Developing Nanoengineered Surfaces for Thermal Management

Shrey Agarwal | Purva Shah | Atharva Bodhale | Shivrajsinh Bhosale
Department of Chemical Engineering
Prof. Soumyadip Sett, Department of Mechanical engineering
Indian Institute of Technology Gandhinagar, Gujarat

Abstract and introduction

Studying the heat transfer in the TiB2 coated nano-sheets. It is to check the application of nano-sheets as heat spreaders. The application of these heat spreaders is extensively in the automobile, aerospace industry.

The project involves the experiments on bare copper nanosheets, TiB2 coated nanosheets and fullerene coated nanosheets at different voltages. Then, analysing the data of temperature change and plotting it helps us to get insight into the heat transfer capacities of these sheets.

Objectives

The objective of this project is to learn fabrication of TiB2 nanosheet on copper and to investigate the heat transfer characteristics of Bare copper and TiB2 (nanosheet) coated copper. It also involves the investigation about fouling/antifouling of bare copper and TiB2 coated copper sheet.

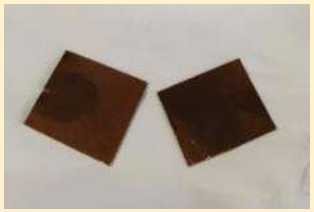

Fig1.Bare copper

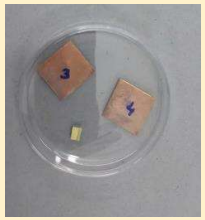

Fig2.TiB2 coated copper

Planned workflow and tentative timelines

1. Skill Acquisition: Coating Bare Copper Surfaces with TiB2 Nanosheets
2. Experimental Investigation: Heat Spreading on Bare Copper, TiB2 Nanosheet-Coated, and Fullerene-Coated Surfaces
3. Dynamic Heat Dissipation: Drop-Evaporation Experiments on Copper Surfaces
4. Data Analysis and Visualization of Results for Different Copper Surface Configurations

Results and discussions

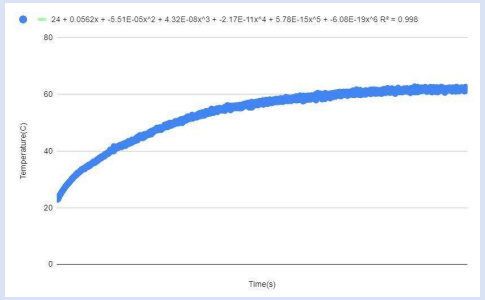

Fig 4. Graph of Temperature profile of Copper surface with time

Expected learning outcomes

1. Rapid Temperature Increase: copper surface temperature swiftly escalates due to constant power input.
2. Thermal Equilibrium: Once a steady state (dQ/dt=0) is attained, the temperature distribution across the copper surface becomes uniform, signaling thermal equilibrium with the surroundings. Consequently, the temperature remains relatively constant, as seen in the graph.
3. Transient Behavior: Throughout the experiment, transient behavior occurs, especially during the heating and cooling phases, resulting in fluctuations or oscillations in the temperature profile.

Current status

Currently, we have fabricated the 6 TiB2 coated copper nanosheet.
Also, we have carried out heat transfer experiments on bare copper at different voltages.
Also, we learnt to use the Keysight BenchVeu software to store the temperature data at various voltages.

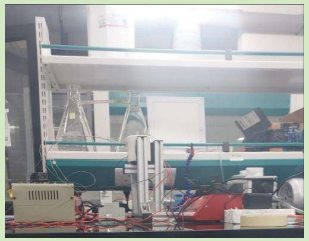

Fig3.Experimental Setup

Acknowledgement & references

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References:

Heinz, Michael, I. U. Chowdhury, Peter Stephan, and Tatiana Gambaryan-Roisman. "Water drops on nanofiber-coated substrates: Influence of wall temperature and coating thickness on hydrodynamics and wall heat flux distribution." *International Journal of Heat and Mass Transfer* 222 (2024): 125117.