

## **Development of Measurement Technique of Thermal Contact Resistance at Bump Joint in Flip Chip Assembly Structure Using Photothermal Reflectance Method in High Temperature Storage Test**

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We have developed the measurement technique of thermal contact resistance at bump joints in a flip chip assembly structure using the photothermal reflectance method. When the sample is heated by a modulated laser diode with the wavelength of 405 nm, the periodic temperature variation caused by heating is generated inside the Au bump. A continuous He-Ne laser with the wavelength of 633 nm is focused on the center of the bump of 30  $\mu\text{m}$  in diameter to monitor the changes in the light reflection from the bump surface. We detect the reflected He-Ne laser from the bump surface by a balanced detector, and this reflected beam is proportional to the small temperature amplitude. Under these conditions, there is a phase lag between the reflected beam and the modulated beam, and this lag contains information about the thermal contact resistance. Therefore, it is possible to extract the thermal contact resistance by a curve-fitting analysis of phase lag data which is detected by a lock-in amplifier in the frequency domain. We changed the wavelength of the probe beam from 633 nm to 532 nm due to the larger temperature dependence of Au reflectivity. By using the apparatus, we conducted a high temperature storage test at 250 °C and measured the thermal contact resistance and the electrical resistance. In this measurement, we have succeeded in detecting the thermal contact resistance change caused by deterioration. During the deterioration test for 60 hours, the electrical resistance increased about 6 times at a maximum and the thermal contact resistance about 13 times at a maximum.