

## A Brief History of the Solder Resist

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**Abstract:** Solder resist is a polymer material that covers printing wiring board as a passivation layer of wiring and make it possible to put solder only on soldering pads. Although both resists are patternable, but meaning of the word “resist” in solder resist is not same as the word “resist” in photo resist for ULSI fabrication. Solder resist remains after fabrication and keeps printing wiring board sound. The patterning of solder resist started at screen printing and moved to photo patterning. Epoxy resin is used widely with acryl compound as photosensitive group. The feature size of the patterning is several tens of micrometer and alkaline water developable negative tone is the de fact standard. Green color is characteristic of solder resist for long time, but nowadays the color is varied from black to white according to applications. The range of uses of solder resist is widening with the increasing range of uses for electronics.

**Keywords:** Solder resist/ Printing wiring board / passivation layer / Epoxy resin /Alkaline water developable

### 1. What is solder resist

Fig. 1 shows photograph of a part of printing wiring board. The green color material that covers all over the board except pads (rectangle) and thorough holes (circles for soldering) is the solder resists. The name is named after the function during high temperature soldering process. Solder resist repels solder and puts the solder on appropriate place: pads and thorough holes. So the resist called solder mask sometimes. The resist passivate the wiring (lines) to avoid short and open of the circuit during all the life time of products. Patterning, heat resistance, reliability are essential for the resist.

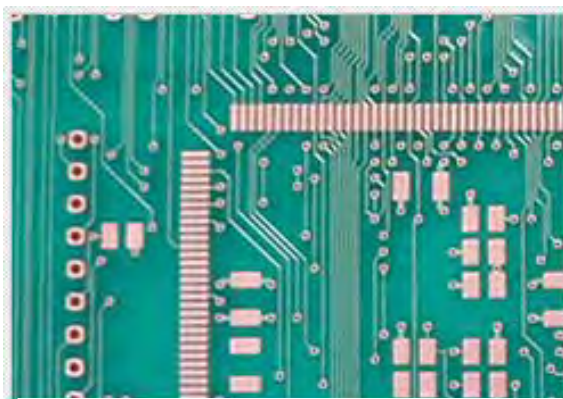


Fig.1 Printing wiring board

### 2. The resist and Taiyo

Printing wiring board was invented by Paul Eisler in 1936. During the 1950s, the invention of transistor launched electronics industry and many printing wiring boards were used in many products such as transistor radio. Screen printing was used for patterning of the resist so long time. Therefore solder resist sometimes called resist ink. Taiyo holdings was a printing ink making company that time and decided to get into electronics industry in 1970. Melamine alkyd resin system was utilized for all kinds of solder resist. Formalin that is generated during condensation reaction of melamine alkyd resin caused toxic atmosphere. In 1972 we developed epoxy type solder resist that did not cause any toxic gas.

### 3. Expanding of The Resist

In the 1980s, as increasing of the density of the packaging higher resolution (below 100 micrometer) was required to the resist. Solvent developable photo sensitive solder resists represented by PROBIMER (Ciba-Geigy) were on the market. In 1983 we started the research for alkaline water developable photo sensitive type solder resist<sup>1)2)</sup>. Figure 2 shows main structure of the solder resist. Vinyl group attached to novolac skeleton gives photosensitivity. Photo radical generators are used as initiators. Carboxylic acid structure introduced by reaction between hydroxyl group and maleic anhydride makes the resist soluble in alkaline water solution.

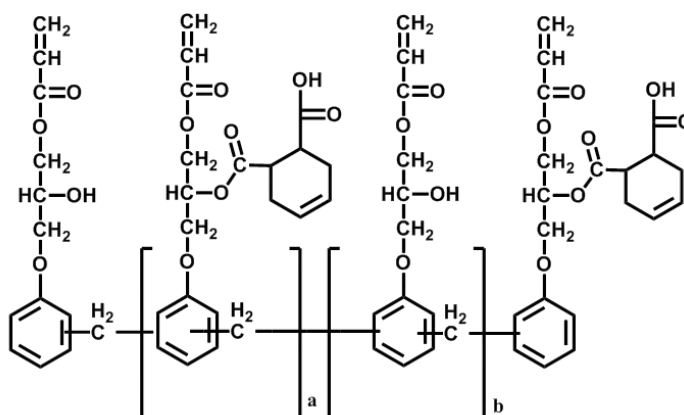


Fig.2 Structure of alkaline developable solder resist

Fortunately, alkaline water developable negative tone resists were welcomed and have been the de fact standard.

### 3. Black Resists

The leads of electronics industry have shifted from mainframe computer to personal computer in 1990s (Downsizing). Today, mobile devises such as mobile phones, tablet PCs and wearable devices (Watch, Glasses) are widely spreading all over the world. The impacts of mobile devises on solder resists are surprising. Regardless of leads: mainframes, personal computers, there are very strong demands for performance such as higher resolution, higher sensitivity and low price so on. Mobile devises are much more dresses than devices. The name “wearable” represents the character. Design is one of the most important for customer and creator who makes new horizon. Green is the color of solder resist every time. Black resist<sup>3)4)</sup> for smart phone was requested by very creative company. The reason was “Black is more chic than green and suitable for the phone”. Black means absorb every light and contradicts photo sensitivity. Variety of the colors are ranging from black to white<sup>5)6)</sup>. The white resists are used widely as reflectors of LED light.

Solder resist; a versatile and feature-rich photo polymer<sup>7)8)</sup> will help us to realize a pleasant society.

### References

- [1] JP1799319, Y. Kamayachi, S. Inagaki (1989.11.17) .
- [2]JP2133267, Y. Kamayachi, S. Inagaki, M. Suzuki, K. Sawazaki (1995.3.1)
- [3] JP4994923, Y. Yamamoto, C. Ueta (2012.5.18)
- [4] JP5380034, Y. Yanagida, T. Nagano (2013.10.4)
- [5] JP4523679, K. Fusegawa, S. Matsumoto, K. Hamada (2010.6.4)
- [6] JP4340272, S. Ushiki, M. Kusama (2009.7.10)
- [7] JP4152106, S. Iwaida, Y. Oono, S. M. Isono, A. Sekimoto (2008.7.11)
- [8] JP4936725, M. Kakinuma, S. Ushiki, M. Kusama (2012.3.2)