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Multi-Filler Composite Thermal Interface Materials with Liquid Metal Solder Drops and Tunable Electrical Properties

AzTE Case #M16-125P

Inventors

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Background

The amount of heat dissipated from electronic devices increases as the size of the devices become smaller. Thermal interface materials (TIMs) reduce the thermal contact resistance between two solids. A recent development in TIMs is a composite that consists of a solid elastomer matrix with liquid metal drops, but has low thermal conductivity. If the liquid metal content is increased or the composite is compressed, percolation effects (liquid passing through a filter) lead to the formation of an electrical conductive composite, which is undesirable in electronic applications. Therefore, there is a need to design a TIM with higher conductivity for applications in electronics.

Invention Description

Researchers at ASU have developed a TIM with improved thermal conductivity achieved through addition of solid additives as well as liquid metal drops. This novel approach combines the two current approaches in which either only solid particles or only liquid metal drops are used. The liquid metal acts as a high thermal conductivity filler with the ability to withstand large deformation due to its liquid state. Furthermore, the liquid metal reduces interfacial resistance of the other high thermal conductivity solid additive particles.

Potential Applications

- Microgap filling in integrated circuit chip and flip chip interfaces
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Benefits and Advantages

- **Improved Thermal Conductivity –** The combination of liquid metal and solid additives increases the thermal conductivity in contrast to TIMs that use only liquid metal or only solid additives
- **Innovative –** The heterostructures can come in various shapes such as plates, sheets and branched structures
- **Tunable Rheology –** The choice of functional oxide surface enables the metal oxide growth rate to be controllably slowed

Intellectual Property Status:

Pending

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