The Evaluation of CAF property for narrow TH pitch PCBs

Hikari Murai

Hitachi Chemical Co. America, Ltd. 10080 North Wolfe Road Suite SW3-200 Cupertino, CA 95014 h-murai@hitachi-chem.co.jp

EXECUTIVE SUMMARY

Conductive Anodic Filament(CAF) that is one of the copper migration phenomena becomes significant problem with higher density circuit for printed circuit board.(PCB) In the past CAF property was judged the test vehicle included through hall(TH) (wall to wall 0.3-0.5mm) Recently the circuit of PCB becomes higher density, the evaluation vehicle is requested more narrow TH pitch. So we had studied drilling process ability and the structure of PCB, finally we made evaluation vehicle that can evaluate anti-CAF property by using very narrow pitch TH(wall to wall 0.05-0.10mm) We tested several laminates to use this test vehicle and found out one of high Tg halogen-free FR-4 had an excellent anti-CAF restraining property. Additional our migration test to use extract liquids indicated the different trend between good CAF property's laminate and bad one.



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Hitachi Chemical Co .,Ltd 1500 Ogawa Chikusei-shi, Ibaraki, Japan E-mail: h-murai@hitachi-chem.co.jp

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The factors of copper ion migration



<u>CAF</u>: Conductive Anodic Filament Resin / Fiber (TH/TH,Inner L/TH etc.) Depending on the laminate properties **The factor of CAF occurrence** <u>Chemical factor</u>
/ The elusion of copper ion
/ The migration of copper ion

Dendrite: Line / Line Occurring during MFG. process Mechanical factor
 / Drilling processability
 (Shortening of the insulation distance)



IPC 2003





IPC 2003



Insulation Resistance Property by FICS



Trend of PKG structure

Logic (MPU, Graphic)



<u>Trend of packaging(Trend of interface)</u>



Trend of packaging (Trend of interface)





Fig. ITRS2004 BGA and FBGA/CSP Package Potential PWB"High Performance"

Yesr of Production	2004	2005	2006	2007	2008	2009	2012
Pad size (µm)	160	120	120	80	80	80	60
Line width (µm)	48	36	36	24	24	24	18
Line spacing (µm)	48	36	36	24	24	24	18

Developing plan

• To make clear what kind of laminate should be suitable for narrow pitch TH PCBs.

• The proposal of material which has excellent reliability

- Which material is suitable for narrow TH pitch? \Rightarrow ?
- •What is a subject of laminate material? \Rightarrow ?
- Which level can laminates maintain? \Rightarrow ?

⇒Needs: a new test vehicle to be able to evaluate CAF property of narrow TH pitch

2.The design of CAF evaluation PCB <u>The original plan of evaluation vehicle for narrow TH pitch</u>



Examination of drilling condition



The cross section of evaluation vehicle





Through hole (Φ0.100mm)

Surface photograph of evaluation vehicle



Cross section (inner joint area)



3. Evaluation of laminate materials

Table. The laminate materials of PCBs for CAF evaluation

Material	Glass fabric	Resin system	Br contents(%)	Filler	Tg(TMA)
А	1080	Epoxy	15	Non	180
В			15	Included	170
С			17	Included	170
D			18	Non	130
Е			0	Included	180
F		Non-epoxy	15	Non	180

3. Evaluation of laminate materials



Surface photograph (CAF part)

Cross section photograph (CAF part)

3. Evaluation of laminate materials



The evaluation result of CAF property



4. Result and consideration



4.Result and consideration Copper migration test equipment



Test cell

Test equipment

Voltage / Charge time: 30V/30min. Max. electric current : 6mA

	Extracted liquid				
Material	Electric conductivity(µs/cm)	PH	Br ion peak(µs)		
A	6.9	5.7	0.015		
В	6.1	6.3	0.009		
С	7.6	5.8	0.009		
D	35	6.7	0.122		
E	20	8.1	0		
F	14.3	5	0.118		

Table. Properties of each extracted liquid

Extract method:

sample (40mmX 30mm: 3pcs) in pure water D-200/110

4. Result and consideration

E (Halogen-Free) Br peak 0 EC 20.3



10min 20min Treating time (Max 6mA, 30V)

D Br peak 0.122 EC 35.0



E

D

$Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$

Conclusion

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- 1. We could propose a new CAF evaluation vehicle for having narrow through hole pitch PCBs.
- The new CAF evaluation vehicle can be tested 50μm from the wall to wall between through holes.
- 3. We evaluated CAF restraining property using several types of laminates.
- 4. Our evaluation result indicated a new halogen-free material had the best anti-CAF property.
- 5. The migration test to use extract liquids indicated the different trend between good one and bad one.