Example of Thermal Interface Material Measurement with Thermowave Analyzer

Dr. Kimihito Hatori, Bethel Co., Ltd., Hudson Laboratory

1. Introduction

Electronic parts generate heat that shortens product life and increases power consumption, so it is necessary to release heat efficiently. Packages of electronic components have irregularities, and interfacial thermal resistance becomes a problem when dissipating heat. To reduce the interface thermal resistance, it is effective to use a thermal interface (hereinafter referred to as TIM). This document introduces an example of measuring the thermal diffusivity of TIM using a thermal microscope. There are diverse types of TIM such as thermal conductive grease, thermal pad, and PCM.

Thermal pads are composites that combine resin with fillers and other materials. Therefore, it is necessary to evaluate the anisotropy and distribution of thermal diffusivity, which cannot be measured using conventional thermal diffusivity/thermal conductivity measurement methods. The Thermowave Analyzer enables these measurements, making detailed material evaluation possible. The thermal diffusivity was also compared with that of the flash method.

Please refer to "Application Sheet TA-001E Multifunctional Thermal Diffusivity Thermal Conductivity Measuring Equipment: Thermowave Analyzer Measuring Principle and Equipment" for the measuring principle and equipment of the Thermowave Analyzer.

2.Measurement sample

Since thermal pads are composite materials, the uniformity varies depending on the dispersion state, and the thermal diffusivity/thermal conductivity also varies depending on the amount of filler blended and the state of the interface between the filler and resin.

In this study, PT-V[1] made by Sekisui Polymatech, Inc. with carbon fibers oriented along the out of plane direction of the sample was measured for thermal diffusivity in out of plane and in-plane directions and thermal diffusivity mapping in out of plane direction.

Two sample thicknesses were prepared, A: 1 mm and B: 0.5 mm. The external dimensions of the samples were 10 mm x 10 mm.

3. Measurement results

3.1 Thermal diffusivity in the in-plane direction /in out of plane direction

Table 1 shows the thermal diffusivity of the samples in the in-plane and out of plane directions. Five pieces for each of A and B were cut from the base material. Five measurements were taken at five separate locations within each sample, and all values were averaged. The thermal diffusivity in the out of plane direction was also measured by the laser flash method. The value measured by the laser flash method is the average of the five samples.

The thermal diffusivity in the out of plane direction is about three times higher than that in the plane direction, indicating that this is due to the structure of carbon fiber orientation in the out of plane direction. In comparison with the flash method, which has been conventionally used as a method for measuring thermal diffusivity, the results are consistent within the range of variation. Since the flash method cannot measure the thermal diffusivity in the in-plane direction, only the thermal diffusivity in the out of plane direction is shown.

Table 1 Thermal diffusivity of thermal interface materials & graphite sheets

Sample Name	Sample thickness, d /μm	Thermal diffusivity, κ /×10^{-6}m^{2}s^{-1}		
		Spot periodic heating-radiation thermometry		Flash method
		Out of plane direction	In plane direction	Out of plane direction
Sample A	1000	3.4±0.3	0.9	3.8±0.4
Sample B	500	3.5±0.4	1.3	3.4±0.3

3.2 Thermal Diffusivity Mapping in the out of plane Direction

Figure 1 shows the results of mapping the thermal diffusivity of the thermal interface material in the out of plane direction. The measurement range was 5 mm x 5 mm with a pitch of 0.5 mm. The thermal diffusivity differs by up to 50% depending on the measurement location. Such results are difficult to measure with ordinary thermal diffusivity measurement methods.

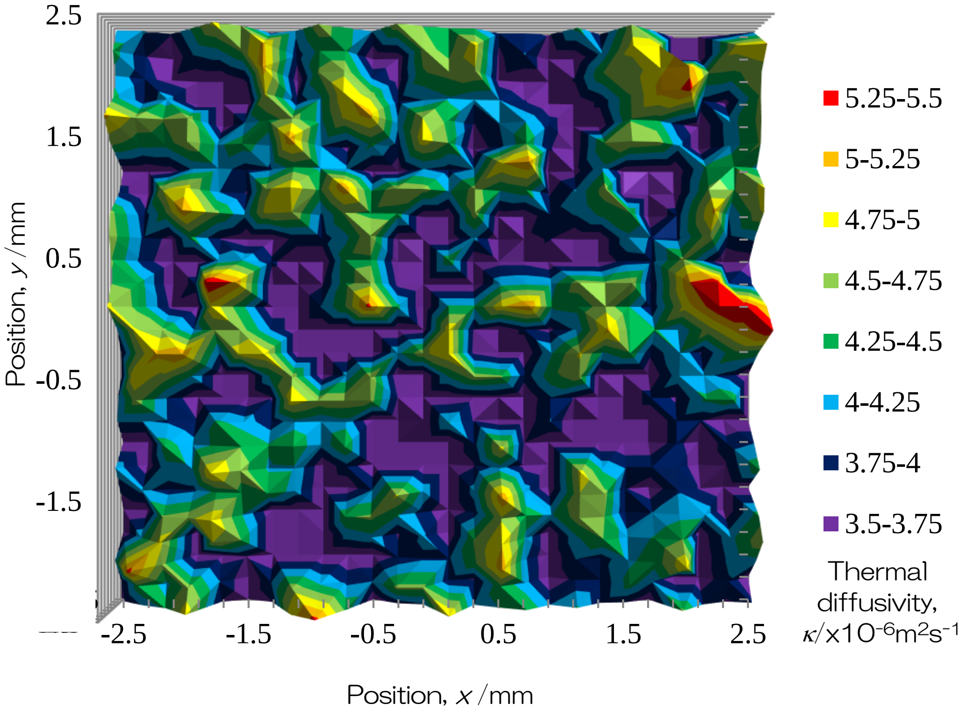

Figure 1 Mapping measurement of thermal diffusivity in the out of plane direction of the thermal interface material

4. Summary

The thermal diffusivity of the thermal interface material in the out of plane and in-plane directions was measured and the thermal diffusivity in the out of plane direction was mapped, showing that the anisotropy and distribution of the thermal diffusivity can be measured. The measured values were compared with those of the flash method and were found to agree within the range of measurement variation.

These results indicate that this measurement method can evaluate the detailed thermal diffusivity of materials that are not homogeneous and isotropic and can be applied to the measurement of a wide variety of heat-conducting materials.

*Thermal diffusivity display of mapping measurement is only available for requested measurement.

5. References

[1] Sekisui Polymatech Product Introduction Web Page, https://www.polymatech.co.jp/c-3.html

*The measurement results shown in this datasheet are typical results and do not guarantee individual measurement results.

*The product specifications described in this data sheet are subject to change without notice.

BETHEL

Bethel Co., Ltd.
Hudson Lab.
〒300-0037
4-3-18, Tsuchiura brick Bld. 1F, Sakura-machi, Tsuchiura-shi, Ibaraki, 300-0037, Japan
TEL：+81-29-825-2620 FAX：+81-29-307-8451
E-mail：info@btl-hrd.jp
WEB Site：https://hrd-thermal.jp/en/
Facebook：https://www.facebook.com/thermal.testing/