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Heat Transfer Graphite Sheets With Improved Mechanical Drop Performance

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ABSTRACT

This disclosure describes techniques for improving the mechanical performance of graphite sheets used for heat transfer in electronic devices. A pressure-sensitive adhesive (PSA) material layer is provided between the heat source component and the heat sensitive component for improved mechanical performance, while the graphite sheet is formed as a cladding surrounding the heat source. The PSA layer performs well under tensile stress, while also providing effective thermal insulation. The graphite sheet is formed over the heat source component, wrapped around its sides, and attached to the heat sensitive component. During a dynamic event, e.g. a drop of the device, most of the stress is exerted upon and absorbed by the PSA layer. The graphite sheet experiences relatively lower tensile stresses while still being positioned to transfer heat away from a large portion (surface area) of the heat source component. In limited-space designs, the graphite sheet is formed around the upper portion of the heat source component and extends on only one side of the heat source component and onto the heat sensitive component.

KEYWORDS

- Heat source
- Heat transfer
- Drop strength
- Graphite sheet
- Tensile stress
- Peeling stress
- Pressure-sensitive adhesive (PSA)
- Mechanical via
- Thermal cladding
- Graphite sheet

BACKGROUND

Electronic devices commonly include one or more components that are heat source(s), e.g. system on chip (SOC), integrated chip, battery, etc. Due to the compact nature of electronic devices, such components are sometimes adjacent to or otherwise located in the vicinity of a heat sensitive component, e.g., a display module. A design requirement for such devices, therefore, is to provide sufficient heat transfer away from the heat source, while minimizing heat transfer into the heat sensitive component.

Graphite sheets are commonly utilized for this purpose, since the molecular structure of graphite leads to a high in-plane (along a horizontal surface of the sheet) thermal conductivity and a low through-plane (perpendicular to the surface of the sheet) thermal conductivity.

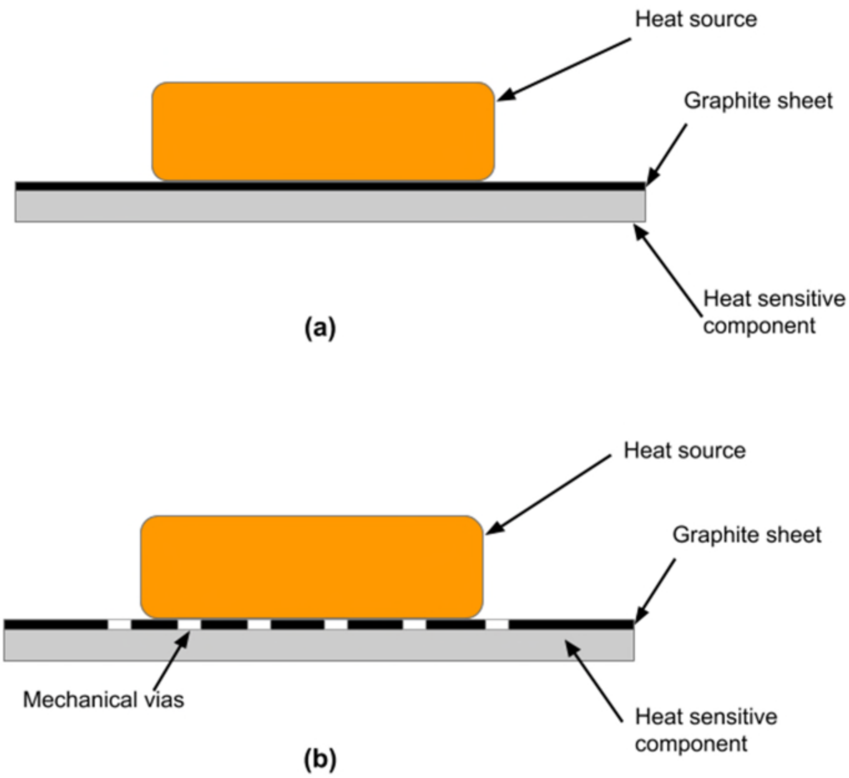

Fig. 1: Graphite sheet disposed between a heat source and heat sensitive component

Fig. 1 depicts an example of the use of a graphite sheet disposed between a heat source component and a heat sensitive component. As depicted in Fig. 1(a), the graphite sheet enables heat transfer away from the heat source, while minimizing heat transfer into the heat sensitive component.

However, graphite sheets are very brittle and can be easily torn apart, when a tensile force is applied. Graphite sheets are not optimal for tensile load bearing purposes. This leads to poor performance under dynamic events such as when a device experiences a fall, e.g., when the device is dropped by a user. For example, during a drop test, the heat source component can exert a pulling force onto the graphite sheet, which can lead to it tearing apart, with likely permanent damage to the graphite sheet.

Fig. 1(b) depicts an alternative design that attempts to minimize damage to the graphite sheet during dynamic events. As depicted in Fig. 1(b), cylindrical structures, or mechanical vias are provided in the graphite sheet. The mechanical vias can be made from polyethylene terephthalate (PET) or similar materials, and are utilized to provide additional tensile strength to the graphite sheet. However, even with the use of mechanical vias, graphite sheets may still be damaged during dynamic events due to the tensile or peeling stress applied to the graphite sheet.

DESCRIPTION

This disclosure describes techniques for improving the mechanical performance of graphite sheets in electronic devices. Per techniques of this disclosure, a pressure-sensitive adhesive (PSA) material layer is provided between the heat source component and the heat sensitive component for improved mechanical performance, while the graphite sheet is disposed as a cladding surrounding the heat source.

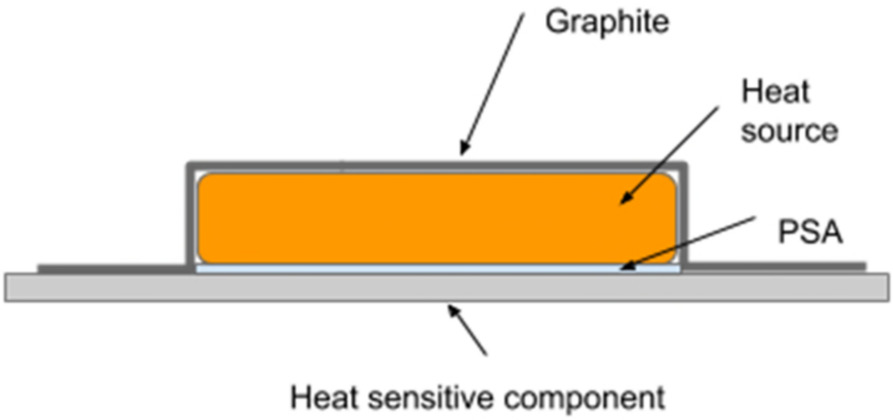

Fig. 2: A graphite sheet cladding around a heat source component

Fig. 2 illustrates an example arrangement of a heat source component and heat sensitive component, per techniques of this disclosure. As depicted in Fig. 2, a PSA layer is provided between the heat source component and the heat sensitive component. Most PSA materials perform well under tensile stress, while also providing effective thermal insulation. The graphite sheet is formed over the heat source component, wrapped around the sides, and attached to the heat sensitive component.

During a dynamic event, e.g., a drop of the device, most of the stress is exerted upon and absorbed by the PSA layer. In this illustrative example, the graphite sheet experiences relatively lower stresses while still being positioned to transfer heat away from a large portion (surface area) of the heat source component.

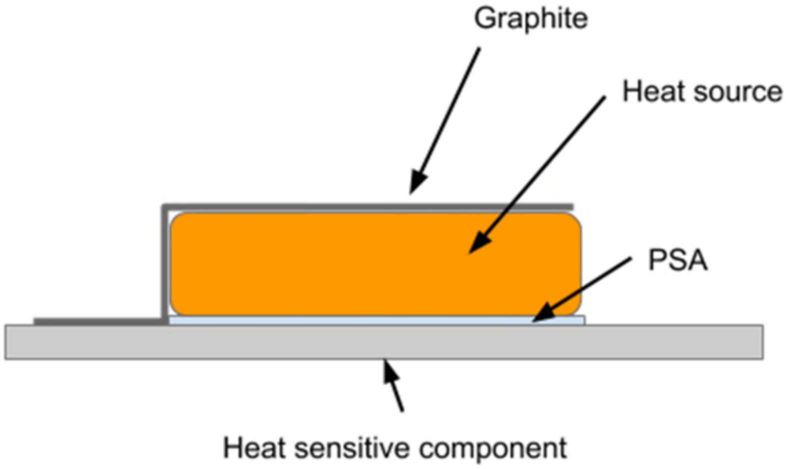

Fig. 3: Alternative component and graphite sheet arrangement

Fig. 3 depicts an alternative component arrangement of the heat source component and heat sensitive component, per techniques of this disclosure. This arrangement may be suitable for devices with limited space, e.g. on a component board. In this illustrative example, the graphite sheet surrounds the upper portion of the heat source component and extends on only one side of the heat source component and onto the heat sensitive component. This enables heat transfer away from the heat source component in limited space settings, while still providing superior mechanical performance during dynamic events.

CONCLUSION

A pressure-sensitive adhesive (PSA) material layer is provided between the heat source component and the heat sensitive component for improved mechanical performance, while the graphite sheet is formed as a cladding surrounding the heat source. The PSA layer performs well under tensile stress, while also providing effective thermal insulation. The graphite sheet is formed over the heat source component, wrapped around its sides, and attached to the heat sensitive component. During a dynamic event, e.g. a drop of the device, most of the stress is exerted upon and absorbed by the PSA layer. The graphite sheet experiences relatively lower tensile stresses while still being positioned to transfer heat away from a large portion (surface area) of the heat source component. In limited-space designs, the graphite sheet is formed around the upper portion of the heat source component and extends on only one side of the heat source component and onto the heat sensitive component.

REFERENCES

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