

# Thermal cycling test of tin-bismuth and tin plating

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R&D department

## Introduction

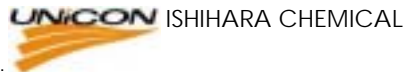
The tin alloy plating is applied to the IC leadframe in Japan. On the other hand, the pure tin plating is applied to there in the United States and Europe .

We compared the tin whiskers generation of the tin-bismuth finish and the pure tin finish after the thermal cycling test.

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## Conclusion

The long whiskers are generated on the pure tin finish on the alloy42 substrate. On the other hand, the tin-bismuth finish generate no whiskers.

Therefore, it was shown the tin-bismuth finish mitigate the generation of the tin whiskers. In other words, the tin finish doped bismuth can mitigate the tin whiskers.

Table 1 Maximum length of tin whiskers on thermalcycling test

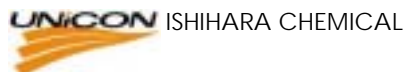
Finish	Substrate	Thermal cycling		
		500	1000	1500
Pure tin	CDA194	14	20	26
	alloy42	28	47	67
Tin-bismuth	CDA194	Not observed	Not observed	Not observed
	alloy42	Not observed	Not observed	Not observed

Unit:micrometer

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# Experimental

## Experimental condition

### Whisker observation method

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

### Test pieces

- Leadframe: copper alloy(CDA194) and alloy42
- Finish:
  - Pure tin plating process :General pure tin process
  - Tin-2%bismuth plating process :UTB PF-05SH process
- Thickness: 10μm measured by XRF coating thickness measurement

## Plating composition

Pure tin process			Tin-2%bismuth process		
		amts.			amts.
UTB PF-SN15	(g/L)	467	UTB PF-TIN15	(g/L)	533
UTB PF-A	(g/L)	125	UTB PF-BI15	(g/L)	26.7
Commercial additive	(ml/L)	30	UTB PF-ACID	(g/L)	125
Sn2+	(g/L)	70	UTB PF-05SH-A	(ml/L)	30
Free acid	(mol/L)	1.4	UTB PF-05SH-B	(ml/L)	10
			Sn2+	(g/L)	80
			Bi3+	(g/L)	4
			Free acid	(g/L)	140

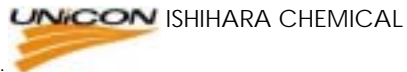
## Plating condition

Pure tin process			Tin-2%bismuth process		
Cathodic current density	(A/dm <sup>2</sup> )	15	Cathodic current d	(A/dm <sup>2</sup> )	15
bath tempearute	( )	40	bath tempearute	( )	50
Anode material		Tin	Anode material		Tin

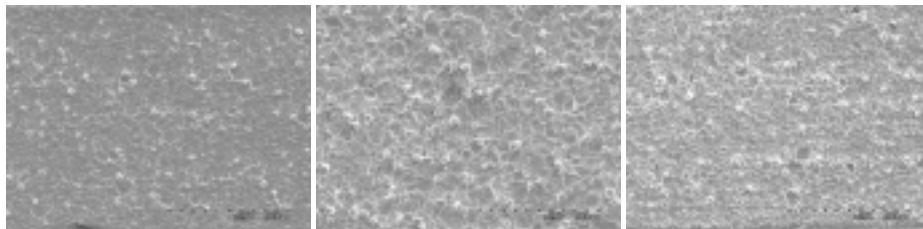
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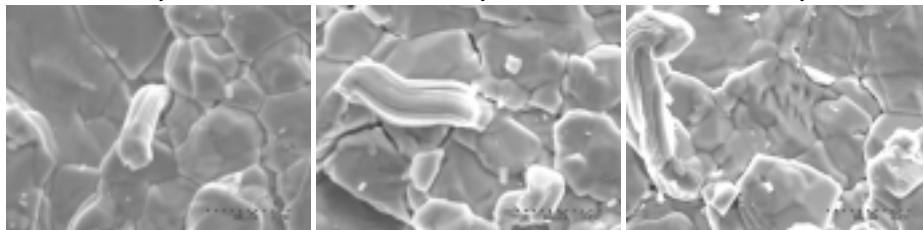
# Results of tin finish on copper(CDA194)



500cyc.

1000cyc.

1500cyc.



14μm

20μm

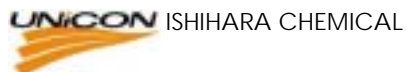
26μm

(Maximum whisker length)

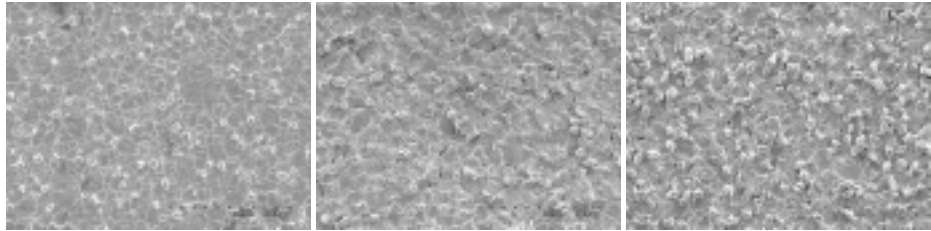
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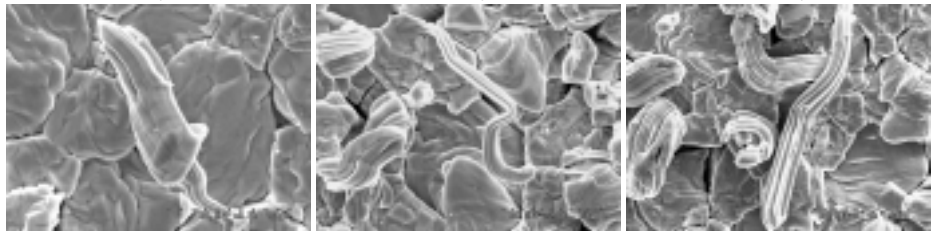
# Results of tin finish on alloy42



500cyc.

1000cyc.

1500cyc.



28 $\mu$ m

47 $\mu$ m

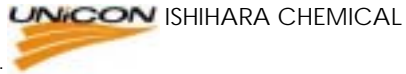
67 $\mu$ m

(Maximum whisker length)

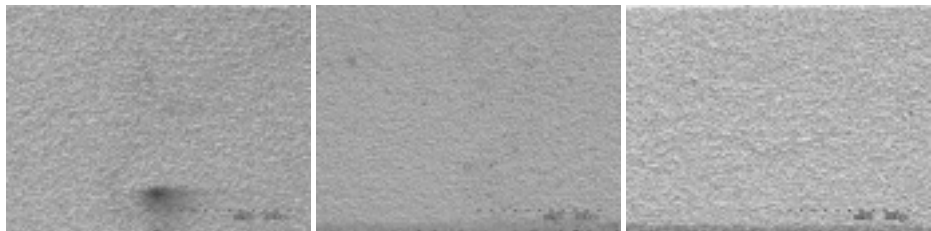
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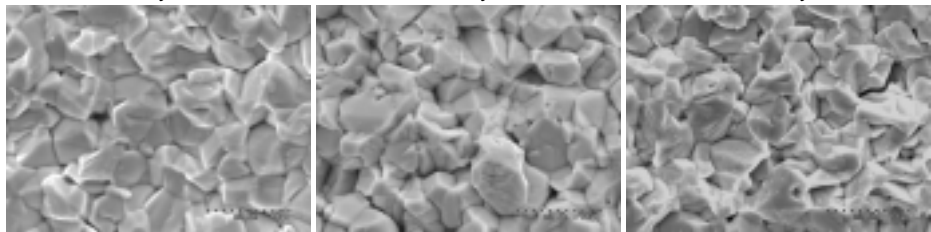
# Results of tin-2%bismuth finish on copper(CDA194)



500cyc.

1000cyc.

1500cyc.

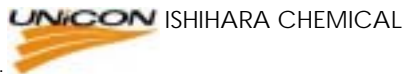


Tin whiskers were not observed.

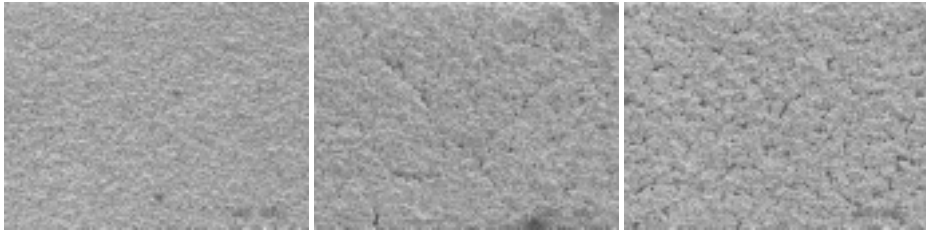
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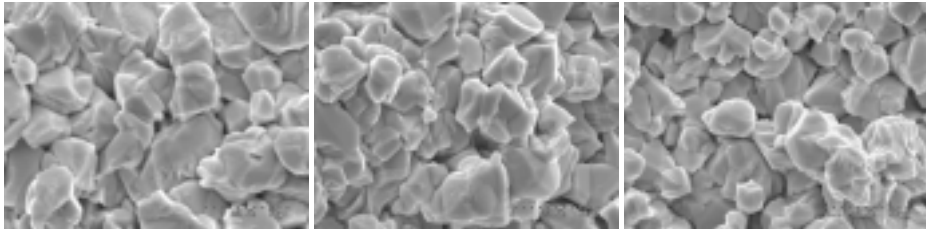
# Results of tin-2%bismuth finish on alloy42



500cyc.

1000cyc.

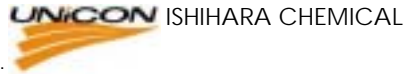
1500cyc.



Tin whiskers were not observed.

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