Measurement of Thermal-Contact-Resistance Distribution for Semiconductor Heat Dissipation Substrate by Using Lock-in Thermography Periodic Heating Method

Harumi Niida[1, S, C], Hosei Nagano[1], Ryohei Fujita[1], Naoto Kodate[2], Kei Uchida[2] and Masasi Nagaya[2]

[1]*Nagoya University, Nagoya City, Japan*
[2]*U-MAP Co., Ltd, Nagoya City, Japan*
niida.haruumi.a8@s.mail.nagoya-u.ac.jp

The thermal contact resistance (TCR) is a phenomenon when the heat flow is impeded at the contact interface between two materials. Thermal contact resistance has the potential to cause significant issues in the performance and operation of electronic devices by hindering efficient heat dissipation. Accordingly, it is important to measure TCR accurately.

This study proposes a new method for measuring TCR using Lock-in Thermography. By the lock-in thermography with an infrared microscope, the dynamic temperature behavior across the contact interface was visualized in the sample side surface.

This paper proposes an assessment of the distribution of TCR between metal and ceramic interfaces through improvements in measurement equipment and sample handling techniques. The sample configuration consisted of two types: Cu/AlN and Cu/SiN, with carbon coating used for the surface treatment of the samples. The surface of the sample was periodically heated using a diode laser at 50 Hz, and the one-dimensional heat conduction was visualized by observing the sample's side using lock-in thermography. After that, the phase lag obtained from the experiments was analyzed using the one-dimensional heat conduction model where it served as a fitting parameter for the interfacial thermal resistance. Consequently, two-dimensional distributions of TCR for each sample were obtained, allowing an assessment of the differences in TCR based on material composition.