

Gliccoat SMD Organic Solderability Preservatives

SHIKOKU INTRODUCES GLICOAT SMD F2 AND F2(LX)

The next generation organic solderability preservative has been introduced by Shikoku Chemical Corporation of Japan and marketed by Electrochemicals, Inc. The Gliccoat SMD F2 is suited for all general solderability purposes and is used particularly with lead-free solders due to very high melting temperatures of these lead free solders.

The Gliccoat SMD F2(LX) provides the same solderability protection as the F2, but has an additional advantage of not depositing an organic film on gold or other metals such as silver.

The trend toward alternative surface finishes to promote the solderability of bare copper surfaces has been well defined. While it is true that hot air solder leveling, (HASL) is still the predominant surface finish; alternative technologies are being implemented for a variety of reasons:

- Environmental and safety concerns over lead
- The need for a coplanar surface
- Lowest possible ionic contamination of the surface
- Fine-pitch device assembly
- Reliability
- Cost

The IPC and numerous industry consortia are actively exploring alternatives to HASL. The documentation relating to the requirements for alternative surface finishes have been well publicized at many industry forums. Many of the requirements, in fact, are obvious. Regardless, the pwb fabrication industry needs to work closely with contract manufacturers and end users to fully appreciate the true impact of technology trends. These trends are significant and include:

Surface mount continues to increase at the expense of through-hole; with surface mount reaching 70-80% of the product, and 20-25% through hole.

The use of non-tin/lead coatings and surface finishes will increase. Surface finishes such as electroless nickel/immersion gold, OSP and immersion tin will be utilized.

With political movements toward banning lead in all electronic assemblies gaining significant momentum, lead free solder pastes and wave solder materials will be adopted, as well as lead-free finishes.

The alternative surface finishes must perform through multiple thermal cycles with less active pastes and fluxes, providing maximum joint strength and long term reliability .

The use of multiple metal finishes on the same bare board will place new emphasis on the compatibility of coatings with each other, and the actual assembly module.

Increased I/O demand and reduced lead pitch will require much tighter controls over the processes used to fabricate the bare board. High I/O packages will test the process limitations in imaging, etching, soldermask and surface finishes.

Assemblies are becoming harder to inspect and rework.

In recent years, in order to achieve high-density surface mounting on printed wiring boards, the number of terminals of circuit components have been increasing, and the pitch of the terminals has been significantly reduced. With the trend for increased packaging density has come the use of COB (chip on board), flip chip and TAB (Tape Automated Bonding).

In many instances, the surface mounting of such components may be required on pwb's with copper pads and other features plated with gold, silver, tin or solder. These mixed metal finish boards are becoming very common today and the surface treatment of such circuits will continue to grow in importance. The demand was such that a water soluble surface-treating agent, that was capable of

protecting the bare copper from oxidation without leaving a film on the other metals, needed to be developed and implemented. In other words, the need for an OSP that selectively bonds to the copper without adversely affecting other metals such as gold or solder was established.

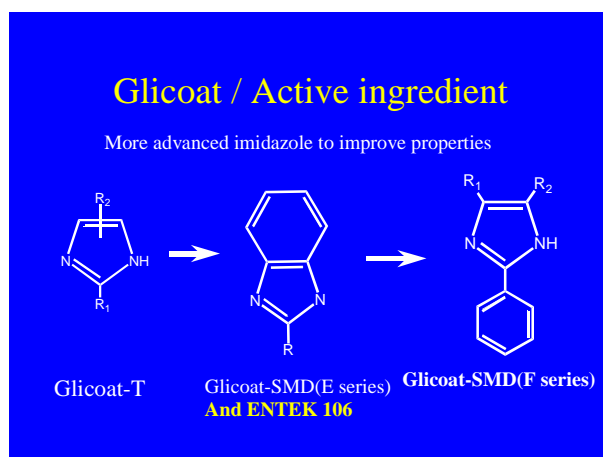
Conventional OSP processes (such as ENTEK® brand OSP'S) based on long chain alkylimidazole compounds and substituted benzimidazole compounds functioned adequately to protect the bare copper. However, these materials also deposited a significant film on other metals such as gold, tin and solder. This additional film interfered with subsequent operations such as wire bonding, and surface mounting of Quad Flat Packs on solder surfaces. In addition, the contact resistance on the gold increased to unacceptable levels. Thus, when pwbs are fabricated with multiple metal finishes, the metals such as gold or solder would have to be masked to prevent the OSP film formation on their surfaces. In some instances, the coating would have to be removed with alcohol, adding additional labor and cost to the fabrication process. A factor in promoting this film formation on the metal surfaces is the copper contained in many organic solderability formulations. The copper ions form a complex with the active azole ingredient in the OSP chemistry and actually helps to promote film growth. When a copper-solder mixed metal board is processed through such a process, the OSP forms on the solder and has the affect of discoloring the solder, making long-term solderability literally impossible to achieve.

It has also been determined that the copper ions that are part of the OSP protective film contribute to ionic contamination, a situation being constantly scrutinized by assembly houses and end users. It is desired to keep ionic residues as low as possible. It has been demonstrated that the copper contributes to the staining/darkening of the solder and causes undo build-up of residue on the gold.

Therefore, it was imperative to develop an OSP process that would selectively deposit on the bare copper surfaces only, with low residual ionics. However, a film formed on the copper must have sufficient ability to maintain the solderability of the base copper through multiple thermal excursions and with a variety of low activity wave soldering fluxes and pastes.

The Gliccoat F series was developed in order to solve many of the problems outlined in the previously. Gliccoat F2 and F2 LX give the ultimate in solderability protection, in particular with lead-free

solders. Lead-free solders require much higher liquidus temperatures than standard lead-bearing solders. In addition, a slightly longer soldering time is required. The next generation Gliccoat (F2 series) provides excellent solderability protection and heat resistance due the nature of the patented aryl-phenyl-imidazole organic compound. This material is unique in structure and properties and is covered under several patents including US 5,498,301 and US 5,560,785. The F2 and F2(LX) will only deposit between 1000-2000 angstroms of coating thickness, which is more than sufficient to protect the base metal and promote solderability. The heat resistance imparted to the aryl-phenyl-imidazole is mainly due to the high molecule weight of the azole and the additional benzene ring. Competitive OSP's require much higher film thicknesses in the range of 4000-6000 angstroms. Even with the greater thickness, additional solderability protection is not achieved. Thicker organic films make it more difficult for the solderpaste to spread because of the greater film thickness. The flux vehicle (particularly those found in low activity fluxes and pastes) has greater difficulty in dissolving the organic film, thus retarding the spreadability of the paste. The thinner coatings of the Gliccoat F2 and F2LX eliminates this problem. See the molecular formula below:



The molecule for the F series contains a benzyl group at the R1 position and a lower alkyl group at R2.

What advantages does this new generation Gliccoat additive have?

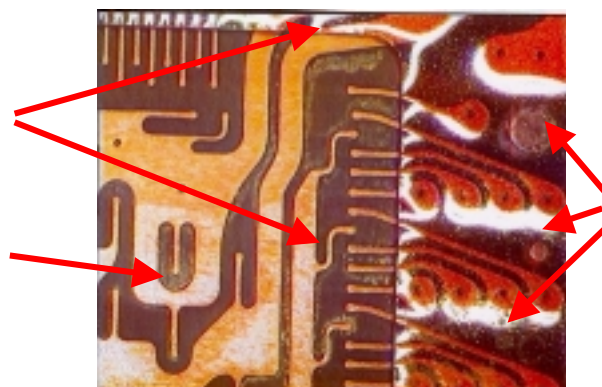
The additive that makes up the main active ingredient of the F2 and F2 LX has several unique properties not found in competitive processes:

1. The active ingredient is more soluble in aqueous solutions, thus allowing the product to be concentrated. In addition, the higher solubility of the ingredient is due mainly to its molecular structure. Thus, the active ingredient in the Glicoat F2 and F2 LX is much less likely to precipitate out of solution due to pH fluctuations. Many commercially available OSP's have such difficulty.
2. The unique molecular structure of the active ingredient allows the Glicoat process to form a uniform yet thin organic layer on the copper surface. The organic film is formed by the reaction of hydrogen groups on the active ingredient with the copper surface of the pwb. The Glicoat F2 LX is able to form uniform coating without the use of copper ions. Copper ions or other metallic ions are required by many commercially available OSP's to accelerate the growth and increase the thickness of the organic film. The Glicoat F2LX contains no such additive and the Glicoat F2 contains only a minute amount. The major benefit here is that with mixed metal finish pwb's (such as those that are bare copper with selective gold), the Glicoat F2LX will not tarnish or deposit its film on these other metals. This is significant particularly for interconnect devices that are sensitive to ionic contamination and/or require low contact resistance on the surface. It should be noted that organic films forming on gold surfaces will increase contact resistance, an undesirable outcome. **The Shikoku Glicoat SMD Process relies on its unique chemistry to form the organic coating on the surface of the copper.**

The gold plated coupon on the left processed with ENTEK®, the one on the right with Glicoat SMD F2LX



3. The Glicoat F2 and F2 LX processes were designed for the higher temperatures and lower wetting tendencies of the lead-free solders that are gaining increased use in the electronics assembly industry. Higher temperatures are required to allow the lead-free solders to reach liquidus temperatures. **The unique molecular structure and properties of the Glicoat active ingredient provides additional protection of the base metal copper and preserves wettability.**
4. The Glicoat OSP processes utilize acetic acid as its solubilizer for the active ingredient. Competitive processes require the use of formic acid as its solubilizer. The main concern with formic acid is its tendency to vaporize under normal operating temperatures. When such an event occurs, the pH of the OSP solution is altered, causing the active azole to precipitate out of solution and build up significant organic film thickness. See the example below. This will cause difficulty with solderability and organic contamination of the copper surfaces and possibly the soldermask. Glicoat is able to eliminate this difficulty through the use of acetic acid. This acid has little tendency to evaporate under normal operating conditions, thus preserving the critical pH range.



Note: red arrows pointing to OSP residues from competitive process

Flexible Operation

The Glicoat F series OSP's are simple to operate and the equipment costs are greatly reduced versus competitive processes:

- Gliccoat OSP can be delivered to the pwb via spray, flood or immersion modes
- Gliccoat processes require acid clean followed by micro-etch as a pre-clean prior to OSP application
- Competitive processes require persulfate micro-etch, followed by the necessary extra step of acid neutralization. Gliccoat does not require persulfate (although it can be used). Instead the Gliccoat SMD Processes can use the more environmentally friendly hydrogen peroxide-sulfuric acid micro-etchants, such as CO-BRA ETCH® from Electrochemicals, Inc.
- CO-BRA ETCH® does not require the additional expense and time of neutralization.
- Competitive OSP's try to go around Shikoku's patents with respect to mixed metals by requiring an **additional organic pre-coating step** prior to actually treating with the OSP solution. Again, this requires additional and costly equipment.

Shikoku establishes world-wide leadership in azole chemistry

Shikoku Chemical Corporation occupies a unique position with respect to organic solderability preservatives. The company is the world's leading

supplier of azole chemistry for many different industries and applications. Shikoku knows azole type chemistry and has synthesized thousands of compounds for these applications.

GLICOAT IS THE CHOICE FOR SOLDERABILITY PRESERVATION

Gliccoat F2 and F2LX provides advantages for both the pwb fabricator and assembler including:

- Gliccoat is compatible with a wide range of no clean fluxes, pastes and lead-free solders
- Gliccoat's thin coating allows for ICT testing through the coating without causing false open readings
- Gliccoat F2 and F2 LX are simple processes to control and are environmentally sound compared to metallic solderable finishes
- Gliccoat F2 and F2 LX easily surpass SIR, ionic contamination and solder joint reliability standards
- Gliccoat F2 LX is compatible with mixed metal finish pwb's. The coating will not deposit on gold

© Electrochemicals Inc
5630 Pioneer Creek Drive, Maple Plain, MN 55359, USA
Phone: 763-479-2008 Fax: 763-479-3344
www.electrochemicals.com

Author: Michael Carano