TAIWAN SEMICONDUCTOR CO., LTD.

Tin Whisker Test Report

For Matrix-SMA Package

Approved By: Vince Li **Prepared By: Roben Jiao**

TAIWAN SEMICONDUCTOR

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Tin Whisker Test Report

Basic Information:	**Sample ID: Matrix SMA**
Date of Inspection	Mar. 09, 2020
Test Condition (Refer to JESD201A)	1. Post finish treatment: Anneal@150°C&1.5hour 2. Precondition: Reflow temperature Tpeak = 260 °C 3. Temp Cycling -55 (+0/-10)°C to +85 (+10/-0)°C air to air; 10minutes soak; ~3cycles/hour 4. High Temp/Humidity Storage (55 ±3°C, 85 ±3% RH) 5. Room Temperature/Humidity Storage (30°C ±2°C and 60% ±3% RH)

Cumulative exposure time (hours) or # of cycles at read point	1. 1500cys 2. 4000hrs
Observations:	
Type of whisker (kinked, straight, branched)	Straight
Length of longest whisker (microns)	22.802 um
Whisker density (Low, Medium, High per inspected area)	Low
Additional Comments / Exceptions	None
Substrate:	
Type (e.g., package, coupon, chip)	Package
Substrate material (e.g., Cu, CuFe2, Alloy 42)	Copper
Forming operation (e.g., etched, stamped)	N/A
Post finish treatment (none, reflow @ C, anneal @ time & temp, etc.)	Anneal@150°C & 1.5hr
Time between pre and post-finish treatment (anneal, reflow, etc.)	< 24hrs
Time between finish application and initiation of environmental aging	>1000hrs
Underplating:	
Under plate date	N/A
Under plate material (e.g., Ni, Ag, etc.)	N/A
Bath type (e.g., sulfa mate)	N/A
Under plate type (bright, matte, satin)	N/A
Under plate thickness (microns)	N/A
Tin Finish:	
Finish application date	Oct. 4, 2019
Alloy Type (e.g., tin, tin-bismuth)	Pure tin

Tin Whisker Test Report

If an alloy of tin is used, alloy content range (e.g., 1-3%)	N/A
Bath type (Methane sulfonic acid, mixed acid, etc)	Methane sulfonic acid
Finish type (bright, matte, satin)	Matte
Finish thickness (microns)	um
Finish grain size (microns) [1]	> 1um
Current density (Amps/ dm)	0.8-1.0
Carbon content in the deposit [2]	85ppm
* Impurity content in the plating bath, Cu	0
* Impurity content in the plating bath, Zn	0
* Impurity content in the plating bath, Fe	0
* Impurity content in the plating bath, Ag	0
* Impurity content in the plating bath, Pb	N/A
* Impurity content in the plating bath, Ni	0

* Impurity content should be measured in the plating bath. These fields are not required, but are recommended to be reported.

[1] Can be measured on the surface of the deposit. The test method should be disclosed. The ASTM method E112 is recommended.

[2] Carbon content may be measured on a separate coupon sample provided that the plating conditions are similar to the conditions used for creating whisker test samples. The test method should be disclosed.

Whisker Information

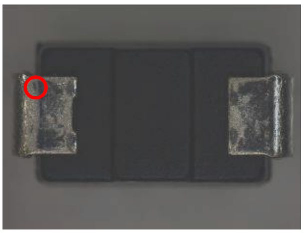
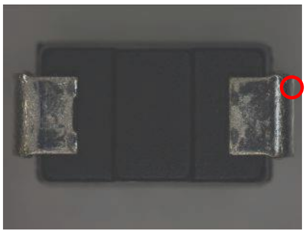
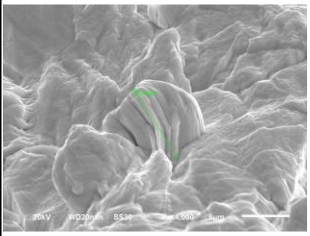
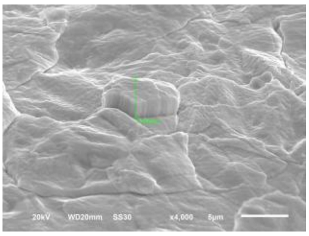
Screening observations:	**Sample Info**	**Features (e.g., corrosion, scratches, clamp marks, etc.)**
Number of samples inspected	27	
Number of terminations or coupon areas inspected per sample	6	
Total number of terminations or coupon areas inspected	162	
Total area inspected	162	
Number of terminations or coupon areas with whiskers	162	
Detailed observations:		
Number of samples inspected	27	
Total number of terminations or coupon areas inspected	162	
Whisker density (Low, Medium, High per inspected area)	Low	
Length of longest whisker (microns) – termination or coupon area 1	8.544um	
Length of longest whisker (microns) – termination or coupon area 2	10.7um	
Length of longest whisker (microns) – termination or coupon area 3	22.802um	
Length of longest whisker (microns) – termination or coupon area 4	10.703um	
Length of longest whisker (microns) – termination or coupon area 5	10.373um	
Length of longest whisker (microns) – termination or coupon area 6	19.258um	
Length of longest whisker (microns) – termination or coupon area 7	5.423um	
Length of longest whisker (microns) – termination or coupon area 8	11.75um	
Length of longest whisker (microns) – termination or coupon area 9	20.166um	
Length of longest whisker (microns) – termination or coupon area 10	<1.00um	
Length of longest whisker (microns) – termination or coupon area 11	<1.00um	
Length of longest whisker (microns) – termination or coupon area 12	5.204um	
Length of longest whisker (microns) – termination or coupon area 13	4.500um	
Length of longest whisker (microns) – termination or coupon area 14	<1.00um	
Length of longest whisker (microns) – termination or coupon area 15	<1.00um	
Length of longest whisker (microns) – termination or coupon area 16	<1.00um	
Length of longest whisker (microns) – termination or coupon area 17	<1.00um	
Length of longest whisker (microns) – termination or coupon area 18	<1.00um	
Length of longest whisker (microns) – termination or coupon area 19	<1.00um	

Length of longest whisker (microns) – termination or coupon area 20	<1.00um	
Length of longest whisker (microns) – termination or coupon area 21	<1.00um	
Length of longest whisker (microns) – termination or coupon area 22	<1.00um	
Length of longest whisker (microns) – termination or coupon area 23	<1.00um	
Length of longest whisker (microns) – termination or coupon area 24	<1.00um	
Length of longest whisker (microns) – termination or coupon area 25	<1.00um	
Length of longest whisker (microns) – termination or coupon area 26	<1.00um	
Length of longest whisker (microns) – termination or coupon area 27	<1.00um	
Additional Comments:		
Additional Comments / Exceptions:	PASS!	

Tin Whisker Test Report

- Temp Cycling -55 (+0/-10) °C to +85(+10/-0) °C air to air; 10minutes soak; ~3cycles/hours

Lot#1: 1500 cycles

	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 8.544 um	Point2-#1 4.25 um
				
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	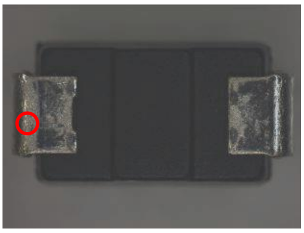	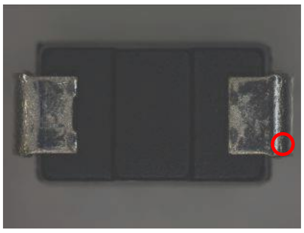	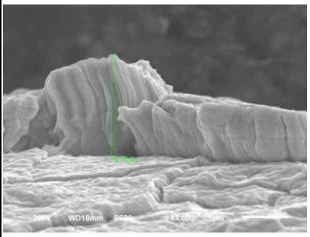	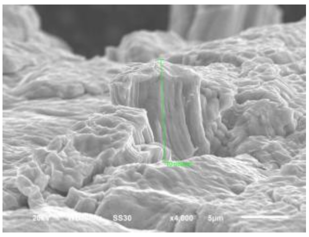
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	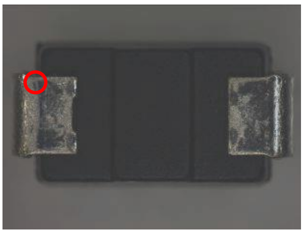	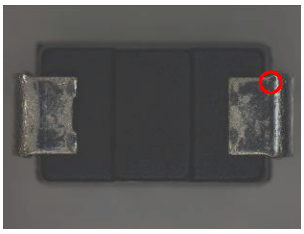	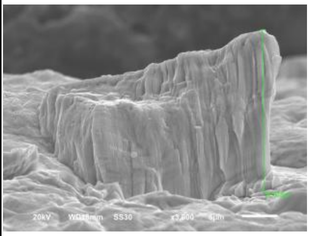	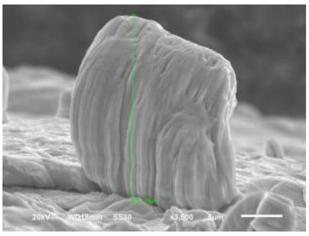

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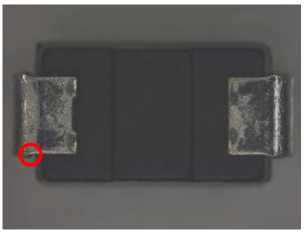
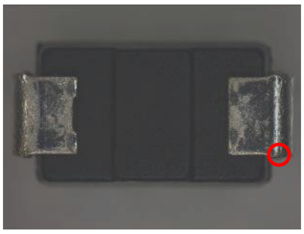
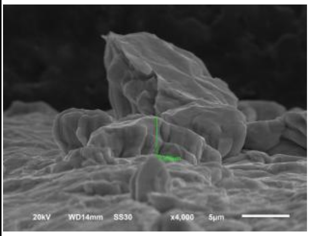
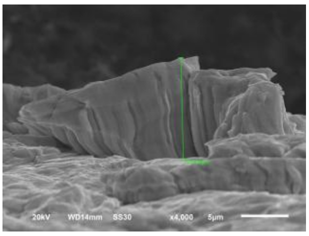
Tin Whisker Test Report

- Temp Cycling -55 (+0/-10) °C to +85(+10/-0) °C air to air; 10minutes soak; ~3cycles/hours

Lot#2: 1500 cycles

	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 3.95 um	Point2-#1 10.703 um
				
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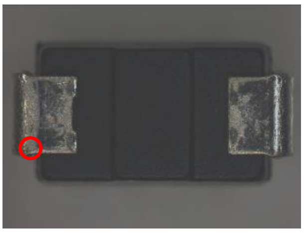
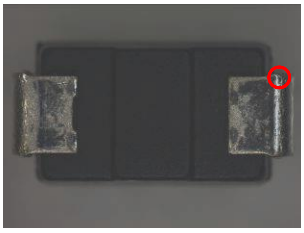
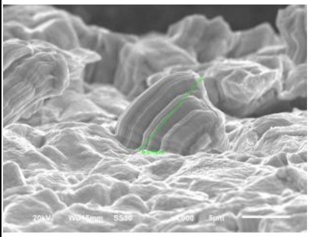
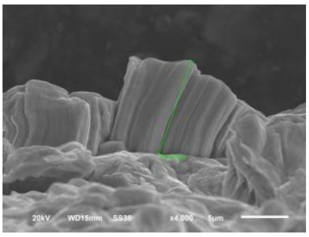
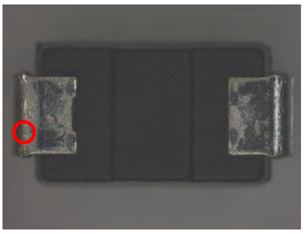
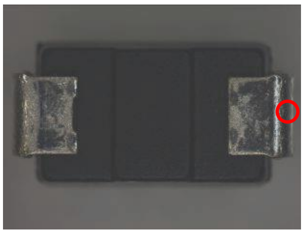
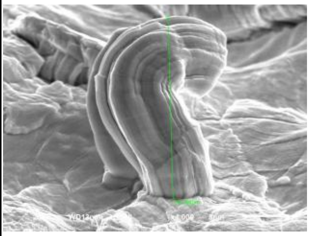
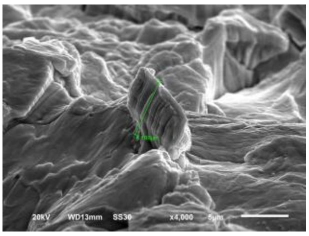
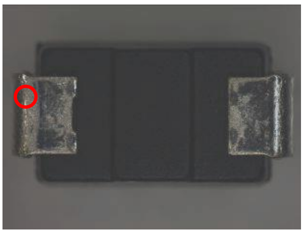
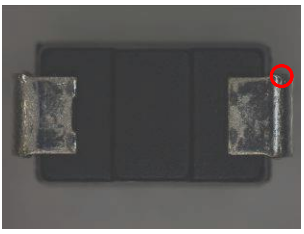
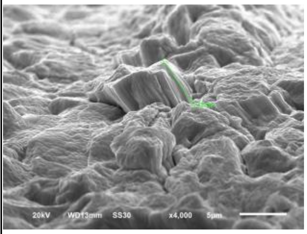
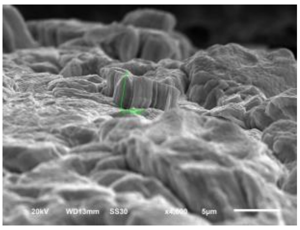
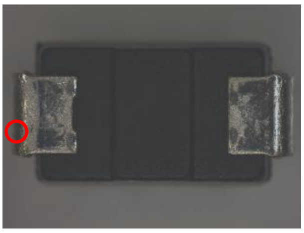
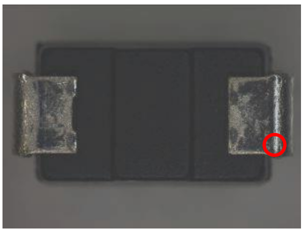
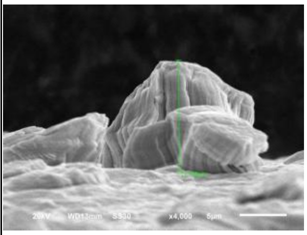
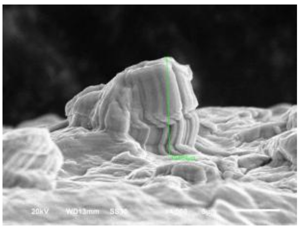
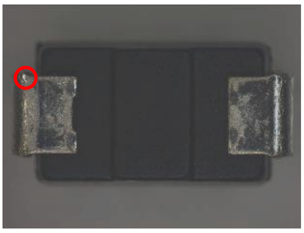
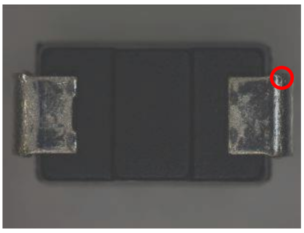
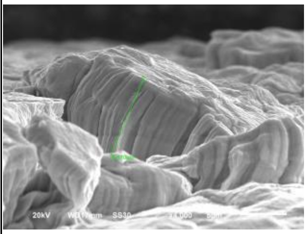
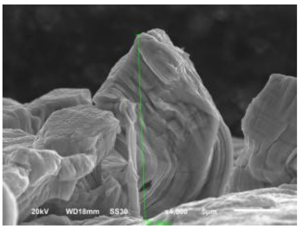
				
#3	Point1-#3	Point2-#3	Point1-#3 19.258 um	Point2-#3 6.199 um
				

Tin Whisker Test Report

- Temp Cycling -55 (+0/-10) °C to +85(+10/-0) °C air to air; 10minutes soak; ~3cycles/hours

Lot#3: 1500 cycles

	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 5.423 um	Point2-#1 3.798 um
				
#2	Point1-#2	Point2-#2	Point1-#1 11.75 um	Point2-#1 10.604 um
				
#3	Point1-#3	Point2-#3	Point1-#1 8.87 um	Point2-#1 20.166 um
				

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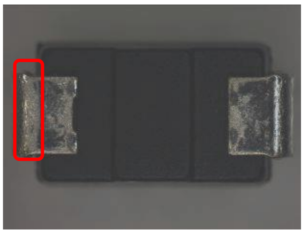
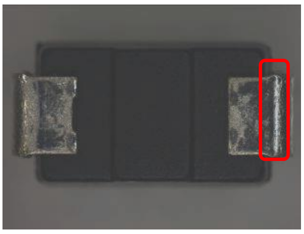
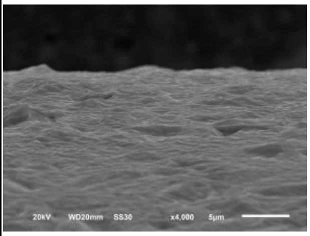
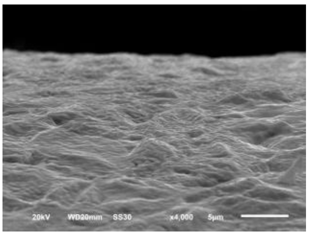
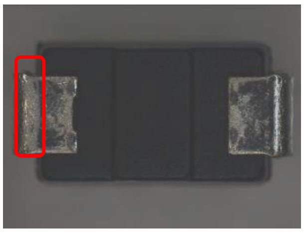
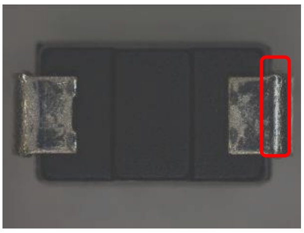
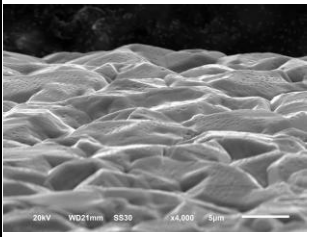
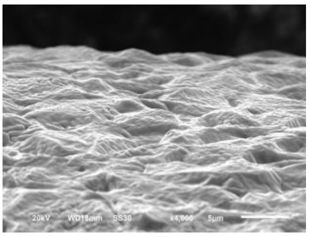
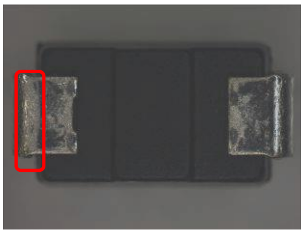
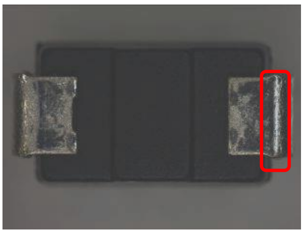
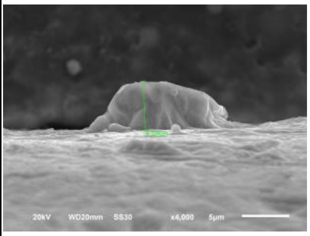
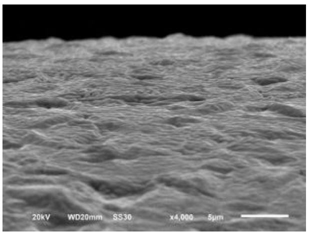
Tin Whisker Test Report

High Temp/Humidity Storage (55 ±3 °C, 85±3% RH)

Lot#1: 4000 hours

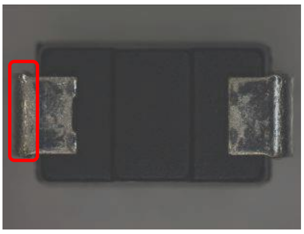
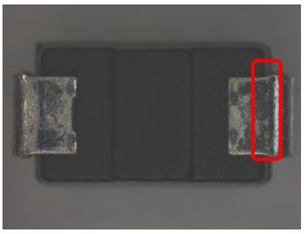
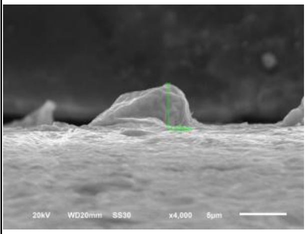
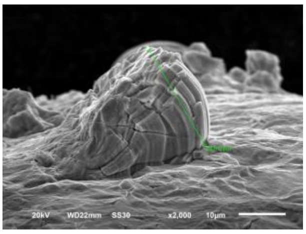
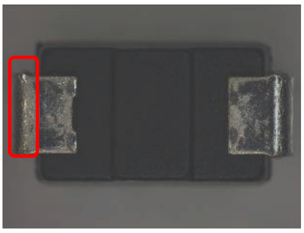
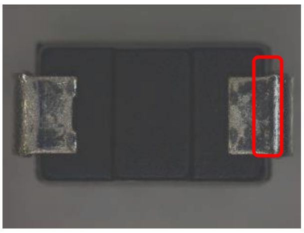
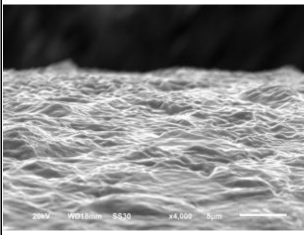
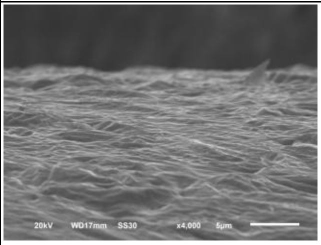
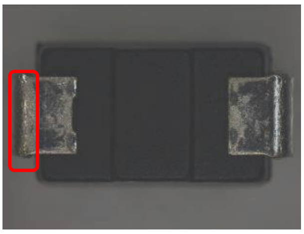
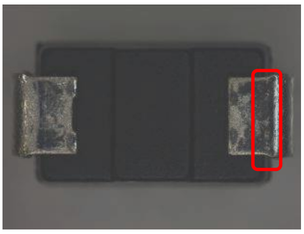
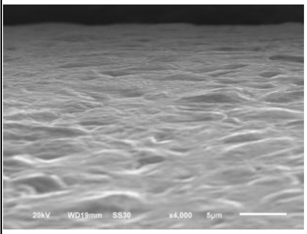
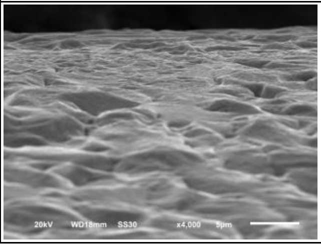
	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 <1.00um	Point2-#1 <1.00um
				
#2	Point1-#2	Point2-#2	Point1-#2 <1.00um	Point2-#2 <1.00um
				
#3	Point1-#3	Point2-#3	Point1-#3 5.204um	Point2-#3 <1.00um
				

TAIWAN SEMICONDUCTOR CO., LTD.

Tin Whisker Test Report

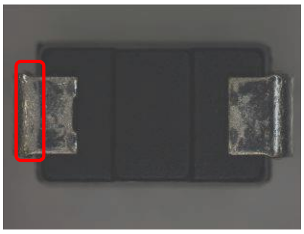
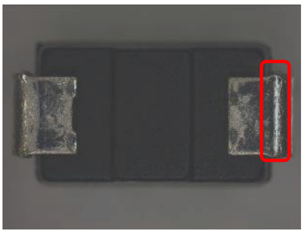
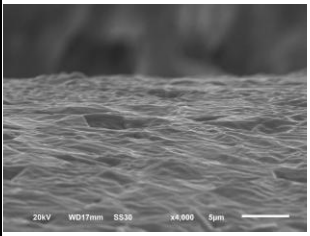
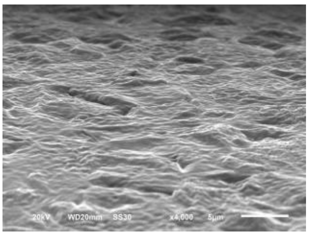
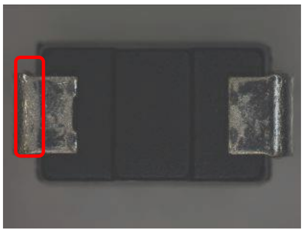
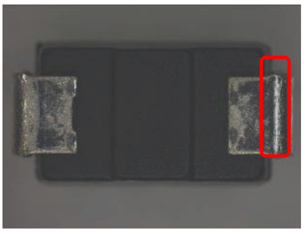
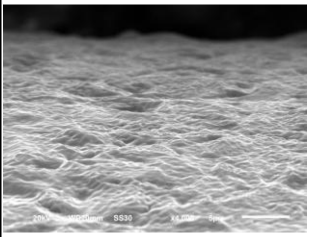
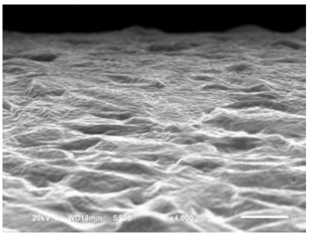
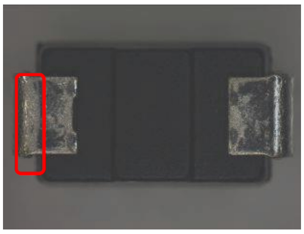
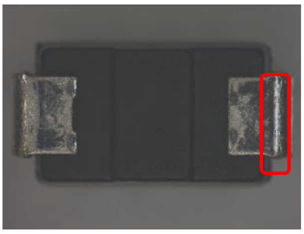
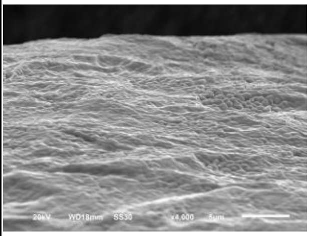
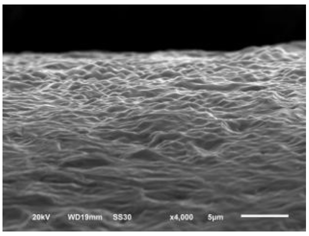
- High Temp/Humidity Storage (55 ±3 °C, 85±3% RH)

Lot#2: 4000 hours

	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 4.500um	Point2-#1 <1.00um
				
#2	Point1-#2	Point2-#2	Point1-#2 <1.00um	Point2-#2 <1.00um
				
#3	Point1-#3	Point2-#3	Point1-#3 <1.00um	Point2-#3 <1.00um
				

- High Temp/Humidity Storage (55 ±3 °C, 85±3% RH)

Lot#3: 4000 hours

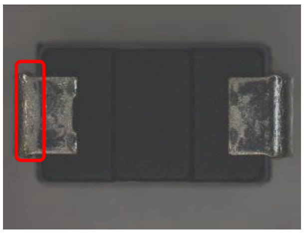
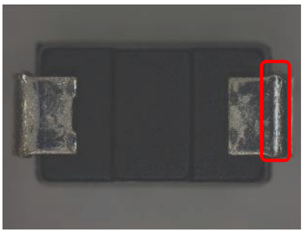
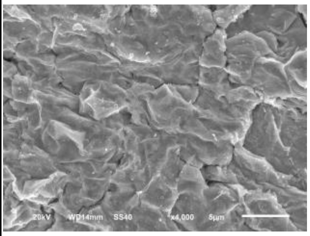
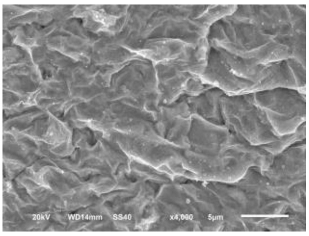
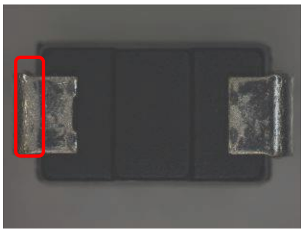
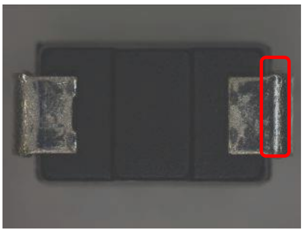
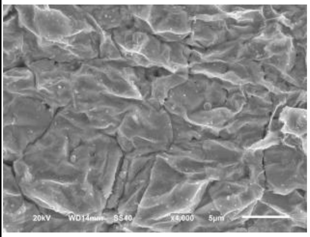
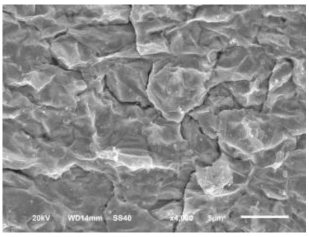
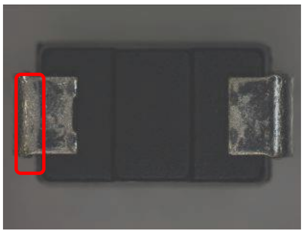
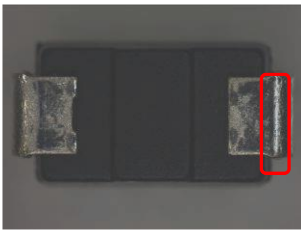
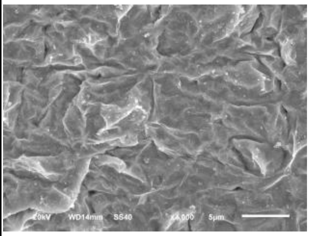
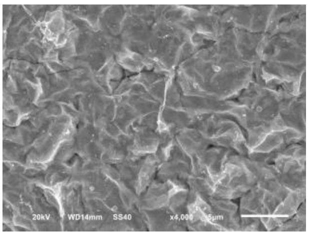
	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 <1.00um	Point2-#1 <1.00um
				
#2	Point1-#2	Point2-#2	Point1-#2 <1.00um	Point2-#2 <1.00um
				
#3	Point1-#3	Point2-#3	Point1-#3 <1.00um	Point2-#3 <1.00um
				

TAIWAN SEMICONDUCTOR CO., LTD.

Tin Whisker Test Report

- Room Temperature/Humidity Storage (30°C ±2°C and 60% ±3% RH)

Lot#1: 4000 hours

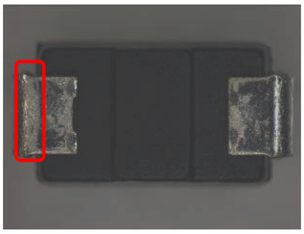
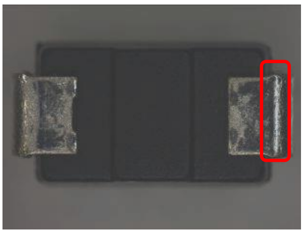
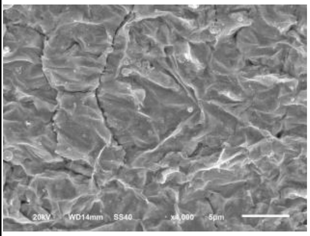
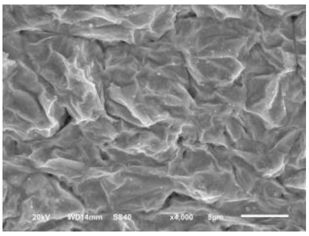
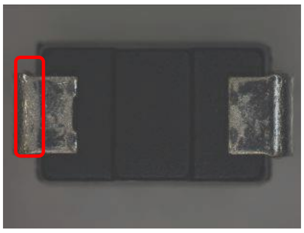
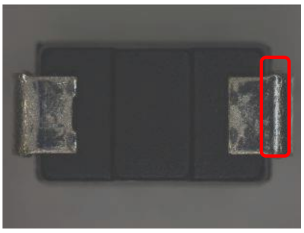
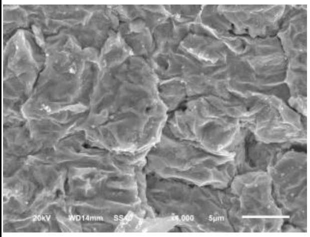
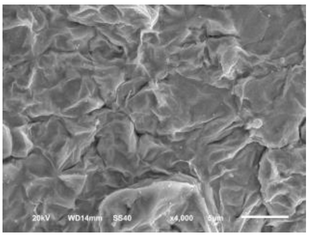
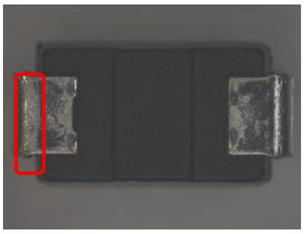
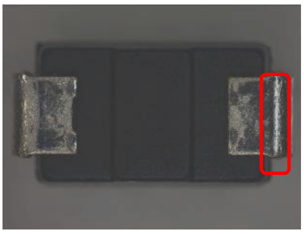
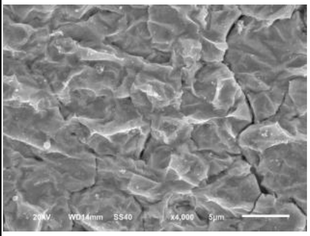
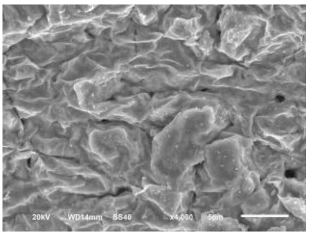
	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 <1.00um	Point2-#1 <1.00um
				
#2	Point1-#2	Point2-#2	Point1-#2 <1.00um	Point2-#2 <1.00um
				
#3	Point1-#3	Point2-#3	Point1-#3 <1.00um	Point2-#3 <1.00um
				

TAIWAN SEMICONDUCTOR CO., LTD.

Tin Whisker Test Report

- Room Temperature/Humidity Storage (30°C ±2°C and 60% ±3% RH)

Lot#2: 4000 hours

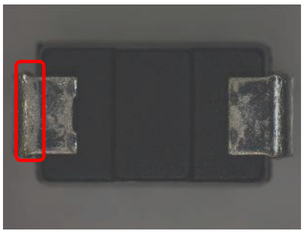
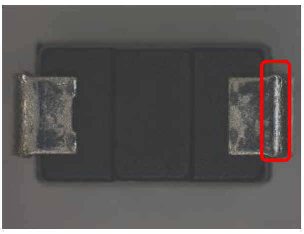
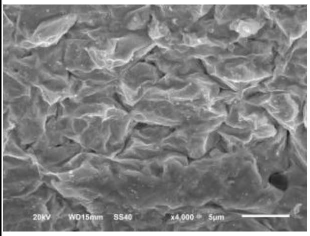
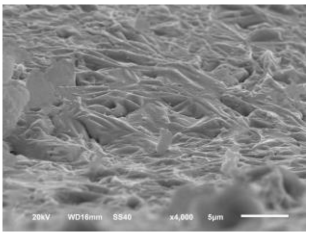
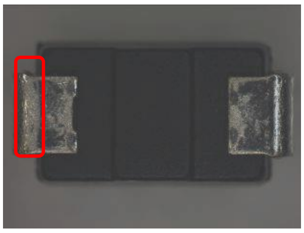
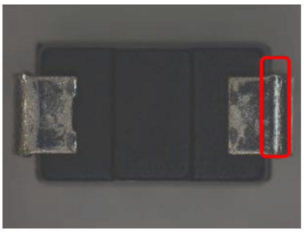
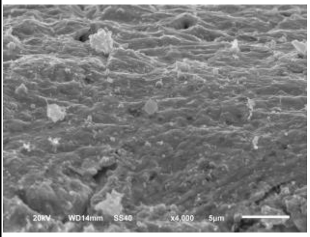
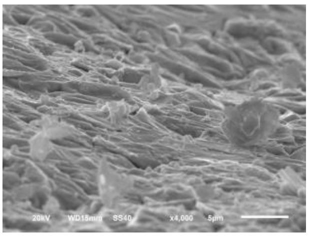
	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 <1.00um	Point2-#1 <1.00um
				
#2	Point1-#2	Point2-#2	Point1-#2 <1.00um	Point2-#2 <1.00um
				
#3	Point1-#3	Point2-#3	Point1-#3 <1.00um	Point2-#3 <1.00um
				

TAIWAN SEMICONDUCTOR CO., LTD.

Tin Whisker Test Report

- Room Temperature/Humidity Storage (30°C ±2°C and 60% ±3% RH)

Lot#3: 4000 hours

	Check point		Photos	
#1	Point1-#1	Point2-#1	Point1-#1 <1.00um	Point2-#1 <1.00um
				
#2	Point1-#2	Point2-#2	Point1-#2 <1.00um	Point2-#2 <1.00um
				
#3	Point1-#3	Point2-#3	Point1-#3 <1.00um	Point2-#3 <1.00um