

Thermal Designs Using Vapor Chambers for Smartphones, Laptops, HPC and Power Electronics

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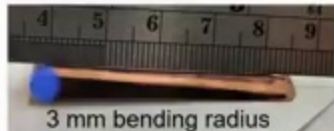
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TGP: Near isothermal





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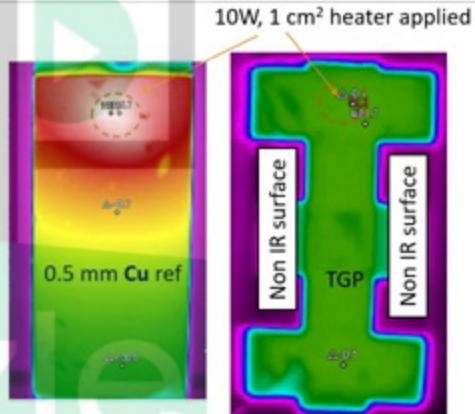
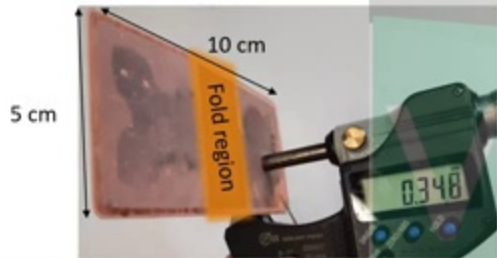
FTGP – Thermal Performance

Maximum power: >10 W

Effective Thermal Conductivity: >10,000 W/m-K

- >25x lower ΔT than Cu

Size: 5 cm x 10 cm x **0.35 mm** in flat 0.45 mm in folding region

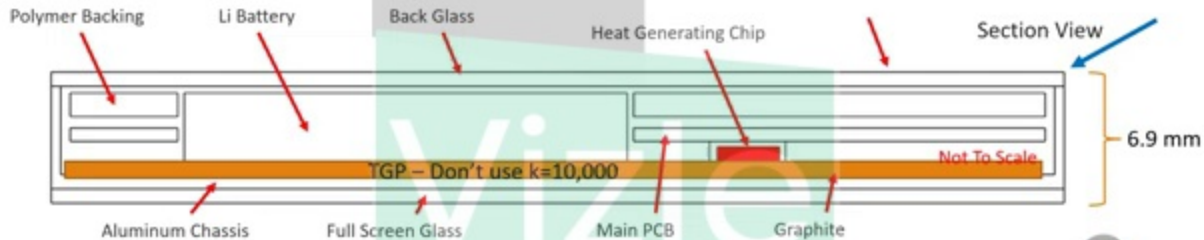
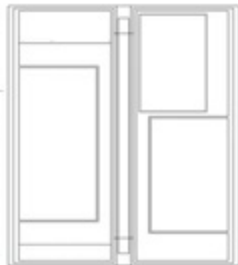




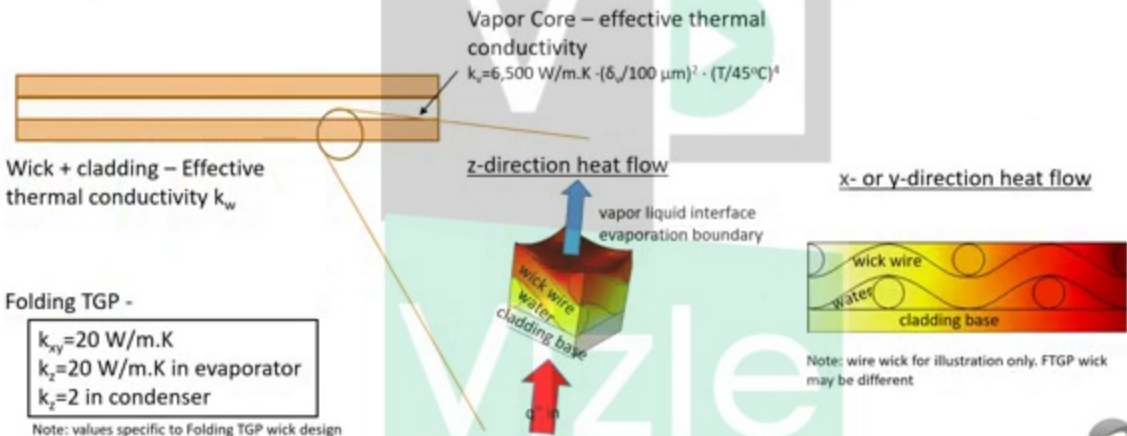
Using Foldable TGP in Thermal Models

How can you model the TGP in the phone model?

- More complicated than $k_{TGP}=10,000$.



Wick Thermal Model



Design Studies – Folding TGP enhances cooling

Foldable Smartphone



Standard Phone

4.7W =>
Temp limit



Foldable TGP

9.4 W =>
Temp limit

Laptop



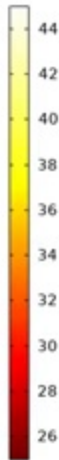
No TGP

9W

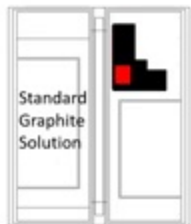


Foldable TGP

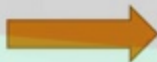
29W



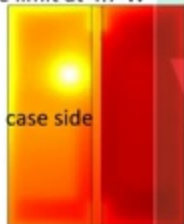
Foldable Smartphone: Increase max power 2x with TGP



100% improved cooling



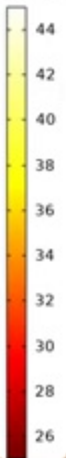
Skin temperature limit at 4.7 W



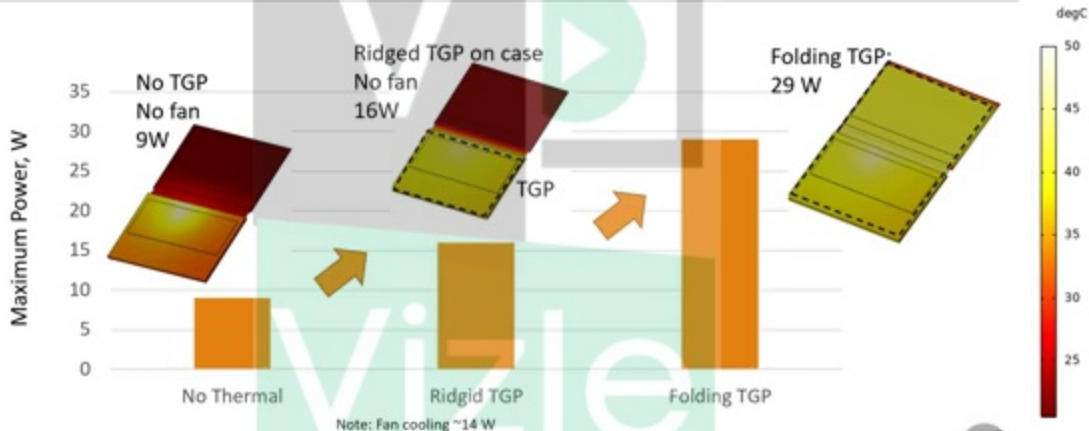
Skin temperature limit at 9.4 W



Degrees C



Laptop Maximum Power – increase 3x





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