Passive Thermal Management using Phase Change Materials

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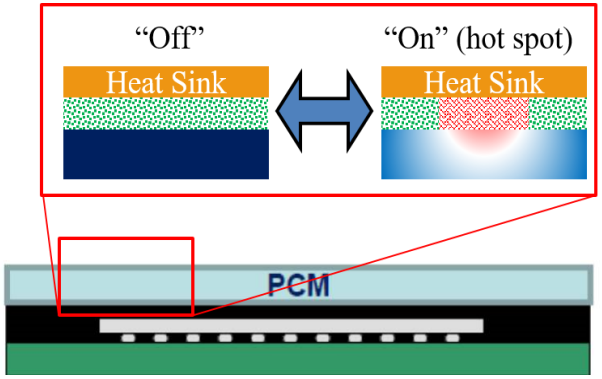
Objectives

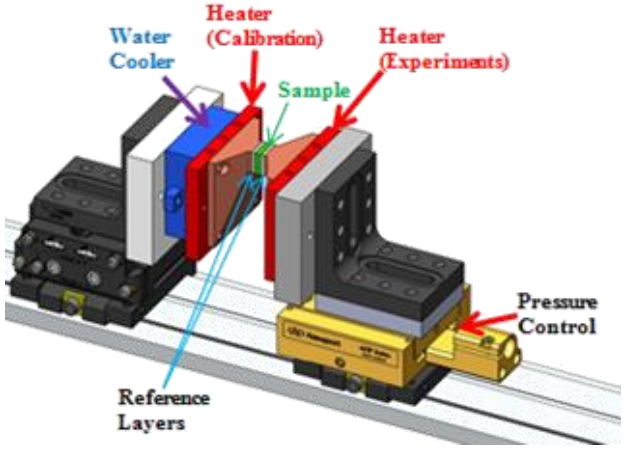
- Develop a thermal management solution based on phase change materials (PCMs) in order to store energy generated by transient hotspots.
- Specifically, the goal of this project is top optimize polymers with themoreversible phase or structure changes (*e.g.* from a gel state to a solid state upon heating) for use in mobile device thermal management.

Approach

1. Characterize commercially available PCMs to determine target thermal properties
2. Model temperature distribution in mobile devices undergoing heating events to optimize integration of PCM
3. Experimentally evaluate system level performance of PCM
4. Synthesize novel solid-solid PCMs and characterize the properties *in situ*



Schematic illustrating possible integration location of the PCM at the chip level to alleviate hot spots. During intense heating, the PCM changes phase absorbing energy at a nearly constant temperature.



Thermal characterization rig to measure thermal resistance based on a miniaturized version of the reference bar method using non-contact infrared thermography for temperature sensing.

Commercial PCM Thermal Resistance (in cm^2K/W) for heating and cooling cycles.

Cycle	During phase change	Fully Solid
Heating	11.0	13.1
Cooling	6.7	6.6

Impact

- This novel dry PCM thermal management solution will grant longer duration for operation of the package and/or device before the thermal limit of the package/system is reached
- This technology would enable locally high removal rates at hot spot locations (phase change + improved thermal conduction), allowing convenient integration and application to existing device configurations.
- The developed metrics will enable *ex situ* comparison of PCM performance

Selected Publications

Yash.G , Amy,M. "Passive Thermal Management Using Phase Change Materials: Experimental Evaluation of Thermal Resistances."ASME *Interpack 2015*

Bruce, A. N., Ganatra, Y., Marconnet, A., Howarter, J. A. "Block Copolymers as Phase Change Materials for Mitigating Heat Spikes in Handheld Consumer Electronics." *TMS 2016*

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