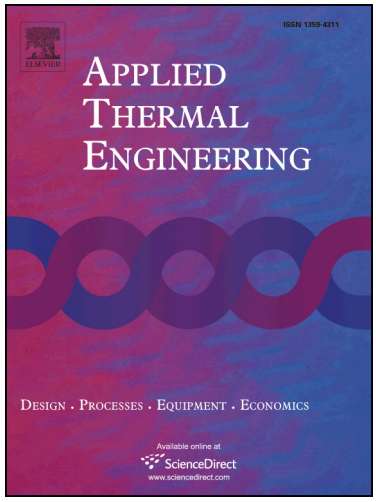

Research Paper

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Investigation of Dimensional and Heat Source Effects in Lock-In Thermography Applications in Semiconductor Packages

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Abstract

Lock-In Thermography (LIT) is a powerful non-contact and non-destructive investigating technique that has recently emerged in the semiconductor industry. The current LIT applications interpret LIT data using the semi-infinite models. However, semiconductor package has finite geometry with convective heat transfer on surface. This paper studies the accuracy of the interpretation of LIT data based on the commonly used semi-infinite models. The effects of finite dimensions, heat source configuration, convective heat transfer coefficient, thickness of material, thermal diffusivity of material, and lock-in frequency are examined. Furthermore, the effects of heat source's shape and location, as well as the problems involving non-homogeneous materials are also investigated. It has been found that the errors in phase shift estimate using semi-infinite models may occur at lower lock-in frequency with high diffusivity material and thinner specimen. When multiple materials are involved with various scenarios of heat source locations, the phase shift may decrease with the lock-in frequency, as observed in experiment. Finite element transient heat conduction analysis is a useful tool to derive the actual *z*-depth of heat source based on the phase shift data from experiment.

Keywords

- Lock-in Thermography
- Fault-isolation
- Semiconductor device