viscosities available on demand (> 10 kg/month)

LTG 12-52 Low temperature cure PI (glue)



Non-photosensitive, low temperature cure polyimide

Product	Coating solvent	Viscosity (cSt)	CFT (µm)	CTE (ppm/°C)	Patterning
LTG 12-52	GBL/DMSO	5800 – 6400	5 – 25	± 53	Dry etch process

MATERIAL PROPERTIES			LTG 12-52			
			350°C 1h	230°C 3h	200°C 3h	180°C 3h
Mechanical properties (Tensile test)	Modulus	GPa	2.3	2.5	2.6	2.6
	Elongation at break (strain)	%	> 85	> 85	75	60
	Tensile strength	MPa	195	185	180	160
	Tensile stress at yield	MPa	115	115	118	117
Material properties (DMA & TMA)	Tg, tanδ	°C	240	235	230	220
	CTE	ppm/°C	48	53	54	55
Weight loss (TGA)	Weight loss Temperature (2%wt)	°C	405	310	305	285
	Weight loss Temperature (5%wt)	°C	435	340	335	325

Typical applications:

- Permanent adhesive/glue
  - Special applications – Image sensors, SAW, high power devices...
  - WL capping, 3D WLCSP...
- As a glob top/encapsulant material to protect tdevice or wire bond (mold compound replacement).

Key features

- EHS friendly formulation
  - NMP-free and halogen-free
- Based on polyimide polymer backbone
  - Resistant to high working temperatures
- Low or/and high temperature cure applicable
  - Designed for lower cure temperature down to 180°C
- Excellent material properties at low & standard temperature cure
  - Excellent mechanical properties
  - Adhesion force on different materials
- High viscosity range
  - Large bondline thickness possible
- Low outgassing

Note: Lower viscosities available on demand (> 10 kg/month)

* Under R&D development

LTG 12-32 (*) Low temperature cure PI (glue)

Non-photosensitive, low temperature cure polyimide precursor

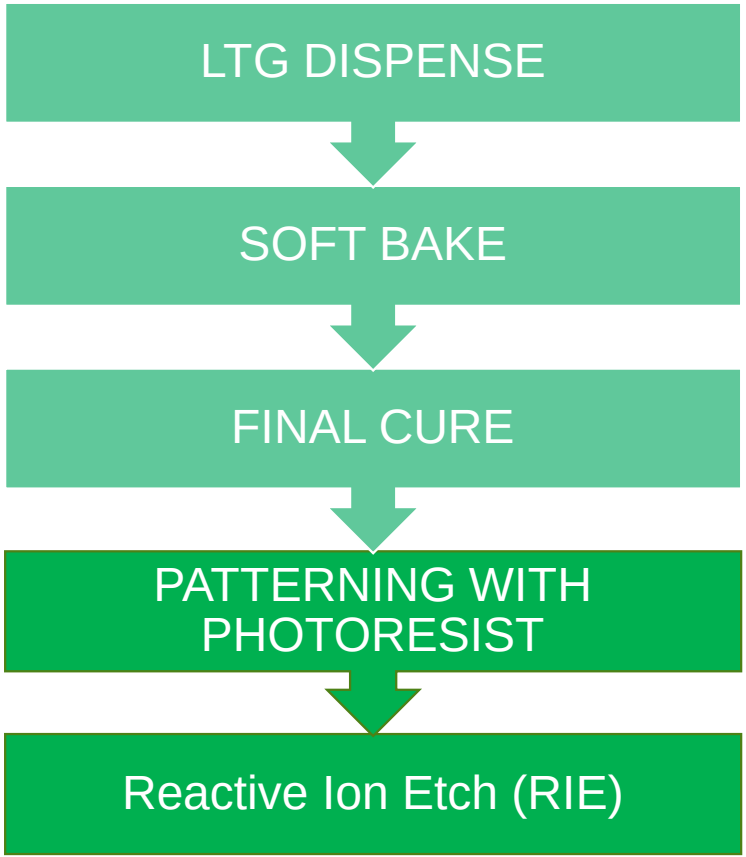
Product	Coating solvent	Viscosity (cSt)	CFT (µm)	CTE (ppm/°C)	Patterning
LTG 12-52	GBL/DMSO	5800 – 6400	5 – 25	± 53	Dry etch process
LTG 12-32 (*)	GBL/DMSO	5800 – 6400	5 – 25	± 30	Dry etch process

Key features

- **High Tg, low CTE material**
- EHS friendly formulation
  - NMP-free and halogen-free
- Based on polyimide polymer backbone
  - Resistant to high working temperatures
- Low or/and high temperature cure applicable
  - Designed for lower cure temperature down to 180°C
- Excellent material properties at low & standard temperature cure
  - Excellent mechanical properties
  - Adhesion force on different materials
- High viscosity range
  - Large bondline thickness possible
- Low outgassing

MATERIAL PROPERTIES		LTG 12-32		LTG 12-52	
		1h 350°C	3h 200°C	1h 350°C	3h 200°C
Mechanical properties (Tensile test)	Modulus (GPa)	2.9	2.9	2.3	2.6
	Elongation at break (%)	> 50%	> 50%	> 85%	75%
	Stress (MPa)	> 150	> 150	195	180
Material properties (DMA & TMA)	Tg, tanδ (°C)	> 350	> 275	240	230
	CTE (ppm/°C)	27	35	48	54
Electrical properties	Dielectric Constant 1MHz, 50% RH	3.3		3.3	3.3
	Dissipation factor 1 MHz	0.007		< 0.01	< 0.01
	Dielectric strength, V/µm	> 345		> 340	> 340
Moisture uptake (wt%)				± 1.2	± 1.2

Typical **buffercoat or RDL layer** process flow - LTG series



Coat or dispense:

- Wafer level glue: Adjust spin speed to change bond line thickness

Soft bake: gentle removal of casting solvents

- Typical process
- 120 to 300 sec at 120 - 160°C

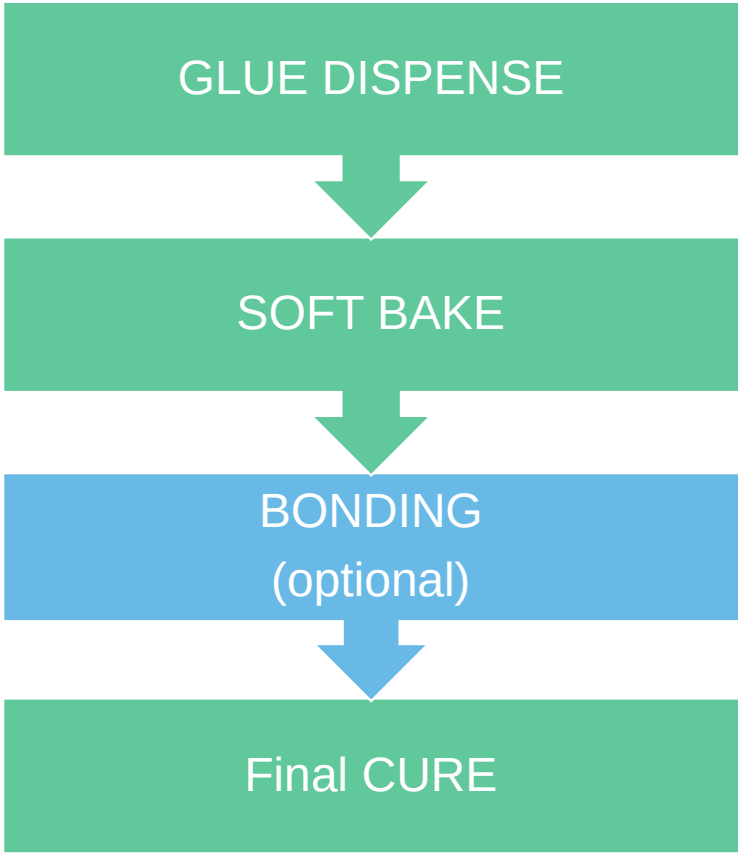
Final cure profile:

- Typical cure cycle: 180 to 250°C for 90 to 180 min
- Ramp-up/down rate: 3 to 5 min
- Rapid cure profile is possible

Patterning of the LTG polyimide layer

- Photoresist coating and patterning
- RIE – transfer photoresist pattern into the PI-LTG film

Typical **bonding** process flow - LTG series



Coat or dispense:

- Die attach: pattern dispenser
- Dispense (glob top) in package cavity
- Wafer level glue: Adjust spin speed to change bond line thickness

Soft bake: gentle removal of casting solvents

- Typical process
- 120 to 300 sec at 120 - 160°C

Bonding: Die or component to substrate

- *Minimum 10°C above soft bake temperature – Viscous elastic region* of glue – good adhesion

Final cure profile:

- Typical cure cycle: 180 to 250°C for 90 to 180 min
- Ramp-up/down rate: 3 to 5 min
- Rapid cure profile is possible

Comparison non-photosensitive polyimides

	Durimide® 32A	Durimide® 116A	LTG 12-52
POLYMER TYPE	Pre-imidized amide-imide system	Polyamic acid system	Polyamic ester system
CASTING SOLVENT	NMP/Xylene	NMP	GBL/DMSO
POLYIMIDE PATTERNING	O_2 or O_2/CF_4 RIE plasma	Aqueous development with photoresist	O_2 or O_2/CF_4 RIE plasma
CURED FILM THICKNESS RANGES	1 – 11 µm	4 – 10 µm	5 – 25 µm
SHELF LIFE	36 months	12 months	12 months

Comparison non-photosensitive polyimides – Cured film properties

Parameters	Durimide® 32A	LTG 12-52	
	Cure 200 – 350°C	Cure condition 180 min / 200°C	Cure condition 90 min / 350°C
Ultimate Tensile Strength (MPa)	180	> 175	> 200
Young's Modulus (GPa)	2.8	3.0	3.0
Tensile Elongation at Break (%)	> 50%	> 50%	> 70%
Glass Transition Temperature (Tg by DMA, °C)	280	230	255
Coefficient of Thermal Expansion (CTE, ppm/°C)	~ 50	~ 55	~ 50
Decomposition Temperature (°C)	> 480°C	> 500°C	> 500°C

LTG 12-52 & Durimide® 32A yield very similar material properties.