附件四、技術說明表

均熱元件

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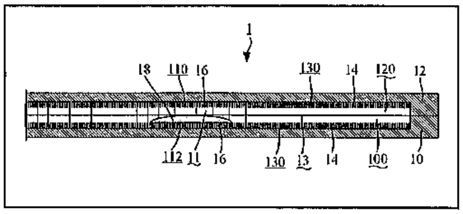
簡　歷： https://che.ntu.edu.tw/che/cwlan.html



市場及需求:

全球熱擴散器市場 2024 年規模約 25 億美元，預計至 2033 年達 40 億美元，年複合成長率 6.5%，主要驅動來自半導體、HPC 及 AI 應用。矽基蒸氣腔室（SVC）需求強勁，受惠於 AI 加速器、GPU 高功率（1000W 以上）及資料中心熱管理需求，預計 2026 年起年成長 8.7%。

技術摘要(含成果):

熱擴散器由上下蓋板真空密封，形成 N 個對應熱源的腔室及徑向通道，內置雙層毛細結構（wick），工作流體蒸發-冷凝循環散熱。模擬成果顯示熱阻低至 0.014 K/W，處理 24W 熱通量 266.6 W/cm²，溫度差小（Tj 105°C），優於傳統 VC（熱阻 0.076 K/W）。

優勢:

相較傳統 heat pipe 或 VC，具低 CTE（2.6 ppm/K vs 17 ppm/K）、薄型（0.6/0.4mm）、抗熱點乾燒（dry-out）及非均勻功率圖，適合 2.5D/3D 封裝高功率 HPC/AI/GPU。結構強度高（Von Mises stress 1.3-4 GPa），填充時間短（60ms），傳熱係數達 50,000 W/m²K。

競爭產品:

- 傳統 VC 及 heat pipe：熱阻較高，易乾燒，不適合矽基高密度封裝。
- 金剛石熱擴散器：高性能但成本高，市場 2026 年約 3.7 億美元，成長 6.86%。
- TSMC CoWoS/Intel EMIB 矽中介層：類似 2.5D 應用，但散熱整合度較低。

專利現況:

無

聯絡方式(請不用填):

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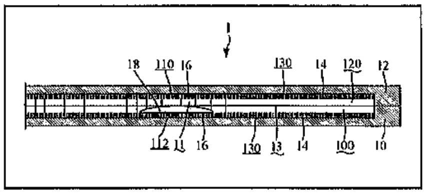
HEAT EXCHANGING APPARATUS



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Experience:

Please visit https://che.ntu.edu.tw/che/cwlan.html

Market Needs:

The global thermal spreader market is projected to reach approximately $2.5 billion in 2024 and is expected to grow to $4 billion by 2033, with a compound annual growth rate (CAGR) of 6.5%, driven primarily by semiconductor, HPC, and AI applications. Demand for silicon vapor chambers (SVCs) is strong, driven by AI accelerators, high-power GPUs (1,000W and above), and data center thermal management needs, with annual growth projected to reach 8.7% starting in 2026.

Our Technology:

The heat spreader consists of upper and lower cover plates sealed under vacuum, forming N chambers corresponding to the heat sources and radial channels. It incorporates a double-layer capillary structure (wick), with the working fluid evaporating and condensing in a cycle to dissipate heat. Simulation results show a thermal resistance as low as 0.014 K/W, capable of handling a heat flux of 24 W at 266.6 W/cm^2, with a small temperature difference (Tj 105°C), outperforming traditional vapor chambers (thermal resistance 0.076 K/W).

Strength:

Compared to traditional heat pipes or vapor chambers, it features a low CTE (2.6 ppm/K vs. 17 ppm/K), a thin profile (0.6/0.4 mm), resistance to dry-out and non-uniform power distribution, making it suitable for high-power HPC/AI/GPU applications in 2.5D/3D packaging. It features high structural strength (von Mises stress of 1.3–4 GPa), short fill time (60 ms), and a thermal conductivity of up to 50,000 W/m^{2}K.

Competing Products:

- Traditional VC and heat pipes: High thermal resistance and prone to dry burning; not suitable for high-density silicon-based packaging.
- Diamond heat spreaders: High performance but high cost; the market is projected to reach approximately $370 million by 2026, with 6.86% growth.
- TSMC CoWoS/Intel EMIB silicon interposers: Similar to 2.5D applications, but with lower thermal integration.

Intellectual Properties:

None

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