Chapter 5: Materials for Thermal Management for Advanced Semiconductor Packaging

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Abstract

Computing efficiency requires more powerful microprocessors to be packed closely for efficient communication, a feature often called ‘scale down’ and ‘scale out’. One of the challenges with such advanced packaging approach is the efficient thermal management of such devices. Conventional heat spreaders take the heat away from a chip, but heat flows through a multitude of materials and interfaces. Efficient heat transport across these interfaces is necessary to ensure minimal temperature drops across these interfaces so that the chip operating temperatures are within acceptable limits, as both the performance and the reliability of the chip is dependent on its temperature. This chapter provides a detailed overview of thermal interface materials (TIMs), which provide a compliant interface between the chip/assembly and the heat spreader. The chapter begins with an overview of heat transfer and goes into details on different available TIMs, their compositions, benefits and limitations. Further, this chapter elucidates different interfaces in an electronics package, with an overview of modeling and characterization techniques for TIMs. Three brief case studies for applications of TIMs, in data centers, automotive electronics, and high-power LEDs, are described.

Key Words Bondline Thickness, Contact Resistance, Electronics Cooling, Interfacial Heat Transfer, Surface Roughness, Thermal Contact Resistance, Thermal Interface Materials, TIM 1.0. TIM 2.0, TIM 1.5, TIM Characterization, Thermal Management, Thermal Resistance,



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