Development of Liquid Solder Resist Based on Polyimide

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1. Introduction

Flexible Printed Circuit Board(FPC) is a useful for microelectronic devices such as handy phones, mobile audio players and mobile personal computers. Usually surface of FPC is protected by a solder resist from solder and oxidation. The resist is specifically designed to both protect the surface tracks and prevent solder bridges and oxidation during soldering.

Recently patterning pitch between wiring becomes very fine. Especially, in the COF tape package for Flat Panel Display, patterning pitch has narrow below 25 μ m.[1-3] Solder resist is required to be enough electro resistivity as well as low warpage of COF. In addition chemical resistance, flexibility, thermal stability and high adhesion of coating is absolutely imperative.

Conventional solder resist is composed of epoxy resin. The materials do not have enough electro resistivity at such a fine feature size. [4]

To meet the requirements, we designed a new polyimide base solder resist.

Fig. 1. COF tape packaging

2. Experimental

2.1 Synthesis of organic soluble low modulus polyimides.

Figure 2 shows polymerization of organic soluble low modulus polyimide.

A typical procedure is as follows: in a 4-necked flask, diamines were completely dissolved in -butyrolactone in a dry nitrogen atmosphere at 60 °C. To this solution, tetracarboxylic anhydrides were added and reaction for 1 hour. Then heated at 180 °C for 2h.

Fig. 2. Polymerization of organic soluble – low modulus polyimide.

2.2 Preparation of solder resist composition

Polyimide and other ingredients such as cross-linker were mixed together with -butyrolactone. Then inorganic filler was added to the solution by option.

2.3 Coating process

The solder resist composition was coated on Kapton® by screen printing method.

Then coating film was dried in convection oven at 120 °C for 30 min.

2.4 Electro migration stability(HHBT test)

The solder resist composition was coated on FPC

with comb Cu pattern (pattern pitch is 20 μ m). The coated sample was cured at 120°C for 60min. Then the electro migration stability was measured by using ESPEC AEI-020-P. Electrical resistivity was monitored under 85 °C 85% RH atmosphere applied at 60V.

2.5 Chemical resistance

The solder resist material was immersed and measured the weight loss. Chemical resistance was determined by the weight loss.

2.6 Flexural endurance

A 20 μ m thick film of solder resist composition on Kapton® film was prepared by coating with screen printing method, drying in convection oven at 120 °C for 30 min.

The obtained film was cut being size about 50mm in length and 10mm in width. This sample was bent by 180 °.

After bent 10 times, the presence of the crack was observed.

2.7 Curl evaluation

A 20 μ m thick photosensitive polyimide resin composition film on Kapton®(25 μ m) prepared by the method described in the 2.3.

The obtained film was cut being size about 50mm in length and 50mm in width.

This sample was put on the horizontal place, and the height of the highest place was measured.

2.8 Solder heat resistance

The 20 μ m thick film on copper foil prepared by the method described in the above-mentioned was left under the atmosphere of 23 °C in temperature, 50% RH in humidity for 24 hours. Then the sample was floated on solder bath at 300 °C for 10 sec.

After 10 sec floated, the presence of the crack , peeling or swelling was observed.

3. Results and discussion

3.1 Polyimide design

We designed polyimide structure to show low modulus to 1GPa or less. However, glass transition temperature (Tg) of the low modulus polyimide is less than 90°C. The polyimide itself does not show enough electro migration resistance due to its low Tg (fig.3). It is thought that molecular motion of the polyimide makes low electro migration resistance during HHBT test. As shown in figure 4, copper ion moved at the base film-solder resist interface during HHBT test.

3.2 Solder resist design

To obtain good electro migration resistance, we

investigated various types of cross linker which gave high Tg to the composition. Those results were summarized in table 1. Some of the cross linkers shows good electro migration due to its high Tg.

The cross linker gave good chemical resistance as well as high Tg to solder resist.

Fig. 3. HHBT test results of polyimide solder resists

Fig. 4. Metal migration of polyimide solder resist after HHBT test

Table. 1. Insulating resistance of low modulus polyimide and composition

Cross linker	Modulus(GPa)	Tg(°C)	HHBT result
Nothing	1.8	86	400h NG
Addition	1.9	108	1000h OK

3.3 Mechanical properties and heat resistance

The solder resist composition has strong flexural endurance and low stress with good chemical resistance shown in table2 as well as good electro migration.

Table. 2. Properties of polyimide based solder resist

Items	Chemical resistance	Flexural endurance	Curl	Solder Heat Resistance
Result	0% Acetone Weight loss	More than 10 Times (180 ° bent)	0mm	300

Conclusion

We developed new polyimide based solder resist which shows good electro migration and low curvature as well as good thermal resistance for very fine feature size.

Reference

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