Liquid Metal Thermal Interface Materials with Acceptable Manufacturability and Reliability

Faculty: Carol Handwerker Student: Yifan Wu

PURDUE UNIVERSITY

COOLING TECHNOLOGIES RESEARCH CENTER

Background

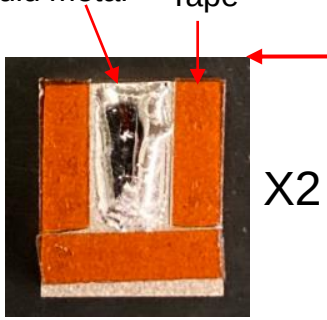
Ga-In-based liquid metal has long been considered as a potential candidate for next-generation TIMs for its high thermal conductivity and low solidification temperature. In practice, however, Ga is highly reactive on metal substrates and has poor wettability.

Objective

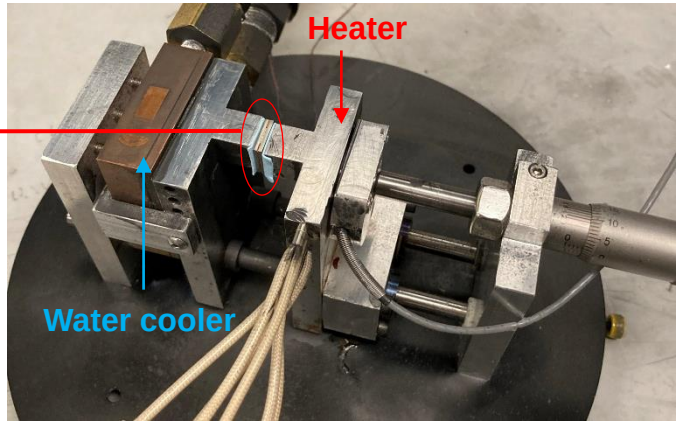
- Develop surface modification methods to facilitate the wetting of Ga-based liquid metal while reducing reactivity and embrittlement
- Characterize the thermal performance of Ga-based liquid metal TIMs on metal substrates and wetting-barrier layers at both time zero and after various thermal treatments

Approach

- Developed two surface modification methods that facilitate wetting and limit reactivity starting with electrodeposited Sn and Ga_2O_3 coatings
- Determine the thermodynamic properties of Ga-based alloys and kinetic undercooling as a function of alloy kinetic undercooling as a function of alloy composition
- Characterize the thermal conductivity and thermal contact resistance of Ga-based liquid metal TIM using IR imaging



Test vehicle: two Ni-plated Cu plates wetted by liquid metal joined together by tapes



IR temperature mapping

Impact

This project demonstrates that the poor wettability of Ga-In-based liquid metals can be overcome with proper surface modification, opening up possibilities for automated mass production. New approaches are being explored to limit reactivity