Flame resisting Solder Resist Ink "UPICOAT FS-851P"

Masahiro Naiki, °Hiroo Yamashita, Takeshige Nakayama, Seiichirou Takabayashi[1]
Research & Development Department Specialty Chemicals & Products Company, Ube Industries, Ltd.[2]
Kogushi, Ube, Yamaguchi 755-8633, Japan
33289u@ube-ind.co.jp

Polyimidepolysiloxane-based solder resist ink "UPICOAT FS-851P" was synthesized from 2,3,3',4'-biphenyltetracarboxylic acid dianhydride (a-BPDA, Ube Industries, Ltd.), α,ω,-bis(3-aminopropyl)polydimethylsiloxane and so on. It was used for a heat-curable solder resist having flame resisting without flame retardant agent such as halogenated compounds. The developed solder resist achieved level 0 in UL94V test in TCP-type layered product. It had excellent flexibility and insulation reliability under a high-temperature and high-humidity environment.

1. Introduction

In the electric and electronic applications, UPICOAT FS-851P is usually used as a coating material. Although, in such cases, the compositions are cured by heat, a curing shrinkage can be suppressed because of low modulus of the polysiloxane segment. Particularly when the composition is employed as an insulation coating for a tape automated bonding (TAB), it shows little warping and is excellent in folding property.

TAB has been increasingly used with increasing the flat panels such as plasma display and the liquid crystal display. There are requirements of flame resisting in an application where TAB is exposed to a high temperature, such as in a plasma display panel. Polyimide film, which is employed as a base of TAB, is flame retardant. However, the TAB package can be burned, due to the less fire resistant adhesive between the copper wiring and the polyimide film and the solder resist on the surface of TAB. Therefore, flame resisting in the entire TAB is requested through giving flame resist to the solder resist layer.

We developed the product that considered the global environment. We suggest a UPICOAT FS-851P which is polyimidepolysiloxane-based solder resist ink having combustion resistance making TAB that is a kind of tape carrier package (TCP) flame resisting without a flame retardant agent such as halogen and phosphorus.

2. Composition of UPICOAT FS-851P

A based polymer of FS-851P was synthesized from 2,3,3',4'-biphenyltetracarboxylic acid dianhydride (a-BPDA, Ube Industries, Ltd.), α,ω,-bis(3-aminopropyl)polydimethylsiloxane and so on. The polyimide was obtained by thermal imidization. The screen printing ink was obtained by kneading with a triple roller from the polyimide dope added some components such as cross-linking agents, fillers, etc. The catalyst was added just before curing. The balance of polyimidepolysiloxane and cross-linker and fillers was the most important for the flame resisting and other solder resist properties.

---

[1] 内貴 昌弘、°山下 宏央、中山 成剛、高林 誠一郎
[2] 宇部興産株式会社 機能品・ファインケミカル 機能品技術開発部 機能性樹脂材料 Gr

3. Evaluation of combustion resistance

Combustion resistance of solder resist was evaluated, in order to reproduce the practical usage, with a 4-layered TCP-type test piece shown in Figure 1. The solder resist ink was coated on the 4-layered sheets, and treated at 80°C for 30 minutes and then at 150°C for 60 minutes. The combustion resistance was evaluated by the vertical combustion test according to UL94 standard.

Table 1 shows results of combustion resistance test, and other characteristics. UPICOAT FS-851P had a flame resisting corresponding to level 0 in the UL-94V test with 4-layered TCP-type samples.

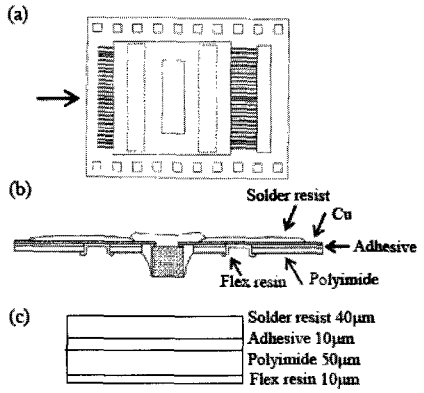

Figure 1 Schematic representation of TCP
(a) Apparatus of TCP.
(b) Cross section at the arrow in (a).
(c) TCT-type layered sample for UL94V test.

Table 1 Characteristics of UPICOAT FS-851P

Item	FS-851P #	The other companies material
UL test (SR/PI Film)	○	○
UL test (structure of TCP)	○	×
Electrical reliability	○	△
Adhesion with molding compounds	○	○
Solder Dip [1]	○	△
Halogen Free	○	×
Sales performance	○	○
5% Thermal Weight Loss[℃]	370	310

1) Do not find abnormality on 260℃, 10sec

○:OK(good), △:OK(normal), ×:NG, —:no data

4. Evaluation of ion migration

The solder resist composition was coated on the comb-shaped wiring pattern, and treated at 80°C for 30 minutes and then at 150°C for 60 minutes. Resistance was measured for 100hours under HAST condition (a bias voltage of 100V and under the conditions of 120°C and 85 %RH).

The result of insulation resistance measurements at bias test is shown Figure 2. As seen in Figure 2, UPICOAT FS-851P coated film has excellent electric reliability as keeping 10^9 Ω of insulation resistance after 100 hours at HAST condition.

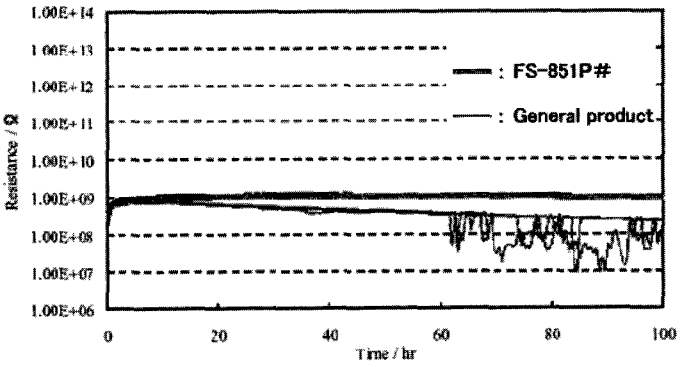

Figure 2 Migration measurements (120°C, 85%RH, DC100V, 30μm L/S)

5. Conclusion

We obtained a flame retardant composition of polyimidepolysiloxane without any flame retardant agent. It is UPICOAT FS-851P has effective flame retardancy effect though it is halogen-free. UPICOAT FS-851P had a flame resisting corresponding to level 0 in the UL-94V test with 4-layered TCP-type samples and had a good insulating property. It is useful as an insulating solder resist for TCP which is exposed to a high temperature, such as in a plasma display panel.

3. Evaluation of combustion resistance

Combustion resistance of solder resist was evaluated, in order to reproduce the practical usage, with a 4-layered TCP-type test piece shown in Figure 1. The solder resist ink was coated on the 4-layered sheets, and treated at 80°C for 30 minutes and then at 150°C for 60 minutes. The combustion resistance was evaluated by the vertical combustion test according to UL94 standard.

Table 1 shows results of combustion resistance test, and other characteristics. UPICOAT FS-851P had a flame resisting corresponding to level 0 in the UL-94V test with 4-layered TCP-type samples.

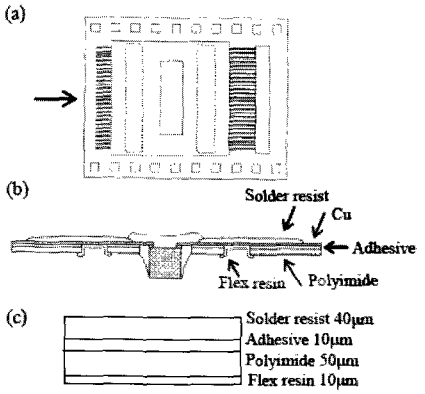

Figure 1 Schematic representation of TCP
(a) Apparatus of TCP.
(b) Cross section at the arrow in (a).
(c) TCT-type layered sample for UL94V test.

Table 1 Characteristics of UPICOAT FS-851P

Item	FS-851P #	The other companies material
UL test (SR/PI Film)	○	○
UL test (structure of TCP)	○	×
Electrical reliability	○	△
Adhesion with molding compounds	○	○
Solder Dip 1)	○	△
Halogen Free	○	×
Sales performance	○	○
5% Thermal Weight Loss[℃]	370	310

1) Do not find abnormality on 260℃, 10sec

○:OK(good), △:OK(normal), ×:NG, —:no data

4. Evaluation of ion migration

The solder resist composition was coated on the comb-shaped wiring pattern, and treated at 80°C for 30 minutes and then at 150°C for 60 minutes. Resistance was measured for 100hours under HAST condition (a bias voltage of 100V and under the conditions of 120°C and 85 %RH).

The result of insulation resistance measurements at bias test is shown Figure 2. As seen in Figure 2, UPICOAT FS-851P coated film has excellent electric reliability as keeping 10^9 Ω of insulation resistance after 100 hours at HAST condition.

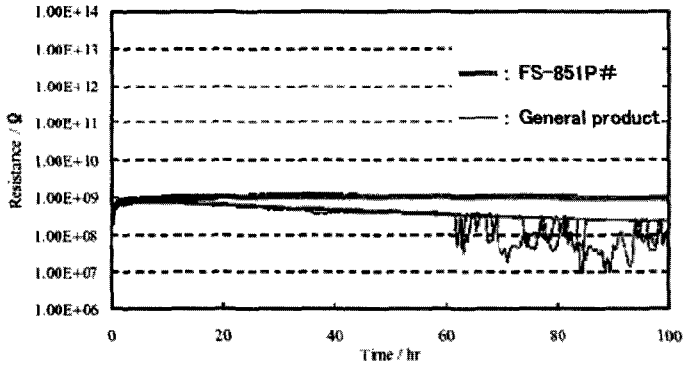

Figure 2 Migration measurements (120°C, 85%RH, DC100V, 30μm L/S)

5. Conclusion

We obtained a flame retardant composition of polyimidepolysiloxane without any flame retardant agent. It is UPICOAT FS-851P has effective flame retardancy effect though it is halogen-free. UPICOAT FS-851P had a flame resisting corresponding to level 0 in the UL-94V test with 4-layered TCP-type samples and had a good insulating property. It is useful as an insulating solder resist for TCP which is exposed to a high temperature, such as in a plasma display panel.