OKI Business Update

Pb-Free Issue

January 17, 2003

Pb-free material specifications

1)Lead frame package

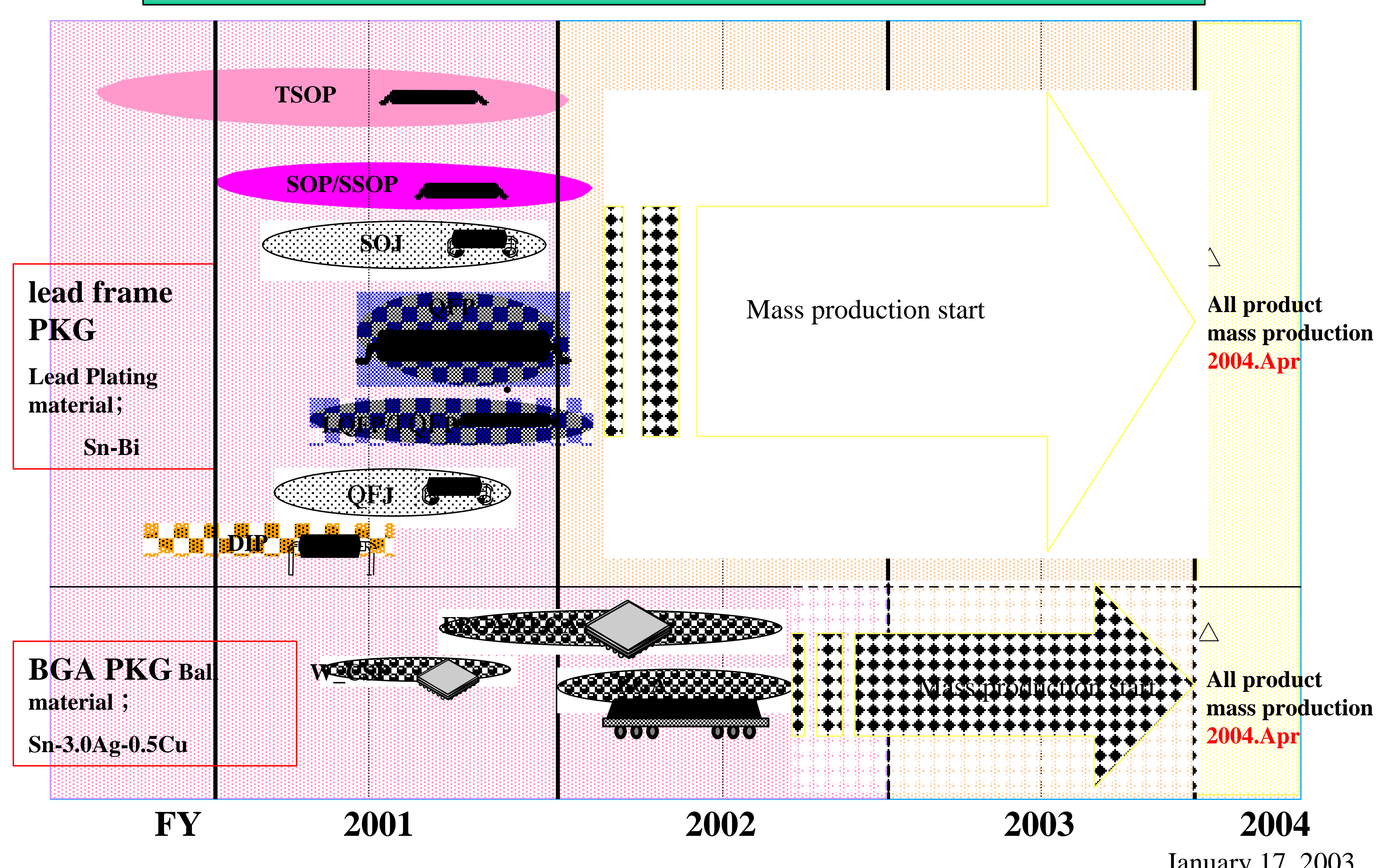
: Sn-Bi (Bi metallic additive ratio =1 to 4%)

2)BGA package

: Sn-3.0Ag-0.5Cu

OKI

Schedule for Pb-free mass production



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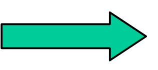
Lead frame package Pb-free evaluation Results -1/4

Terminal appearance after forming process

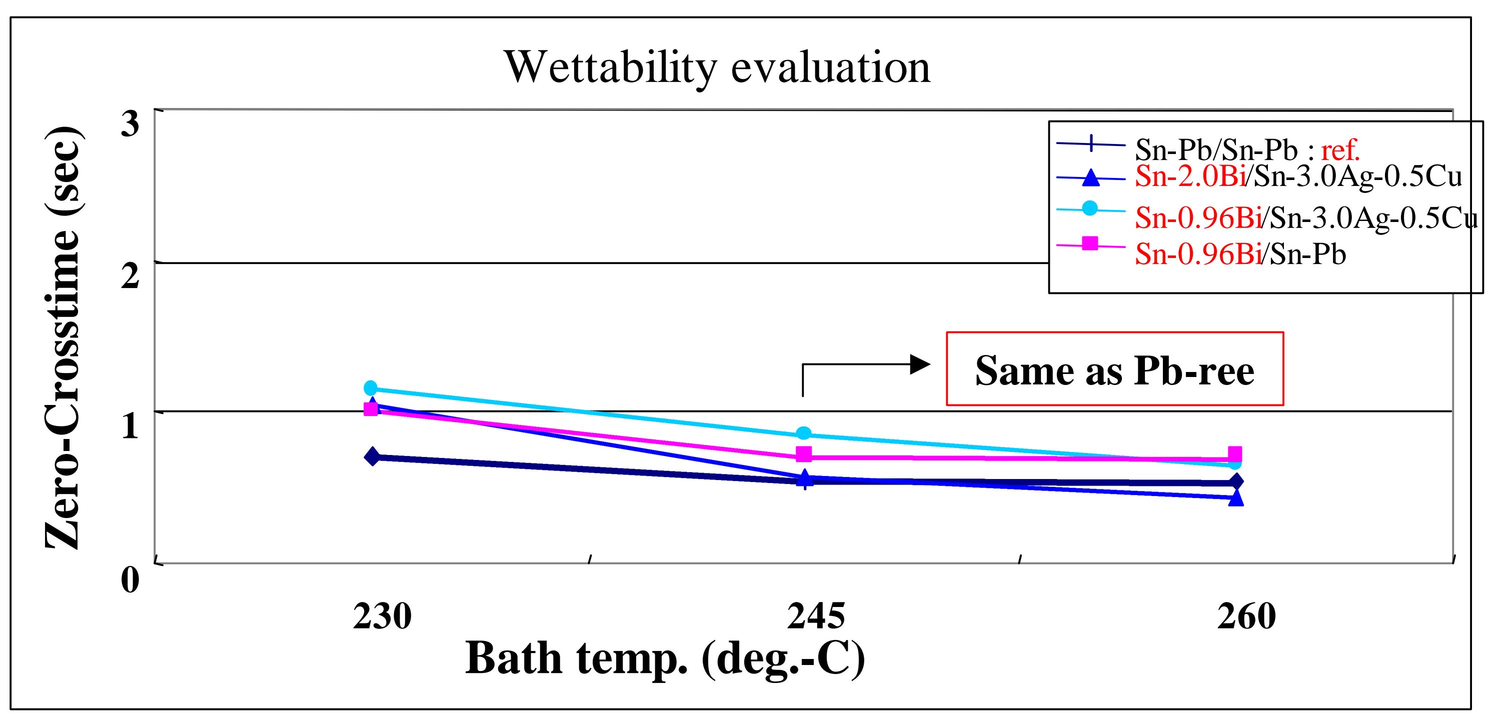
Plating material	Sn-Pb	Sn-2.0Bi	Sn-4.4Bi
Terminal appearance			
Results	Good (No-crack)	Good (No-crack)	Good (No-crack)



No plating material cracks after forming process

Lead frame package Pb-free evaluation Results -2/4

Wettability (Zero-CrossTime)



Pre conditioning : PCT(105deg.-C100%1.2atmospheres)four hours
Dipping depth : 0.2 mm
Dipping speed : 2 mm / sec.
Dipping time : 3 sec.
Criteria : less than 3 sec.

Lead frame package Pb-free evaluation Results -3/4

Results of joint strength evaluation

Strength (N)

20
15
10
5
0

0 200 400 600

Number of temperature cycle (cyc)

Sn-Pb/Sn-Pb : ref.
Sn-2.0Bi/Sn-3.0Ag-0.5Cu
Sn-4.4Bi/Sn-3.0Ag-0.5Cu

T/C condition :
- 40deg.-C ~ 125 deg.-C
20 minutes
TEST PCB :FR-4
108 X 120mm
1.6t / 4Layer

Stable after 600 cycles

Pre-processing condition : PCT(105deg.C100 %1.2atmospheres) 4 hours
Reflow temperature : 230deg -C. max. 225deg-C 20 to 30 sec
Reflow machine : air reflow

Lead Frame Package Pb-free evaluation Results-4/4

Whisker Growth by Temperature Humidity Test

1) Before Reflow Heating

(pcs)

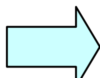
Plating Material	Terminal Plating	Plating Current condition (A/dmm2)	Sample size	Duration Time(H)					
				100	300	500	700	900	1000
Sn-Pb	Rack Plating	3 to 5	30	0	0	0	0	0	0
	Sheet Plating	15 to 20	30	0	0	0	0	2*	2*
Sn-Bi (Bi=0,96%)	Rack Plating	3 to 5	30	0	0	0	0	0	0
	Sheet Plating	15 to 20	30	0	0	0	0	7*	7*

* Whisker size = 150um max.

2) After Reflow Heating (Simulating for board soldering without solder past)

(pcs)

Plating Material	Terminal Plating	Plating Current condition (A/dmm2)	Sample size	Duration Time(H)					
				100	300	500	700	900	1000
Sn-Pb	Rack Plating	3 to 5	30	0	0	0	0	0	0
	Sheet Plating	15 to 20	30	0	0	0	0	0	0
Sn-Bi (Bi=0,96%)	Rack Plating	3 to 5	30	0	0	0	0	0	0
	Sheet Plating	15 to 20	30	0	0	0	0	0	0



Condition that whisker is not found after 1000 hours THB test.

1) After Reflow Heating (Stress relief inside of plating material by reflow heating)

⇨ **Need minimize whisker growth during product storage before shipment (Storage after Plating) .**
Need further investigation for optimum storage condition.

2) Rack Plating (Relatively low Plating current density)

< Other Testing conditions >

1)THB condition : 85℃ 85% RH

2)Reflow Peak temperature : 240℃

3)Visual inspection :Stereo micro-scope (x40)

4)Whisker size Criteria : 50ìm max.

5)PKG :QFP60-P-1519-1.00-K (lead frame material : Alloy -42)

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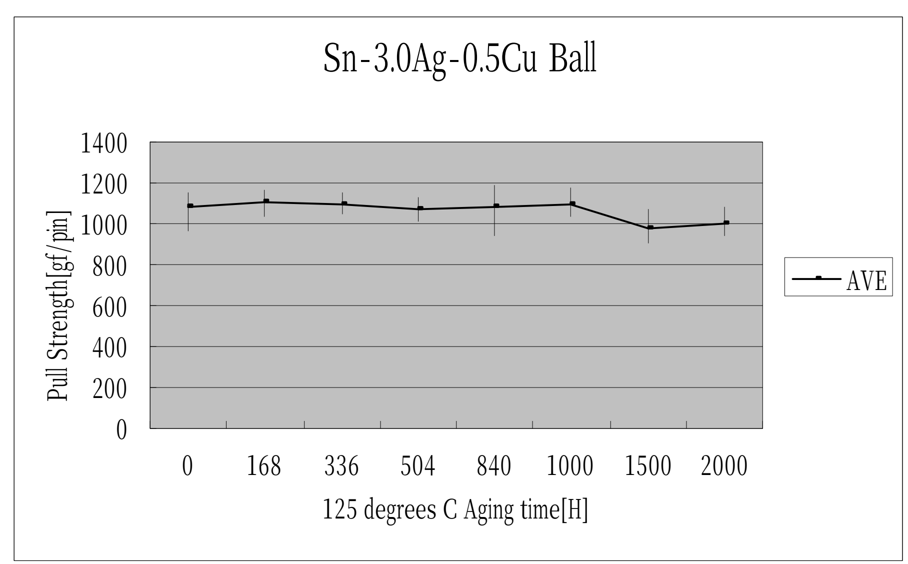
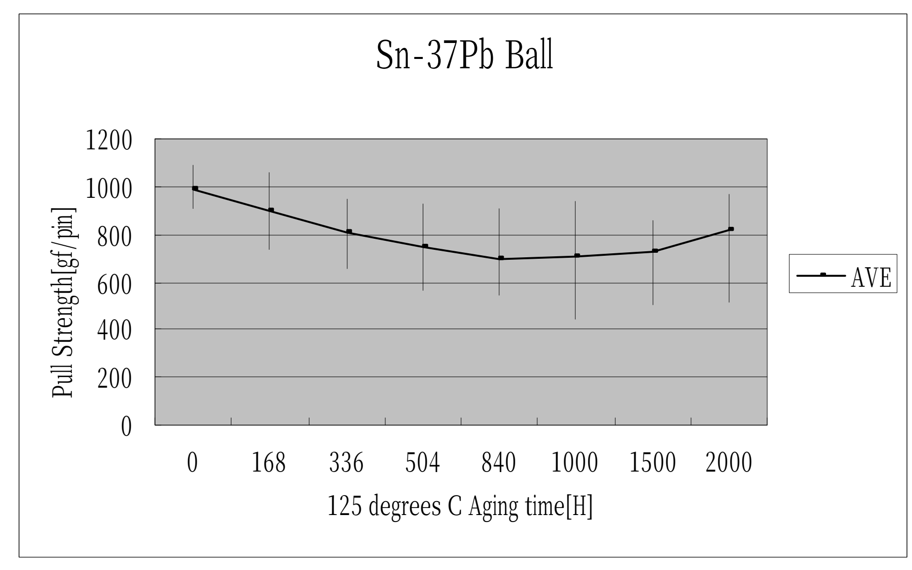
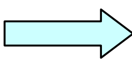
BGA Package Pb-free Evaluation Results -1/2

Ball pull Strength

Test : Ball Pull (Mechanical Pull) at Room Temperature
Aging : 125 degrees C. Storage
Package : FBGA224-1515-0.8
Ball Diameter : 0.5mm
Sample size : 3Packages X 10Balls







Stable after 2000 hours at 125 deg,-C

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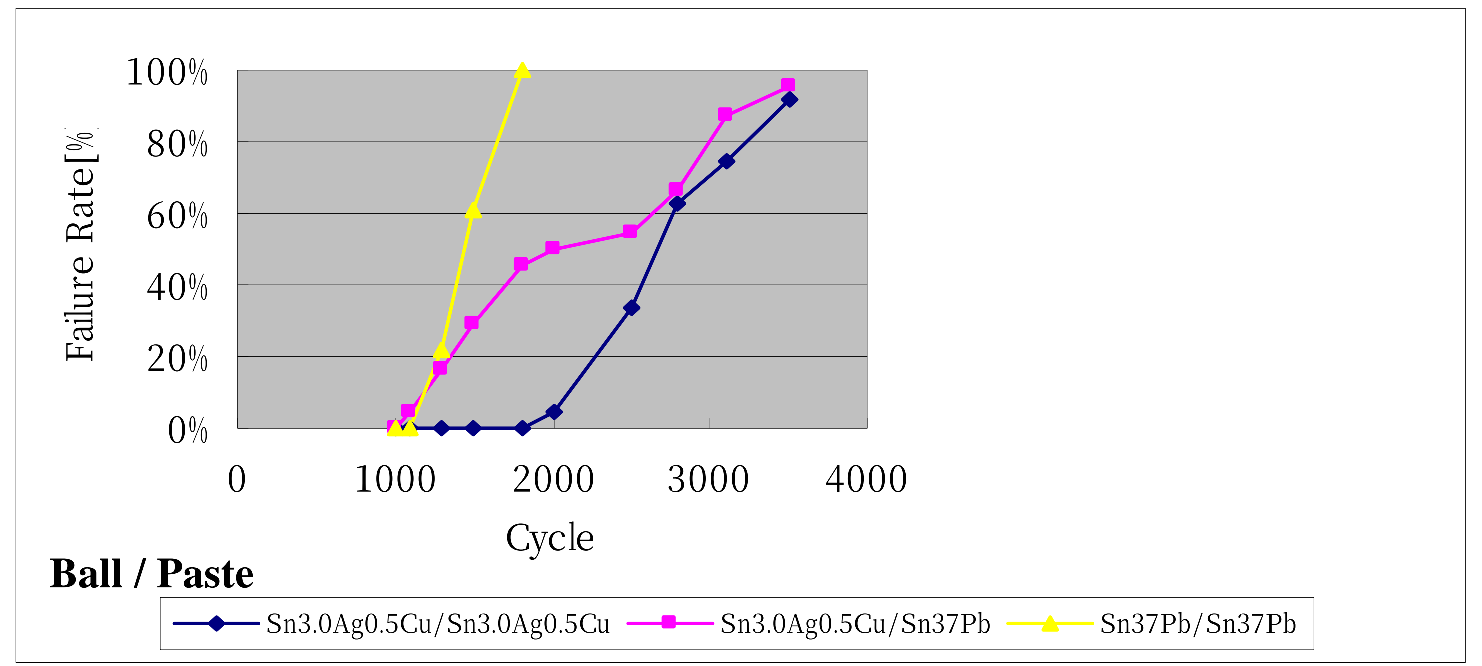
BGA Package Pb-free Evaluation Results-2/2

On-Board Thermal Cycle

Thermal Cycle Condition : -40 degrees C (20min) <--> +125 degrees C (20min)
Measurement : Resistance
Judgement : 10% resistance decrease.
Reflow : Lead-free paste 250 degrees C peak
Non Lead-free paste 240 degrees C peak
Package : FBGA144-1111-0.8 Ball Diameter : 0.5mm
Sample size : 24Packages respectively
Board : 108x100x1.27 / 4layers FR-4



Better than lead free material

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Recommended Pb-free Reflow profile

Discrimination of Lead-free Products

1)Part Number ; Define specific 2 letters at the end of Part Number.

ex.MD56V62160-XXTAZ0$$ $$= 3A,3B,3C,3D,3E,3F,3G,3H

2)Marking

Add "J" at the end of Lot number.

3)Lead free-sticker

Attach lead-free sticker to mark on aluminum bag (dry pack) and on inner box.

lead-free sticker

鉛フリー

Lead free

aluminum bag

(dry pack)

inner box.

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