

Non-Destructive Failure Analysis Method for Semiconductor Packages Based on Dynamic Thermal Response

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Electrical characterization and X-ray inspection have been widely used to analyse semiconductor package failures such as a solder crack and a delamination. However, due to several disadvantages such as a low failure-detection sensitivity of the electrical characterization and an inefficient spatial resolution of the X-ray inspection, several groups have developed new testing methods based on transient thermal analysis to meet the inspection needs [1-2]. They utilize the relationship between an operating voltage and the junction temperature of the semiconductor packages and thermal equivalent circuits (structural function) to investigate the package failures of the semiconductor packages.

Here, a fast non-destructive failure analysis algorithm for the semiconductor packages is presented. It uses a time-domain transient thermal response by measuring the operating voltages of a semiconductor. The time-consuming heat structural function analysis is not required in this method, but only derivative value of operating voltages is required to detect the solder failure of the semiconductor packages. In order to validate our algorithm, we carried out thermal shock test for a LED package. We compared our testing method to conventional methods such as electrical method, X-ray inspection, and thermal equivalent model. Our method had a better sensitivity for solder failure of the LED package. This technology can be useful in the application of power electronic devices such as MOSFET, IGBT etc.

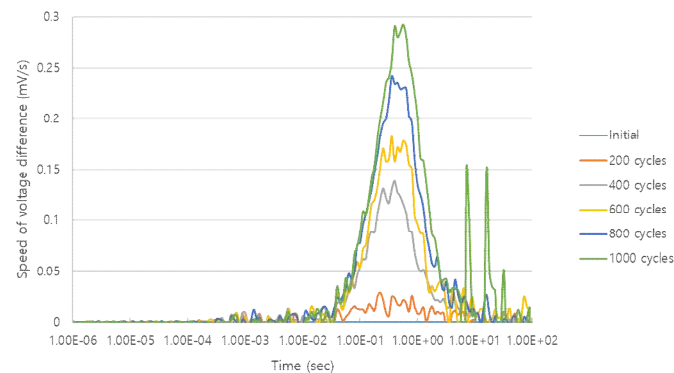


Fig.1. Solder failure monitoring of a semiconductor package during thermal shock test.

[1] A. Hanss et al., EuroSimE 2019, 311-317

[2] T. Dannerbauer and T. Zahner, Mircoelectron. J., 45(12), 1716-1720