

July 26, 2019

GliCAP™ GC-750AP

Chemical Adhesion Process for Innerlayer and Solder Resist

1. GENERAL INFORMATION

GliCAP is newly developed process to improve the adhesion between copper and variety of resin without roughening copper surface by effect of very thin organic coating, composed of novel organic azole compound which is developed by our organic synthesis technology.

2. FEATURES

- 1) Improve the adhesion between copper and variety of resin such as insulating materials for inner layer and solder mask without roughening copper surface.
- 2) Smooth copper surface makes excellent signal integrity especially at high frequency range.
- 3) It's suitable for fine pitch copper circuit due to no microetching
- 4) No pretreatment required on copper such as Tin plating, but just acid cleaning by simple horizontal immersion process
- 5) Novel organic coating only on copper directly by chemical reaction. No residue on solder mask and insulating materials.
- 6) GliCAP coating formed on copper is very thin (70-130 nm), uniform and not tacky.
- 7) GliCAP solution is aqueous and environmentally friendly
- 8) Available to use for low-profile copper foil and laminate, and copper wire and enamel, etc.

3. PHYSICAL PROPERTIES

Use GC-750AP to make up. GC-15 is just for pH control.

Product name	Appearance	pH	Specific Gravity
GC-750AP	Light green aq. sol.	4.7	1.1
GC-15	Colorless - light yellow aq. sol.	2.1	1.0

pH and Specific gravity at 20°C

4. PACKAGE and TRANSPORTATION

GC-750AP:	20 liter net UN plastic container
GC-15:	20 liter net plastic container
GC-750AP:	Dangerous material under UN / IATA UN Number: 1760
GC-15:	Not dangerous material

5. MAKE-UP PROCEDURE

This is the procedure how to make up 100 liter in the operating tank.

- 1) Add 100 liter of GC-750AP to the tank first.
- 2) Circulate solution for 30 minutes.
- 3) Make sure the active ingredient concentration and pH are within the optimum range.

6. DAILY MAINTENANCE

This is the procedure how to recover each control item within the optimum range after production.

- 1) Active ingredient concentration
Confirm the solution level in the operating tank (V) and analyze active ingredient concentration (Active C) first. Replenishment (L) of GC-750AP to recover active ingredient concentration to 100% in the operating tank can be calculated by the following formula.

$$\text{Replenishment (L)} = \{ \text{Make-up quantity (L)} \times 100\% - V \text{ (L)} \times \text{Active C (\%)} \} / 100$$

- 2) pH
Confirm the solution quantity in the operating tank and analyze pH.
Add GC-15 in case of higher than pH4.75.
✓ Replenishment of GC-15 for 1% of solution quantity decrease pH 0.02
- 3) Solution quantity
Add D.I. water to recover solution quantity level after all analysis and replenishment.
- 4) Remarks
Make sure all control items are within the optimum range after circulating the solution well.

7. OPTIMUM RANGE and REPLENISHMENT

Item	Optimum Range	Analysis	Replenish in case of lower limit	Replenish, in case of upper limit
Active ingredient	80 - 120%	UV	GC-750AP	GC-15 or D.I. water
pH (20°C)	4.5 – 4.9	pH meter	-	GC-15
Thickness	70 - 130 nm	UV	GC-750AP	GC-15 or D.I. water

- 1) Active ingredient concentration
Lower concentration does not make sufficient thickness.
If too high, the active ingredient might be crystallized.
- 2) pH
It's the most important item to control the thickness within the optimum range and also the properties of GliCAP coating. Lower pH makes thinner coating.
If too high, the active ingredient might be crystallized.
- 3) Thickness
It's important to control the range as above, which is much related to the adhesion between copper and resin. 70-130 nm thick is the optimum, but it's recommendable to determine the best range with your material actually.

8. PROCESS

Typical process of GliCAP GC-750AP treatment is given as follows. However, this is just typical. Please read carefully and talk to SHIKOKU for process details before making the decision. The most critical processes are "3)", "4)", "5)" and "6)" to make the uniform coating and the best performance in adhesion.

- 1) Acid cleaning
 - a. If it is necessary to remove dirt and residue deposited in the previous process, clean the copper surface with GB-200 (potassium persulfate micro etchant).
 - b. If it is necessary to remove only copper oxide, clean the copper surface with an acid cleaner (3.5% aqueous hydrochloric acid, 5% aqueous sulfuric acid or RM-200 (sulfuric acid based cleaning agent)).
- 2) Water rinse
3 cascade rinse with sufficient freshwater influent to prevent GliCAP solution from pretreatment contamination.
- 3) Air knife
Blow away water dew completely, which should affect uneven coating and also prevent GliCAP solution from contamination. No hot air is required.
- 4) GliCAP GC-750AP
30°C for 30 - 90 sec. immersion.
No spray and aeration is recommendable.
The transport rollers should be designed carefully to minimize the contact with copper circuit. The end surface transport is recommendable.
Install a filter ($\phi = 10$ to $50 \mu\text{m}$) in the circulation path between the lower tank and the treatment tank.
It's recommendable to determine the best thickness range with your material actually.

- 5) Water rinse
3 cascade rinse with sufficient freshwater influent to wash away excess GliCAP solution.
- 6) Air knife
Blow away water dew completely, which should affect uneven coating. No hot air is required.
- 7) Drying
70 - 90°C for 20 - 40 sec. with hot air blow to make sure of no moisture in GliCAP coating.

9. MATERIAL COMPATIBILITY

- 1) Tank
Hard PVC, Hard PE, Hard PP
- 2) Transport roll
Hard PVC, Hard PE, Hard PP, Teflon
- 3) Transport shaft
Carbon, Stainless (SUS304, SUS316, SUS316L), Titanium
- 4) Heater
Stainless (SUS304, SUS316, SUS316L), Teflon
- 5) Remark
No rubber such as neoprene and Viton base is recommendable. If really necessary, use EPDM or Teflon.
No soft PVC or soft PE is recommendable. Plasticizer might be eluted.
No squeezing roller is recommendable. If really necessary, use PP or PE roller.

10. MEASUREMENT of ACTIVE INGREDIENT CONCENTRATION

- 1) Prepare enough “dissolving solution” first by diluting 167 gram of 35% hydrochloric acid (HCl) with D.I. water to 1 liter.
- 2) Measure 0.250 gram (W) of GliCAP solution with the third decimal point accuracy and put into 50 ml of measuring flask.
- 3) Dilute with “dissolving solution” to 50 ml exactly, and stir for 1 min.
- 4) Measure the absorbance (A) of the diluted solution at 220 nm by UV spectrophotometer (quartz cell path width 10 mm), in comparison with the dissolving solution as a reference.
- 5) The concentration of the active ingredient can be calculated by the following formula.

$$C (\%) = 32 \times A / W \quad (A: \text{absorbance at 220 nm})$$

11. MEASUREMENT of pH

Measure pH of GliCAP solution at 20°C +/- 1°C.

Clean electrode with HCl solution followed by D.I. water before measuring every time.

Calibrate pH meter once a week regularly by 3-points method at pH 1, 4, and 7.

pH meter should be capable to measure with the second decimal point accuracy.

12. MEASUREMENT of COATING THICKNESS

Measure the thickness of GliCAP coating on bare copper clad laminate as follows within 1 hour after treatment.

- 1) Prepare enough “dissolving solution” first by diluting 167 gram of 35% hydrochloric acid (HCl) with D.I. water to 1 liter.
- 2) Prepare bare copper clad laminate, which the copper grain structure is similar to the production board hopefully. Make sure of no chromate anti-oxidant coating on the surface.
- 3) Treat the copper clad laminate with GliCAP from the beginning (acid clean as well) and cut it into appropriate size: S cm² (e.g. 4 x 4 cm x both side = 32 cm²).
- 4) Put the cut board in the beaker, pour V ml (e.g. 20 ml) of the dissolving solution, and stir the beaker for 1 minute, in order to dissolve the coating completely.
- 5) Measure the absorbance (A) of the diluted solution at 220 nm by UV spectrophotometer (quartz cell path width 10 mm), in comparison with the dissolving solution as a reference.
- 6) Measure the absorbance (B) of the same copper clad laminate in accordance with the above procedure, but only acid cleaning and drying without GliCAP treatment.
- 7) The coating thickness (T nm) can be calculated by the following formula.

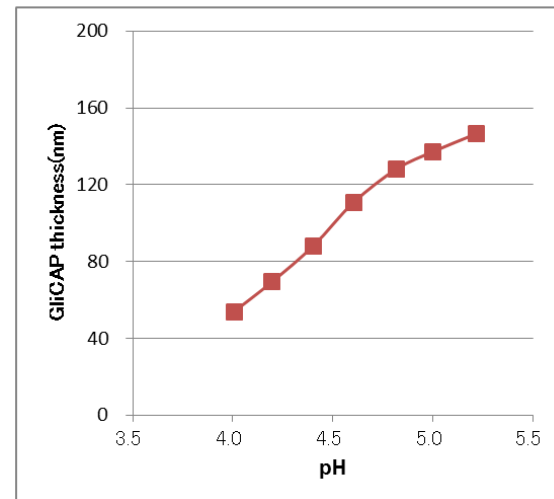
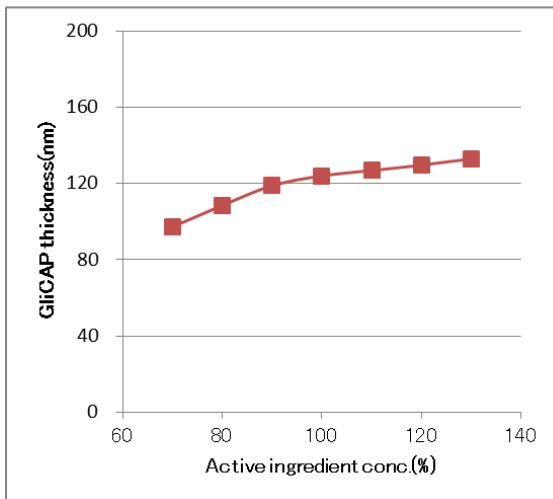
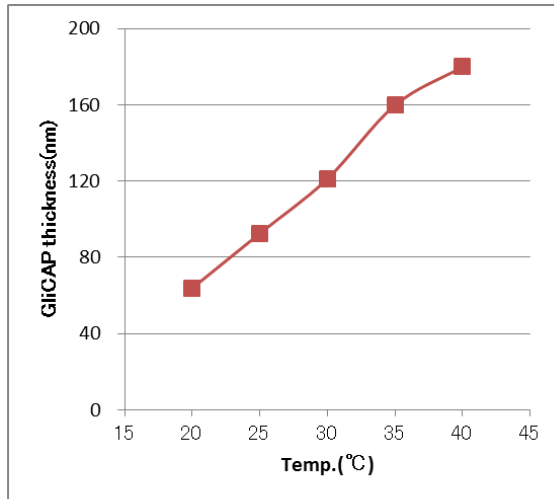
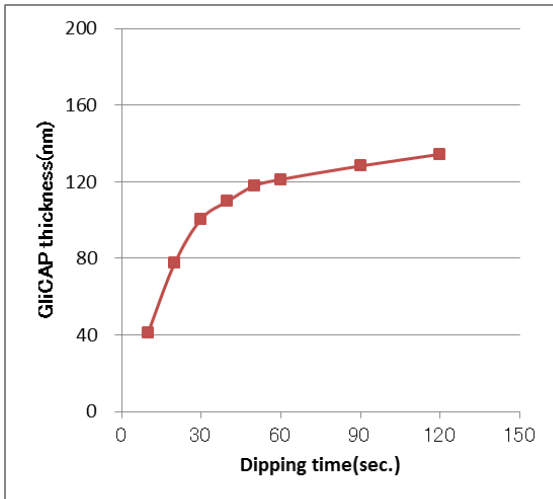
$$T (\text{nm}) = 231 \times (A - B) \times V / S \quad (A, B: \text{absorbance at 220 nm})$$

13. PROCESS CONDITIONS and COATING THICKNESS

The coating thickness can be controlled by immersion time, solution temperature, active ingredient concentration and pH. It's recommendable to determine the best thickness range with your material actually, but 70-130 nm should be appropriate in terms of adhesion between copper and resin.

Standard process conditions:

- 100% active ingredient
- 60 sec. immersion at 30°C
- pH: 4.7 (20°C)



14. WASTE TREATMENT

The solution and rinsing water after GliCAP tank contains organic compounds with nitrogen and copper ion. Do not discharge them even neutralized or diluted spills into any waterway or sewer system without the consent of local pollution control authorities. Follow our recommendation as below.

GC-750AP used solution

- 1) Add activated clay to GliCAP used solution in the ratio of 1 to 100, neutralize with sodium hydroxide and stir for 30 minutes.
- 2) The precipitation containing copper ion should be filtered out and disposed by the industrial waste company. The copper ion concentration after neutralization should be reduced below 1 ppm.
- 3) Discharge the filtered solution after biological treatment and dilution in accordance with local pollution control authorities. COD and BOD after the above treatment are given just for reference.

	GC-703	Filtered solution	Method
COD _{Mn} (mg/L)	6,100	4,900	JIS K 012-17
BOD (mg/L)	3,800	5,900	JIS K 012-21-32.3

15. PRECAUTIONS

Read SDS of GliCAP GC-750AP and GC-15 carefully before use.

Prevention

- Obtain special instructions before use.
- Do not handle until all safety precautions have been read and understood.
- Handle this product at well-ventilated area. Avoid raising a mist.
- Wash hands and eyes thoroughly after handling.
- Do not eat, drink or smoke when using this product.
- Wear protective gloves, protective clothing, eye and face protection.
- In case of inadequate ventilation, wear respirator protection.

Response

- If swallowed, rinse mouth. Do not induce vomiting. Get medical advice rapidly.
- If on skin, take off contaminated clothing and wash with plenty of water. If skin irritation occurs, get medical advice. Wash before reusing contaminated clothing.
- If inhaled, remove person to fresh air and keep comfortable for breathing. Call a doctor if you feel unwell.
- If in eyes, rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice rapidly.
- If experiencing respiratory symptoms, call a doctor.
- If exposed or concerned, call a doctor. Get medical advice.

Storage

- Store in a cool, locked up, dry and well-ventilated area avoiding exposure to sunlight.

Disposal

- Product: Allocation of a waste code number, according to the every nation catalogue, should be carried out in agreement with the regional waste disposal company.
- Packaging: Residuals must be removed from packaging and when empties completely disposed of in accordance with the regulations for waste removal. Incompletely empties packaging must be disposed of in the form of disposal specified by the regional disposer.

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