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EXPERIMENTAL MEASUREMENT AND DEPTH ESTIMATION OF THERMALLY ACTIVE BURIED HEATING SOURCE USING INFRARED MICROSCOPE

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ABSTRACT

Measurement and depth estimation of thermally active buried heating source in stacked die architectures were performed by using the phase image obtained from infrared microscopic sensor. Highly sensitive infrared images were measured and post-processed using a lock-in method. By applying the lock-in method to infrared images, the detection sensitivity and signal to noise ratio were enhanced by the phase-sensitive narrow-band filtering effect. Operational principle of lock-in method concerning the thermal wave propagation through different material multi-layers was discussed and it was demonstrated that the phase information of thermal emission from silicon wafer sample can provides the good metrics about the depth of heat source. In addition, a photothermal model was implemented to evaluate the behavior of thermal waves from multi stacked silicon wafer sample by comparing a calculated depth with real one. Results showed that the infrared microscopic sensor technique with lock-in method and resultant phase information have a good potential in the application of the fault isolation and its depth estimation for the stacked die devices, especially in the packaged semiconductor.

KEYWORDS: Infrared microscope, lock-in thermography, silicon wafer, nondestructive test