3D IC/Stacked device Fault Isolation using Lock-in Infrared Microscopy

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Abstract

A new methodology for fault detection of a multi-wafer stacked semiconductor, e.g., through silicon via (TSV) formation, has received much attention in the semiconductor inspection industry because existing inspection systems have inherent limitations on processing time and reconstruction of three-dimensional structures. An infrared confocal microscope has been studied for 3D spectral imaging (1), but they use a transparent sample that is easier to construct three-dimensional structures than the multi-wafer stacked semiconductor due to its transparency.

We develop a lock-in infrared microscopy for 3D IC/Stacked device fault detection. The developed microscope consists of an infrared thermal camera in the spectral range 7.5~14 ㎛ and a source meter generating a lock-in signal. Lock-in thermography (LIT) is a standard tool in nondestructive testing (NDT). An amplitude and phase images in the multi-wafer stacked semiconductor are obtained by applying LIT. The fault is localized in 2-dimension space by the thermal difference of the amplitude image. The phase image is used to estimate the defects depth considering the thermal diffusivity of a material and a lock-in frequency. The fault detection results are validated using the destructive method.

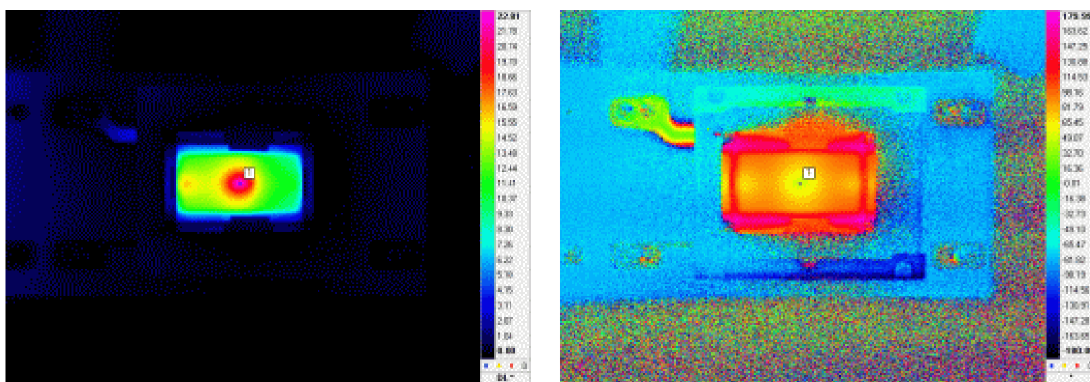

Fig. 1 Amplitude and phase images of the NAND flash memory

References

1. Jamme, Frédéric, et al. "Synchrotron infrared confocal microscope: Application to infrared 3D spectral imaging." Journal of Physics: Conference Series. Vol. 425. No. 14. IOP Publishing, 2013.