超薄均溫板熱擴散率以及有效熱傳導係數之量測

黃筧

T-Global Technology

t-global 高柏
TECHNOLOGY 科技

Heat Sink

Heat Pipe

Vapor Chamber
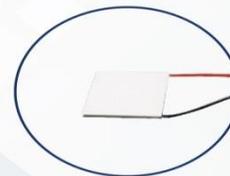
Thermoelectric Cooling Chip

Flexible Absorbent Material

Fan

Thermal Interface Material
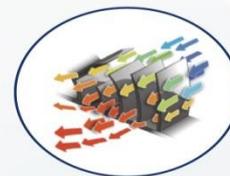
Thermal Simulation

ASUS BOSCH Panasonic SIEMENS NEC

JABIL LITEON D-Link
Building Networks for People ADVANTECH 研華科技 hp

DELTA
Smarter. Greener. Together. AXIS
COMMUNICATIONS PEGATRON
和碩聯合科技 AUO 友達光電
AU Optronics

INNOLUX FLEXTRONICS QUALCOMM

GIGABYTE FOXCONN VIVOTEK SHARP

intel CISCO 泰金寶電通
Cal-Comp Electronics & Communications ARRIS SPECIALIZED TESLA

2019年開始，許多廠商相繼推出5G的智慧手機，由於5G手機的功率比4G大很多，因此散熱的問題越來越重要，傳統的石墨片或熱管方案已經無法滿足其需求，需要變更為均溫板才能解決其問題。

Main heat sources in a smartphone

(Source: Market Opportunities for Thermal Management Components in Smartphones, Yole Développement, November 2017)

Processor

Battery

Image sensor

LED
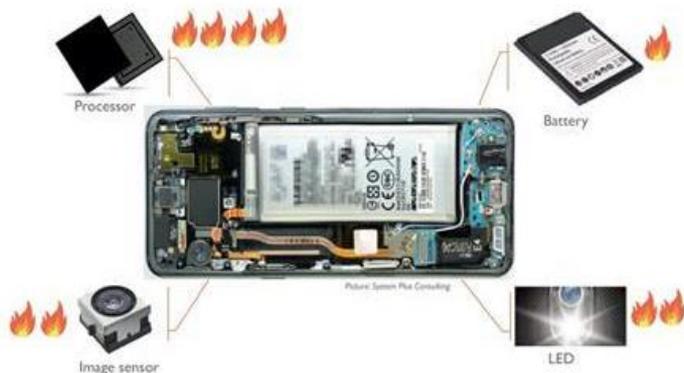
手機中主要發熱源
資料來源：Market Opportunities for Thermal Management Components in Smartphones

均熱板原理

均溫板(Vapor Chamber)為一雙相熱傳裝置，主要的工作原理是利用工作流體的相變化潛熱，將熱量快速的擴散出去，達到均溫的效果。
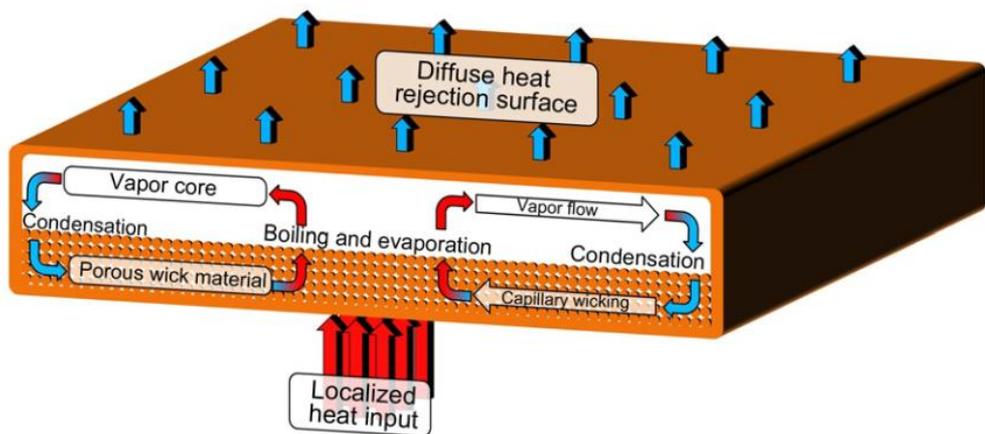
- 均溫性好，其熱傳導係數可以達到10K(W/m-K)以上。
- 因為中間為中空，所以重量較純金屬輕。
- 外型比較不受限制，可以根據不同的機構來設計。
- 厚度也比傳統的熱管薄，目前最薄約0.35mm。

LG V50 Thin Q
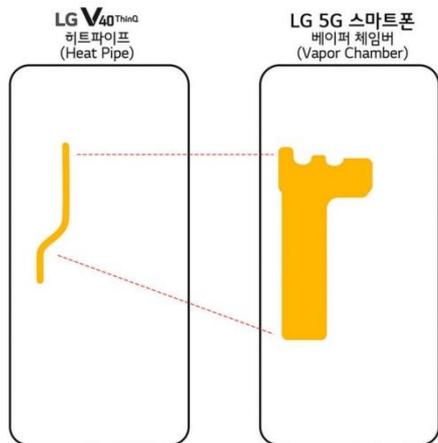
NOTE 10 +5G

Mate 20X 5G
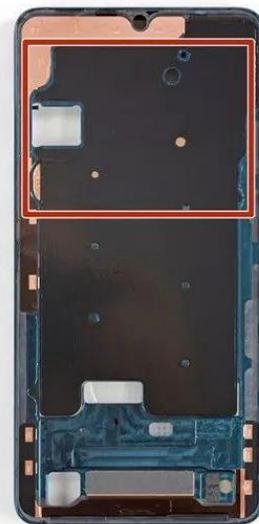
散熱方案

華為Mate 20 X內部拆解
來源：鳳凰科技
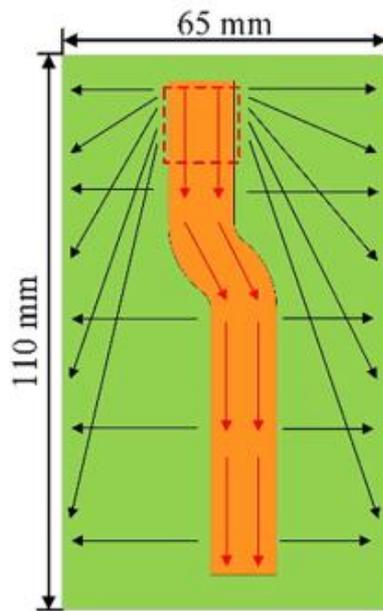
來源：Design, fabrication and thermal performance of a novel ultra-thin vapour chamber for cooling electronic devices
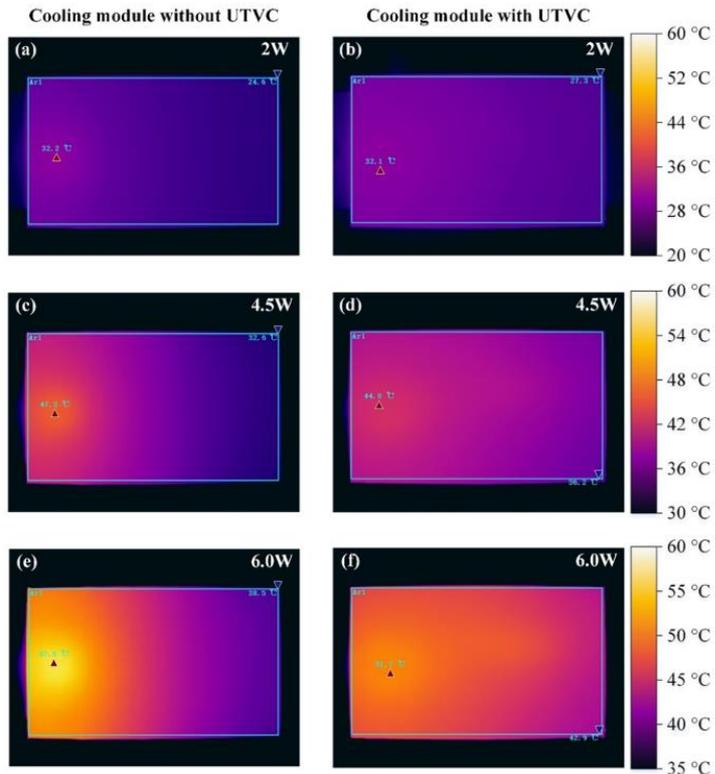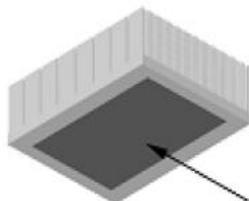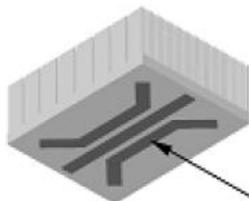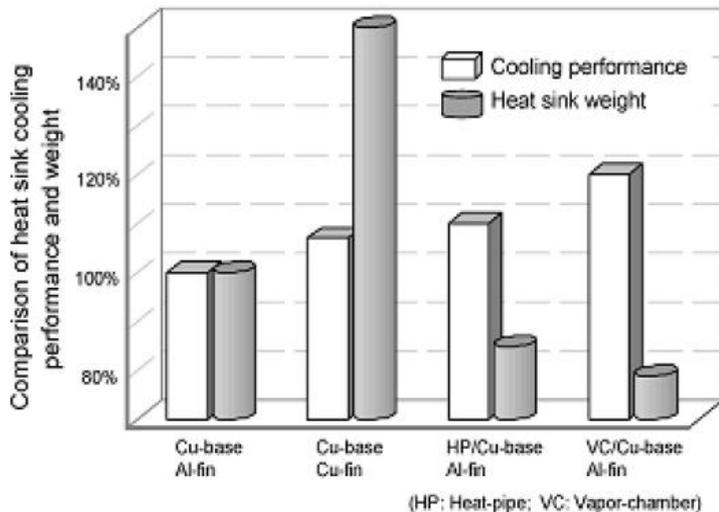
資料來源：
The way we were and are going on cooling high power processors in the industries,
The Seventh International Symposium in Transport Phenomena

Intel Server CPU Platform

Family Branding	Skylake-SP	Cascade Lake-SP/AP	Cooper Lake	Ice Lake-SP/AP
Process Node	14nm+	14nm++	14nm++	10nm+
Platform Name	Intel Purley	Intel Purley	Intel Purley?	Intel Whitley
MCP(Multi-Chip package) SKUs	No	Expeted	TBA	Expeted
Socket	LGA 3647	LGA 3647	TBA	LGA 4189
Max Core Count	Up To 32	Up To 28	TBA	TBA
Max Thread Count	Up To 64	Up To 56	TBA	TBA
Max L3 Cache	38.5MB L3	38.5MB L3?	TBA	TBA
Memory Support	DDR4-2666 6 Channel	DDR4-2933 6 Channel	TBA	8 Channel
TDP Range	140W-205W	165W-205W	TBA	Up To 230W
Competition	AMD EPYC Naples 14nm	AMD EPYC Rome 7nm	AMD EPYC Rome 7nm	AMD EPYC Milan 7nm+
Launch	2017	2019	2019	2020

資料來源：Soothepain；宏遠投顧整理

2U Server

均溫板

$$\alpha = \frac{L^2}{2\Delta t ln(\frac{M}{N})}$$

$$K_{Angstrom} = \alpha \times C_p \times \rho$$

t-global 高柏
TECHNOLOGY 科技
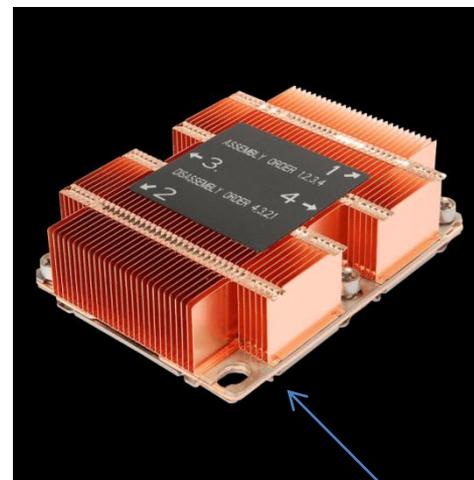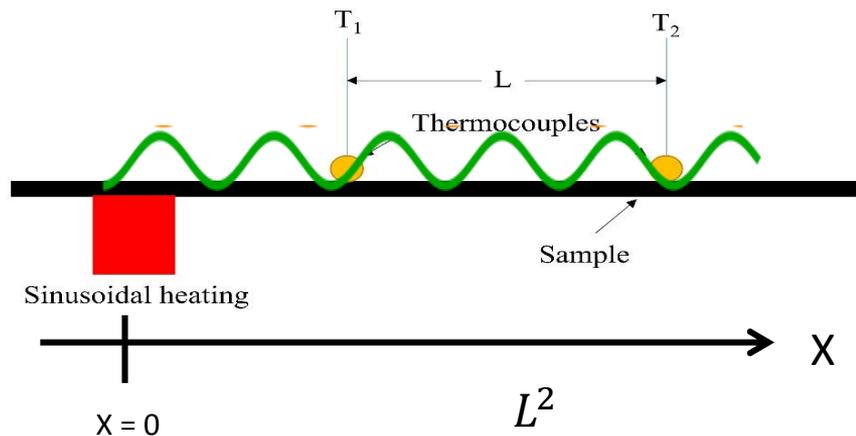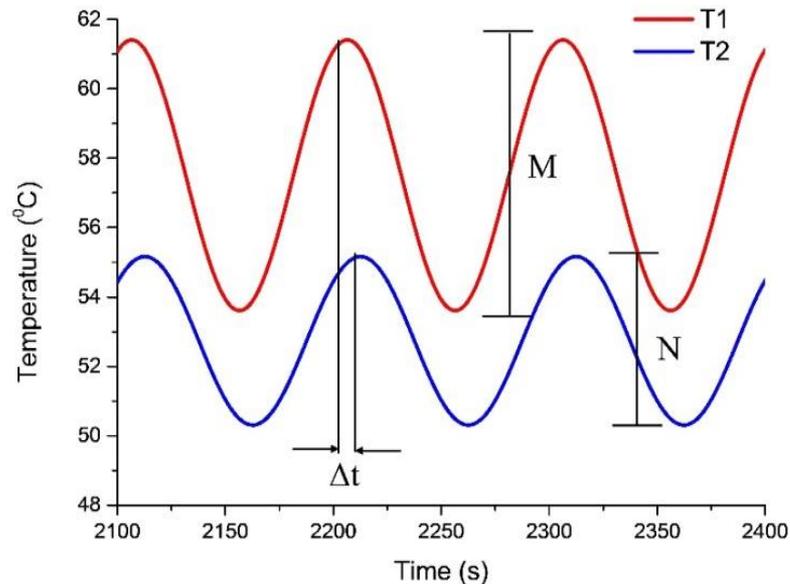
> **Thermal Diffusivity Measuring Instrument (TDMI)**

Measuring ruler rail

T_C T_X

Experimental diagram panel

Power supply

T.E.C heating chip

Heating fixture   gantry support frame
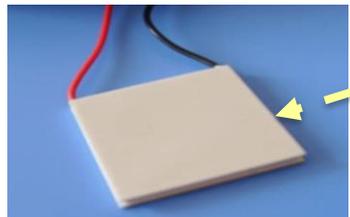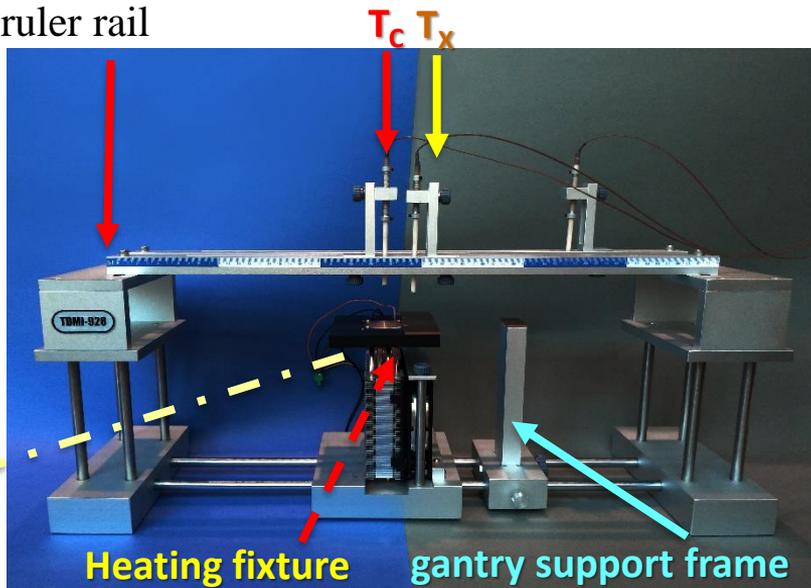
Platform of thermal diffusivity measuring instrument

Power supply of thermal diffusivity measuring instrument
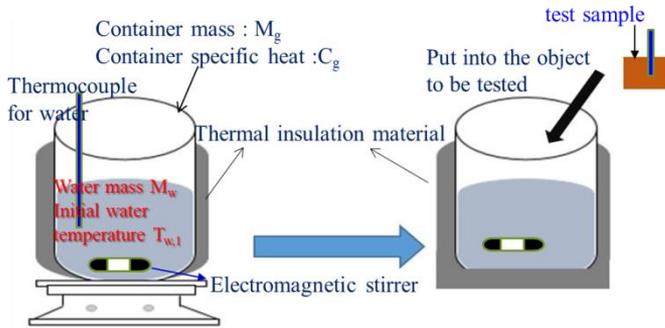
$$Q_{release} = m_w \times C_w \times (T_{w,1} - T_{w,eq}) + m_g \times C_g \times (T_{g,1} - T_{w,eq})$$

$$= \widetilde{C_w} \times (T_{w,1} - T_{w,eq}) + \widetilde{C_g} \times (T_{g,1} - T_{w,eq}) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \text{Eq. (21)}$$

$$\widetilde{C_w} = m_w \times C_w \ldots \ldots \text{Eq. (22)}$$

$$\widetilde{C_g} = m_g \times C_g \ldots \ldots \text{Eq. (23)}$$

$$Q_{absorb} = m_s \times C_s \times (T_{w,eq} - T_{s,1}) \ldots \ldots \text{Eq. (24)}$$

$$\widetilde{C_s} = m_s \times C_s \ldots \ldots \text{Eq. (25)}$$
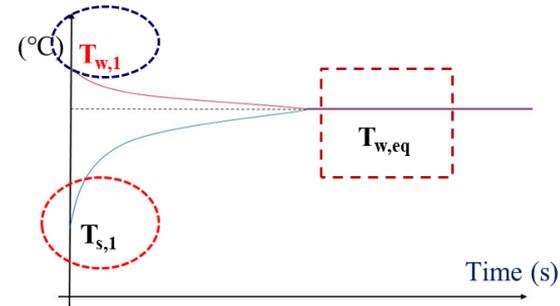
$$\widetilde{C_w} \times (T_{w,1} - T_{w,eq}) + \widetilde{C_g} \times (T_{g,1} - T_{w,eq}) = \widetilde{C_s} \times (T_{w,eq} - T_{s,1}) \ldots \text{Eq. (26)}$$

密度量測

$$\rho_s = \frac{M_s}{V_s}$$

$$V_s = \Delta V = \frac{(\Delta M_w)}{\rho_w} = \frac{(M_{1,w} - M_{2,w})}{\rho_w} \ldots\ldots\ldots\ldots \text{Eq. (19)}$$

$M_{1,w}$: 添加待測物前之水重

$M_{2,w}$: 添加待測物後之水重

ρ_w: 水之密度

ρ_s: 待測物之密度

Source: http://onlinejar.blogspot.com/2012/02/
archimedes-principles-and-buoyancy.html

Fig 15.用於測量熱板密度之容器

均溫版(銅)
90*60*1mm

均溫版(銅)
90*60*0.4mm

不鏽鋼均溫版
90*90*3mm

純銅
90*60*0.4mm

結果

均溫版(銅)
90*60*1mm

均溫版(銅)
90*60*0.4mm

不鏽鋼均溫版
90*90*3mm

純銅
90*60*0.4mm

結果
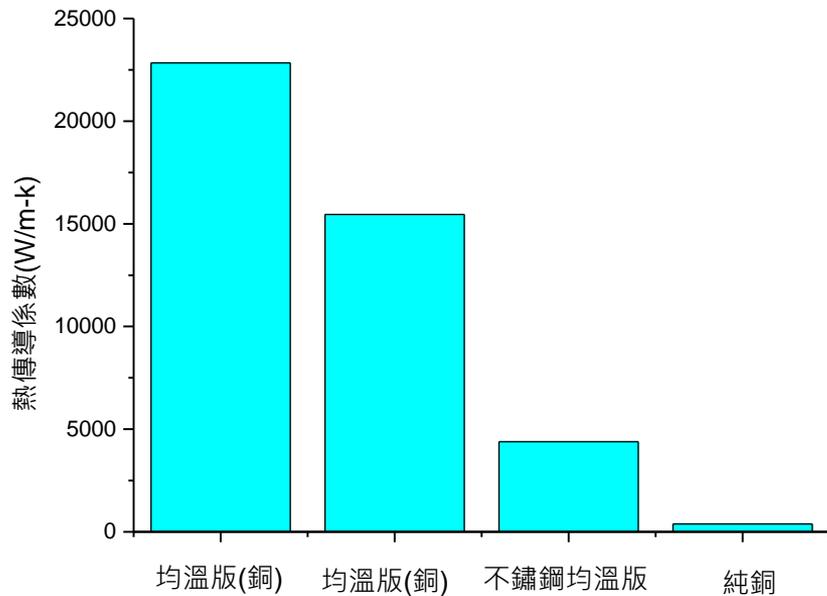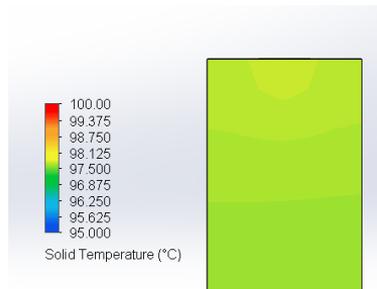
均溫版(銅)
90*60*1mm

均溫版(銅)
90*60*0.4mm
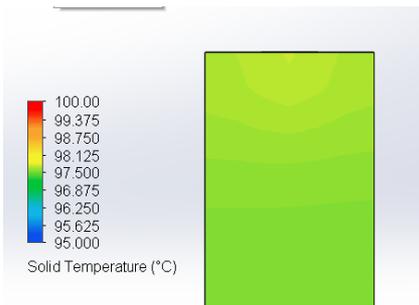
不鏽鋼均溫版
90*90*3mm
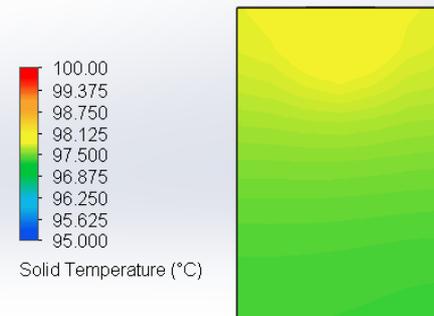
純銅
90*60*0.4mm
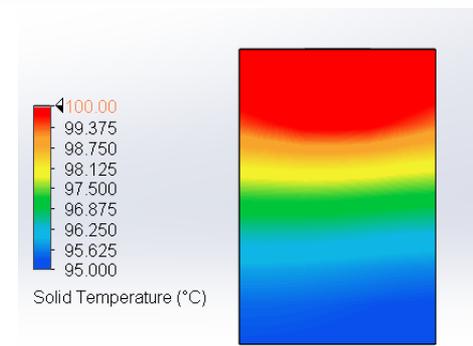
Thank You
For Your Listening~

~THE END~