Developing Nanoengineered Surfaces for Thermal Management

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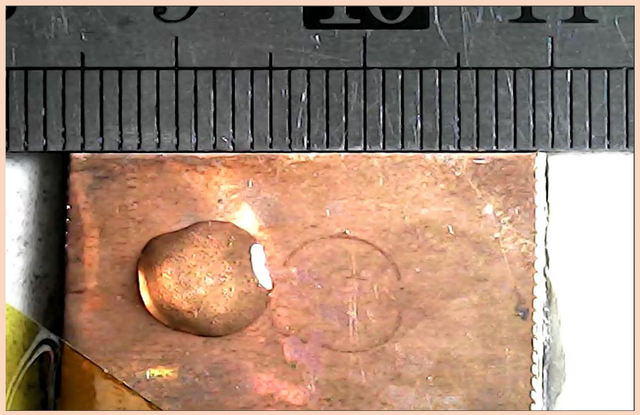
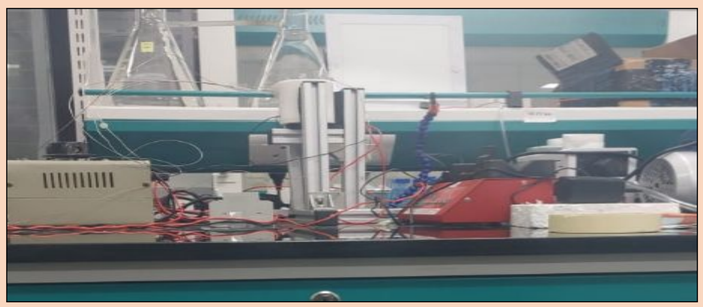
Abstract and Objectives

This study investigates the heat transfer properties of TiB2-coated nano-sheets on copper substrates, evaluating their potential as efficient heat spreaders and exploring their antifouling characteristics. Through a series of experiments including **heat spreading tests, single drop evaporation assessments, drop area analysis , multiple drop test and antifouling tests** (on bare Cu) conducted under various voltage conditions, we compare the thermal performance and fouling resistance of TiB2-coated nano-sheets on copper with bare copper counterparts.

Experimental setup





Results

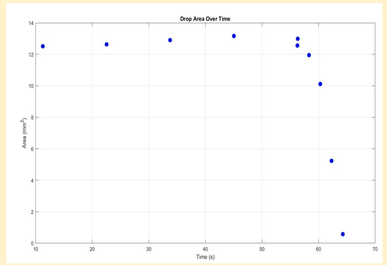


Fig3 : Change in bubble area wrt time for **70V (10ul)**

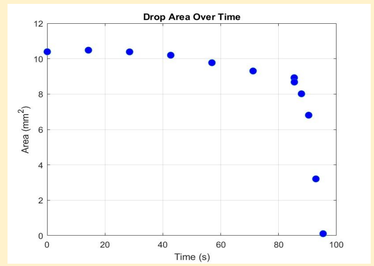


Fig 4 : Change in bubble area wrt time for **70V (20ul)**

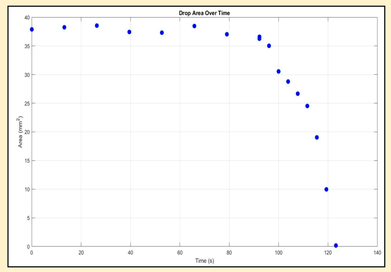


Fig 5 : Change in bubble area wrt time for **50V(10ul)**

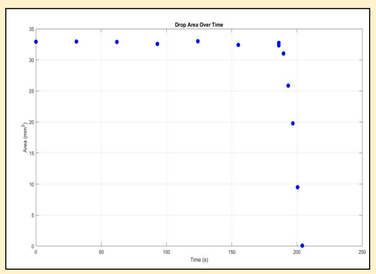


Fig 6 : Change in bubble area wrt time for **50V (20ul)**

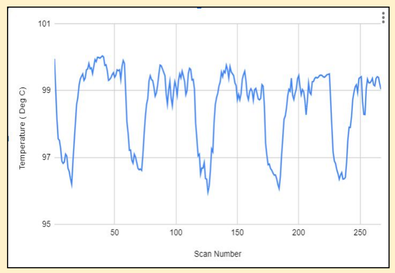


Fig 7 : **Tib2 70V at a flow rate of 5ul**

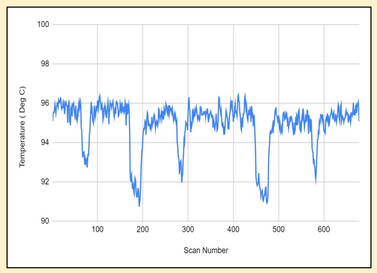


Fig 8 : **Bare 70V at a flow rate of 4ul**

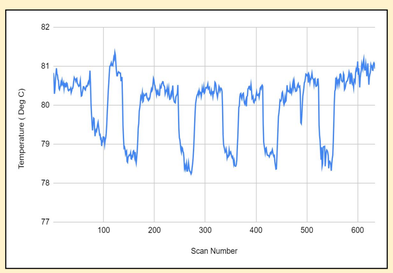


Fig 9 : **Tib2 60V at a flow rate of 4.5ul**

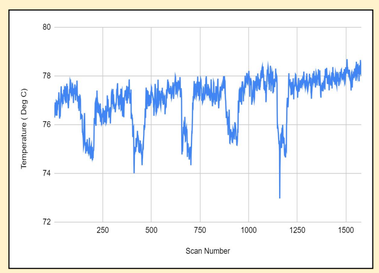


Fig 10 : **Bare 60V at a flow rate of 3.5ul**

Conclusions

1) Tib2-coated copper sheets demonstrate substantial heat spreading capabilities when subjected to elevated temperatures, enhancing their thermal performance.
2) The presence of Tib2 coating on sheets results in a reduced time requirement for bubble evaporation, indicating improved heat transfer efficiency.
3) At lower voltages, the behavior of Tib2-coated sheets becomes unclear, suggesting variability or instability in performance under these conditions.
4) Due to the accelerated water evaporation rate, Tib2-coated sheets require higher flow rates, ensuring efficient cooling and maintaining optimal thermal management.

Future Scope

1. Validate and expand upon initial findings.
2. Conduct further comparative antifouling tests to strengthen understanding of TiB2-coated nano-sheets' fouling resistance on copper substrates.
3. Perform additional thermal management experiments to explore diverse applications of these nanosheets.
4. Refine understanding of both thermal properties and antifouling capabilities.
5. Contribute to the development of advanced heat management technologies with broader industrial applications

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