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Mitigation of Voids During Direct Soldering of Cooling Components to Silicon

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ABSTRACT

This disclosure describes techniques for the mitigation of voids during a direct soldering process whereby a cooling component is soldered to a chip or processor (silicon). Per techniques of this disclosure, mechanical vibration or non-contact vibration is applied to the cooling component-silicon assembly during the soldering process to help disperse solder and eliminate voids or open areas. In some implementations, direct mechanical vibration is applied to the assembly during the soldering process by utilizing a vibrating tray during the direct soldering process. Alternatively, or in addition, non-contact vibration is applied, e.g., by utilizing an ultrasonic or laser that excites the solder material surface during the direct soldering process. Techniques of this disclosure can provide improvement in the thermal interface and the contact between the cooling component and the silicon surface and help improve thermal performance.

KEYWORDS

- Thermal management
- Thermal Interface Material (TIM)
- Cold plate
- Heat spreader
- Heat sink
- Heat transfer
- Mechanical vibration
- Non-contact vibration

BACKGROUND

Modern processors can generate large amounts of heat. Cooling components directly soldered to the chip (silicon) are utilized for effective thermal management. In this design, a cooling component, e.g., heatsink, cold plate, heat spreader etc., is bonded directly to a chip surface. A thermal interface material (TIM) can be inserted between the two components to enhance thermal coupling.

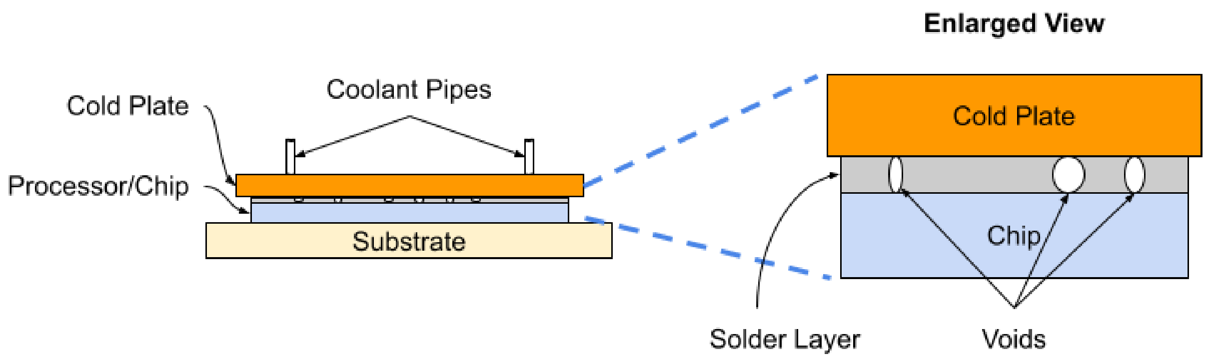

Fig. 1: Heat transfer can be hindered by voids formed during soldering process

Fig. 1 depicts an example processor that utilizes a directly soldered cooling component. As depicted in Fig. 1, a cold plate is directly soldered to a chip/processor surface. The cold plate conducts heat away from the chip, which is then transferred to a coolant. However, the direct soldering process poses the risk of voids, e.g., air pockets, being formed between the cooling component and the silicon. This can be exacerbated in larger chips where the distance of movement of entrapped gasses and/or materials to the edge of the contact surface is relatively large. The voids thus formed can negatively affect heat transfer and lead to poor thermal performance.

DESCRIPTION

This disclosure describes techniques for the mitigation of voids during a direct soldering process whereby a cooling component is soldered to a chip or processor (silicon). Per techniques of this disclosure, mechanical vibration or non-contact vibration is applied to the cooling component-silicon assembly during the soldering process to help disperse solder and eliminate voids or open areas. This can enable a more homogenous and consistent direct contact of the cooling component to the silicon surface, thereby improving thermal performance.

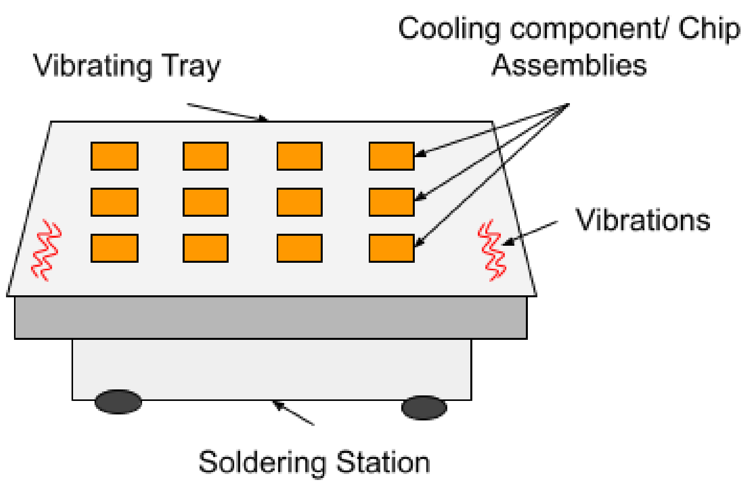

Fig. 2: Mechanical vibration can be applied during direct soldering

Fig. 2 depicts example implementations of the application of mechanical and non-contact vibration to a direct soldering process, per techniques of this disclosure. Fig. 2 depicts application of direct mechanical vibration to the assembly during the soldering process. In this illustrative example, the assemblies of the cooling component and the silicon are placed on a vibrating tray during the direct soldering process.

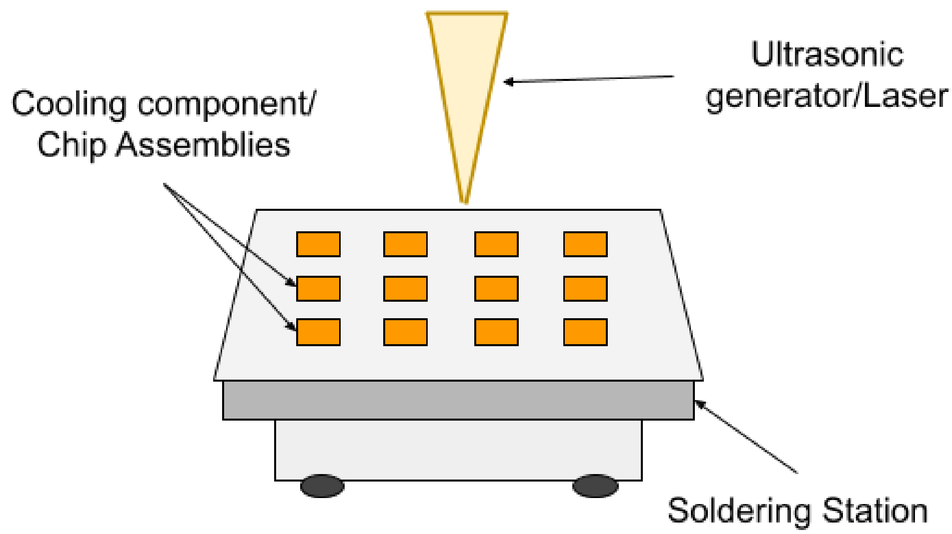

Fig. 3: Non-contact vibration applied during direct soldering

Fig. 3 depicts an example of a non-contact vibration being applied, per techniques of this disclosure. In this illustrative example, an ultrasonic or laser emitter is utilized to apply non-contact vibration to the assemblies by exciting the solder material surface during the direct soldering process. In some implementations, a combination of direct vibration and non-contact vibration can be applied.

Techniques of this disclosure can provide improvement in the thermal interface and the contact between the cooling component and the silicon surface and help improve thermal performance.

CONCLUSION

This disclosure describes techniques for the mitigation of voids during a direct soldering process whereby a cooling component is soldered to a chip or processor (silicon). Per techniques of this disclosure, mechanical vibration or non-contact vibration is applied to the cooling component-silicon assembly during the soldering process to help disperse solder and eliminate voids or open areas. In some implementations, direct mechanical vibration is applied to the assembly during the soldering process by utilizing a vibrating tray during the direct soldering process. Alternatively, or in addition, non-contact vibration is applied, e.g., by utilizing an ultrasonic or laser that excites the solder material surface during the direct soldering process. Techniques of this disclosure can provide improvement in the thermal interface and the contact between the cooling component and the silicon surface and help improve thermal performance.