



Bi-Layer System with Extreme Anisotropic Thermal Conductivity for Heat Spreading and Isolation

A lateral heat-spreader / cross-plane insulator stack that guides heat away while blocking thermal cross-talk in 2.5D/3D ICs.

Heterogeneous integration of varied semiconductor components poses non-conventional thermal challenges. Heat guiding within IC package structures such as 2.5D and 3D-IC packages could potentially address some of those challenges. However, one major issue is often the insufficient cooling of bottom die in heterogeneous integrated circuits and thermal cross-talk between closely located dies. Researchers at Purdue University have developed a bi-layer technology that combines an extreme heat conductor and extreme heat insulator to simultaneously achieve high in-plane thermal conductivity dominated by the conductor and low cross-plane conductivity due to the insulator. This combined bi-layer system allows efficient heat dissipation laterally through the conductor layer. On the other hand, the heat flow across the bi-layer is blocked by the insulator. This technology is believed to have huge industrial potential in the semiconductor packaging industry.

Technology Validation:

Based on the simulated results for graphite combined with an aerogel, the effective in-plane conductivity of the bi-layer is 8400 times that of the through-thickness conductivity. The rectification factor, based on the ratio of the heat flux when the local hot spot is on the graphite side compared to the aerogel side, is 15.8.

Advantages:

-Has similar heat spreading capability as a multilayer graphite heat spreader, with superior thermal isolation.

Applications:

Technology ID

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Category

Semiconductors/Packaging & Integration
Materials Science & Nanotechnology/Nanomaterials & Nanostructures
Materials Science & Nanotechnology/Thermal Management Materials & Solutions

Further information

Will Buchanan

wdbuchanan@prf.org

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-Semiconductor packaging industry

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Intellectual Property:

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