

Proposal for the Mechanism of Whisker Formation and Countermeasures from Sn Plating in High-Speed Communication Connectors (Second Report)

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With the increasing demand for high-speed communication in automotive electronics, the use of connectors with tin (Sn)-plated zinc die-cast shield housings has been expanding(Fig.1). However, tin whiskers are known to form on these platings during temperature cycling tests. In this study, the relationships between whisker formation, tin plating thickness, and grain size were investigated using ten connector types equipped with zinc die-cast shield housings.

Each connector was mounted onto a printed circuit board by reflow soldering and subjected to 4,000 temperature cycles between -40°C and 85°C . The number and length of the generated whiskers were then evaluated. In addition, the tin plating thickness and grain size were measured by cross-sectional observations, and their relationships with whisker formation were analyzed.

As shown in Table 1, whisker formation varied significantly depending on the connector type. Connector No. 1 exhibited extensive whisker formation and had an tin plating thickness of approximately $5\text{ }\mu\text{m}$. In contrast, Connector No. 2 showed substantially fewer whiskers and had an tin plating thickness of approximately $20\text{ }\mu\text{m}$. This comparison suggests that increasing the tin plating thickness to around $20\text{ }\mu\text{m}$ can significantly reduce whisker formation. Furthermore, Connectors No. 2, 3, 6, 8, 9, and 10 exhibited low levels of whisker formation, and all of them showed grain coarsening of the tin plating after reflow soldering. In particular, small-sized connectors exhibited smoother plating surfaces and larger grain sizes after reflow, indicating that remelting during the reflow process may contribute to whisker suppression.

These results suggest that whisker formation on zinc die-cast shield housings can potentially be suppressed by increasing the tin plating thickness to approximately $20\text{ }\mu\text{m}$ or by promoting grain coarsening through remelting of the tin plating during the reflow process.

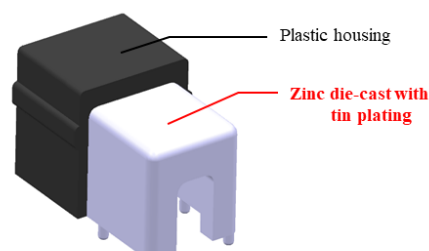


Fig.1 Connector appearance

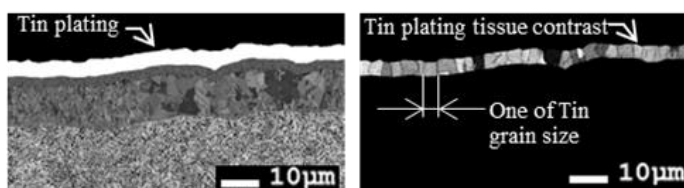


Fig.2 Cross-section of the No.6 connector plating(initial state)

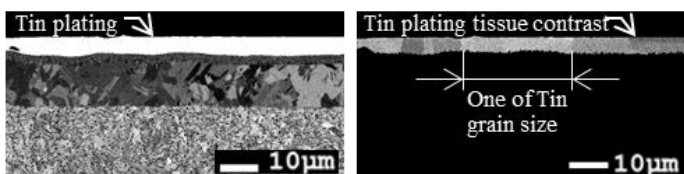


Fig.3 Cross-section of the No.6 connector plating after reflowing

Table 1 Connectors used in the experiments and their Results

No	Housing dimensions	Supplier	Initial tin plating thickness [μm]	Tin plating thickness after reflowing [μm]	Initial tin Grain size [μm]	Tin grain size after reflowing [μm]	Average Length [μm]	Maximum Length [μm]	Number of whiskers
1	Large	A	5.0	4.9	3.4	6.5	246	467	55
2	Large	A	20.6	19.7	16.4	18.7	126	126	1
3	Small	A	3.6	3.8	3.0	18.2	-	0	0
4	Large	B	3.4	3.1	1.1	1.4	356	470	67
5	Large	B	2.39	3.10	1.3	4.03	320	450	50
6	Small	B	4.0	4.5	7.0	21.0	-	0	0
7	Medium	B	3.5	2.5	2.0	3.0	312	516	50
8	Small	C	2.0	3.5	2.0	23.0	145	146	2
9	Small	D	2.0	2.0	2.0	19.0	146	179	2
10	Small	E	2.0	2.0	2.0	15.0	155	155	1