

Effect of reflow temperature of tin-bismuth finish to thermal cycling test

ISHIHARA CHEMICAL CO.,LTD.
R&D department

Introduction

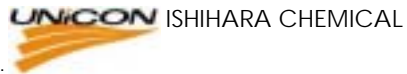
The tin-bismuth finish have excellent whisker mitigation ability than tin finish. But JEITA reported that tin-bismuth finish on alloy 42 after high temperature reflow generated the long tin whisker under heat cycling test.

In this report, an appropriate reflow temperature was investigated from the relation of the reflow peak temperature and tin whiskers generation.

1

2008/10/6

Ishihara Chemical co., ltd., all rights reserved.



Conclusion

The whiskers generated above 240deg.C that caused tin-bismuth deposits to melt completely. By contrast, the reflow temperature is below 230deg.C generated no whiskers. Therefore tin-bismuth finish could apply to alloy42 when the reflow temperature is below 230deg.C.

This evaluation with the electric component terminal without soldering should be used only as a guide. Because electric component terminals with soldering are formed fillet with much solder.

Table 1 Maximum length of tin whiskers on thermalcycling test

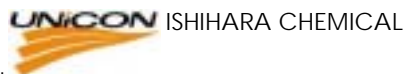
| Reflow temperature (deg.C) | Thermal cycling | | | |
|-------------------------------|-----------------|--------------|--------------|--------------|
| | 500 | 1000 | 1500 | 2000 |
| 210 | Not observed | Not observed | Not observed | Not observed |
| 220 | Not observed | Not observed | Not observed | Not observed |
| 230 | Not observed | Not observed | Not observed | Not observed |
| 240 | 17.9 | 21.0 | 13.2 | 23.7 |
| 250 | 22.2 | 21.0 | 21.1 | 28.0 |
| 260 | 15.0 | 34.2 | 24.2 | 27.0 |

Unit:micrometer

2

2008/10/6

Ishihara Chemical co., ltd., all rights reserved.



Experimental

Ishihara Chemical R&D report

Experimental condition

Whisker observation method

- Thermal cycling test: -45deg.C to +80deg.C (20min./cycle)

Test pieces

- Leadframe: alloy42
- Finish:
 - Tin-2%bismuth plating process :UTB PF-05SH process
- Thickness: 10 μ m measured by XRF coating thickness measurement

Plating composition

| Tin-2%bismuth process | | amts. |
|-----------------------|--------|-------|
| UTB PF-TIN15 | (g/L) | 533 |
| UTB PF-BI15 | (g/L) | 26.7 |
| UTB PF-ACID | (g/L) | 125 |
| UTB PF-05SH-A | (ml/L) | 30 |
| UTB PF-05SH-B | (ml/L) | 10 |
| Sn ²⁺ | (g/L) | 80 |
| Bi ³⁺ | (g/L) | 4 |
| Free acid | (g/L) | 140 |

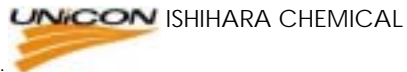
Plating condition

| Tin-2%bismuth process | | |
|--------------------------|----------------------|-----|
| Cathodic current density | (A/dm ²) | 15 |
| bath temperature | () | 50 |
| Anode material | | Tin |

3

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results

Ishihara Chemical R&D report

The whiskers generated above 240deg.C. But the reflow temperature is below 230deg.C generated no whiskers.

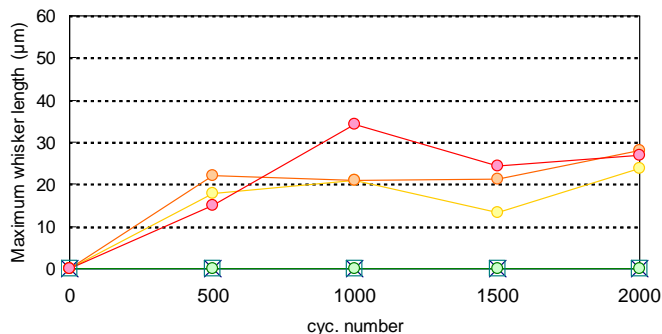


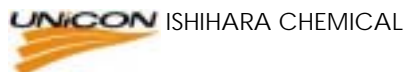
Fig. Effect of reflow temp. of TCT of SnBi/alloy42

—x— 210 —□— 220 —○— 230 —○— 240 —○— 250 —○— 260

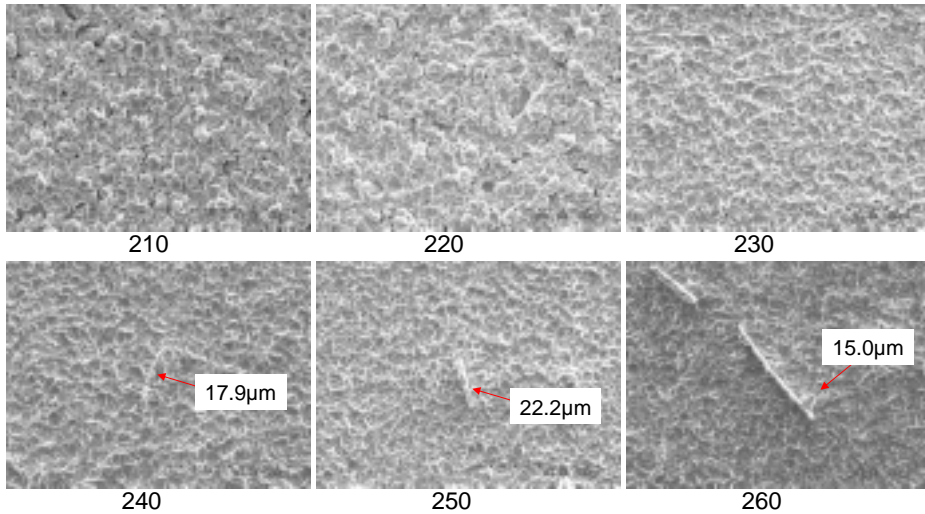
4

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results of tin-bismuth finish on alloy42 after TCT500cyc.

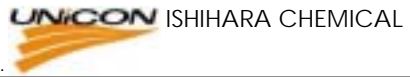


(Magnification:1000)

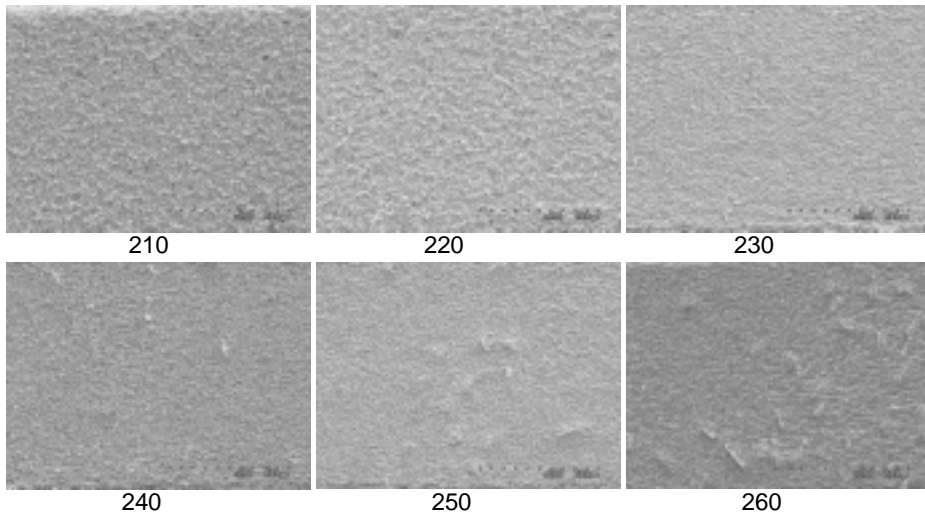
5

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results of tin-bismuth finish on alloy42 after TCT500cyc.

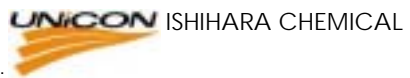


(Magnification:250)

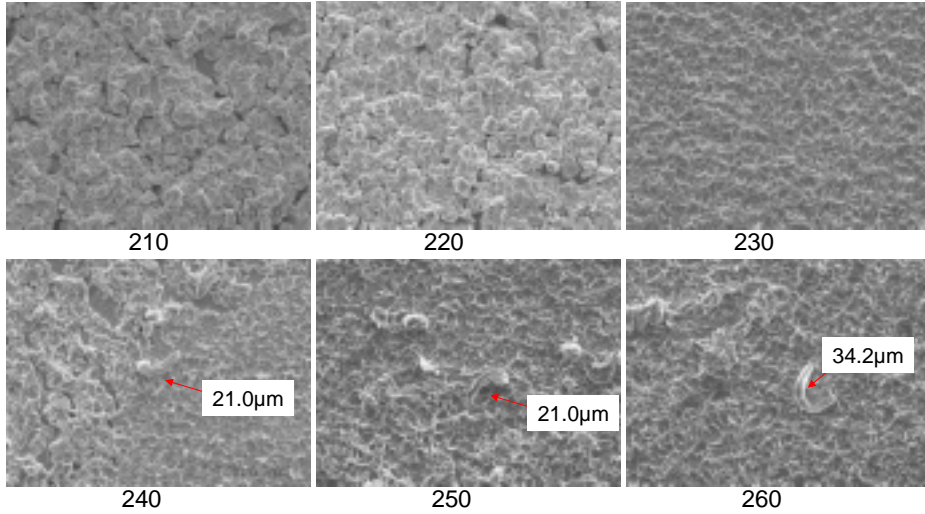
6

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results of after TCT1000cyc.

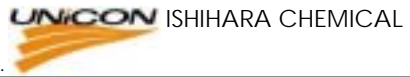


(Magnification:1000)

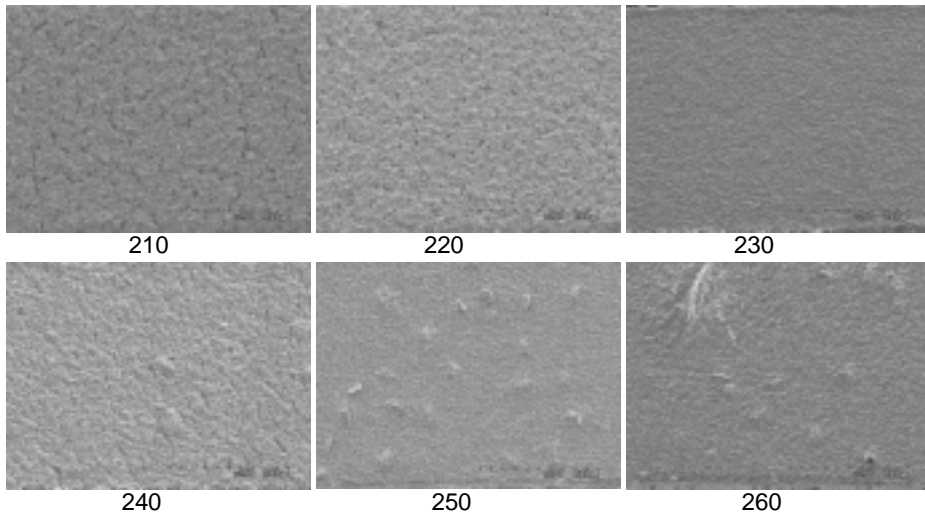
7

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results of after TCT1000cyc.

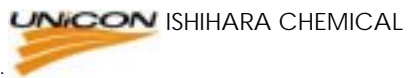


(Magnification:250)

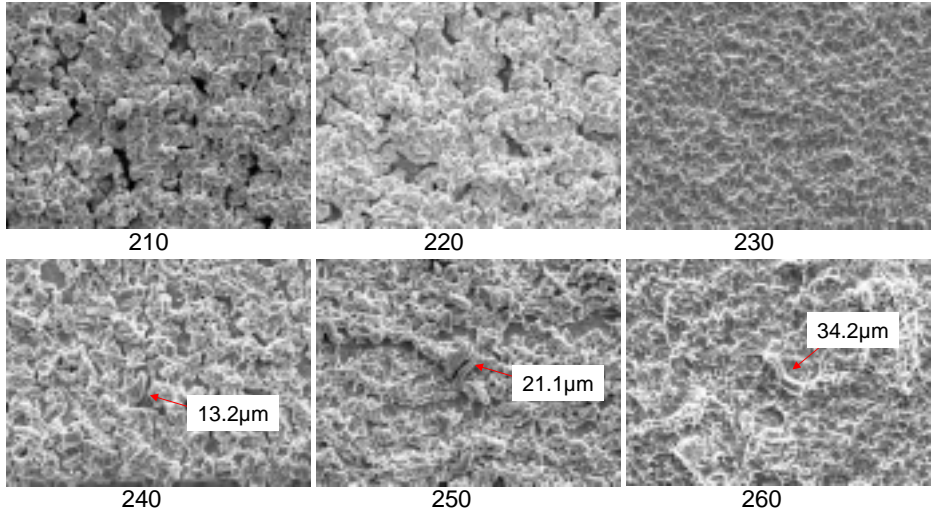
8

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results of after TCT1500cyc.

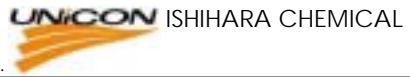


(Magnification:1000)

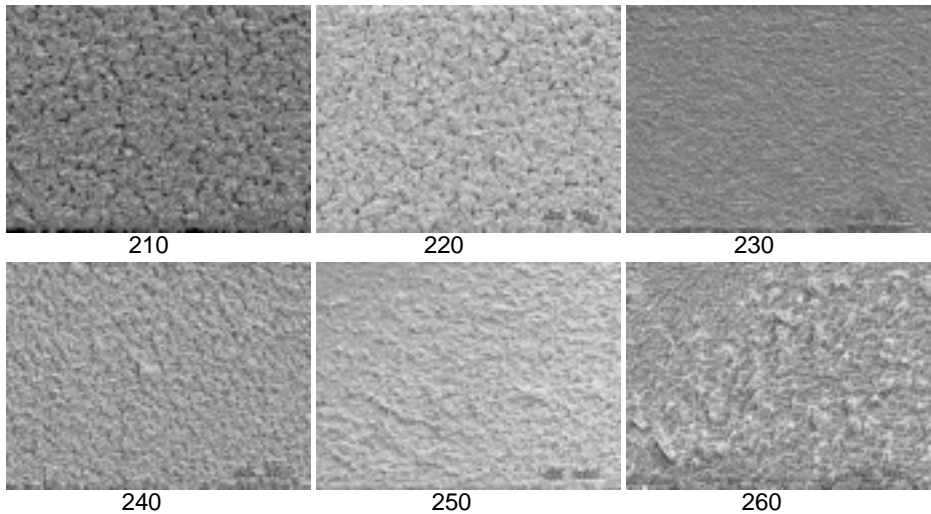
9

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results of after TCT1500cyc.

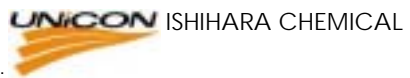


(Magnification:250)

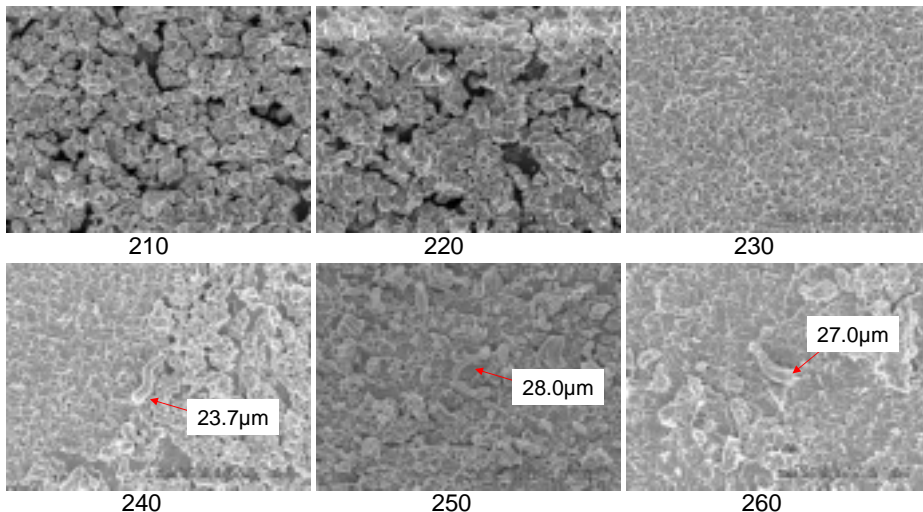
10

2008/10/6

Ishihara Chemical co., Ltd., all rights reserved.



Results of after TCT2000cyc.

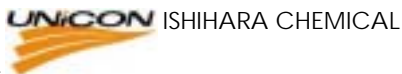


(Magnification:1000)

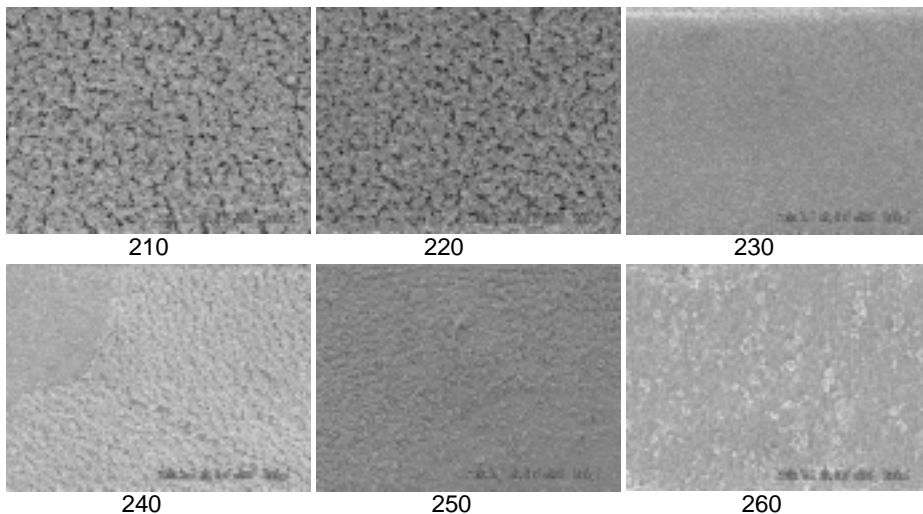
11

2008/10/6

Ishihara Chemical co., ltd., all rights reserved.



Results of after TCT2000cyc.



(Magnification:250)

12

2008/10/6

Ishihara Chemical co., ltd., all rights reserved.

