研究論文

半導体パッケージ実装構造の熱－応力連成解析によるはんだ接合部の信頼性設計法

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Reliability Design Method for Solder Joints Based on Coupled Thermal-Stress Analysis of Electronics Packaging Structure

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概要　半導体実装構造の熱－応力連成解析法により，素子動作時の半導体パッケージと冷却フィン間の接触熱抵抗変化を考慮したうえで，市場での想定負荷における熱応力・ひずみ状態を再現することを試みた。さらに実装設計に内在する設計変数が，はんだ接合部の熱疲労破損に及ぼす影響度を統計的に解析したうえで実装信頼性解析を行い，半導体パッケージの実装信頼性設計において，同時不良発生確率を指標に設計案を算定できることを示した。

Abstract

In order to evaluate the reliability of solder joints for thermal fatigue failure under field conditions, it is necessary to predict the thermal distribution, deformation, and stress distribution of the electronics packaging structure. In the packaging structure, which is composed of electronics packaging, solder joints, heat spreader, and cooling structure, an increase in contact thermal resistance may occur at the interface between plate fin and heat spreader, based on the thermal deformation of the electronics package. Contact thermal resistance problems involve the interaction of thermal distribution and deformation of the packaging structure. Therefore, an accurate analysis requires coupled thermal–stress analysis. In this work, a reliability design method based on coupled thermal–stress analysis and statistical and probabilistic methods was investigated. It was found that the proposed method can assess packaging design solutions with respect to the failure probabilities from their application for the FC-BGA packaging structure design.

Key Words: *Electronics Packaging, Reliability Design, Coupled Thermal–Stress Analysis, Thermal Contact Resistance, Thermal Fatigue Failure of Solder Joints, Statistical and Probabilistic Method*

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