2021「中技社科技獎學金」

2021 CTCI Foundation Science and Technology Scholarship

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Research Scholarship for International Graduate Students

Role of Surface Engineering for Enhanced Pool Boiling of a Highly Wetting Dielectric Liquid, HFE-7200

表面工程在增強型高潤濕性介電液體 HFE-7200 的池沸騰中的作用

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Abstract

While promising results have been reported in the literature for the pool boiling of water, there are comparatively fewer research reports about the enhanced pool boiling of highly wetting dielectric liquids with little understanding, and even less consensus, on the fundamental underlying mechanisms by which structured coatings enhance boiling. In line with this, the emphasis of this research is on: (1) detailed review of engineered surfaces for enhanced pool boiling of dielectric liquids, (2) development of various engineered surfaces, (3) the role of surface engineering for enhanced pool boiling of a highly wetting dielectric liquid, HFE-7200, (4) design and engineering of robust high performance surfaces, and (5) development of artificial intelligence based model to predict the pool boiling heat transfer of micro and nanoscale engineered surfaces subjected to different working fluids.

Research Focus

Extracted Results

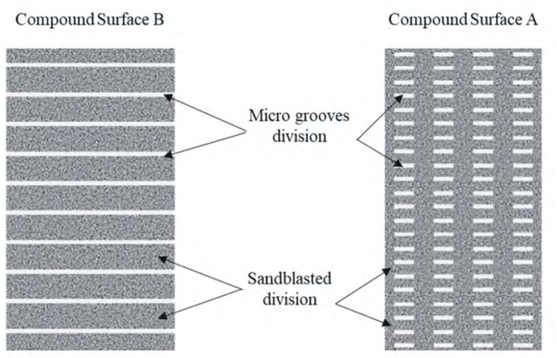

Fig.1. Schematics of compound (sandblasted + micro grooves) surfaces

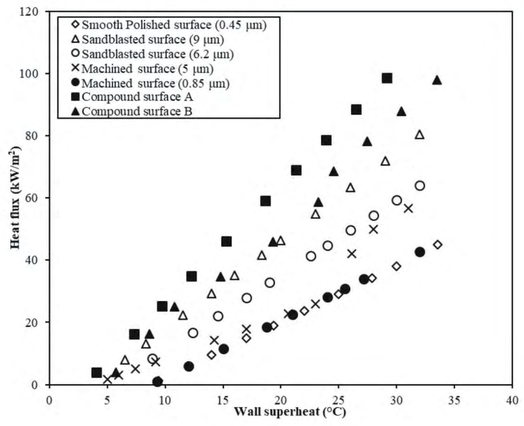

Fig. 2. Pool boiling curves of smooth, roughened, and compound surfaces

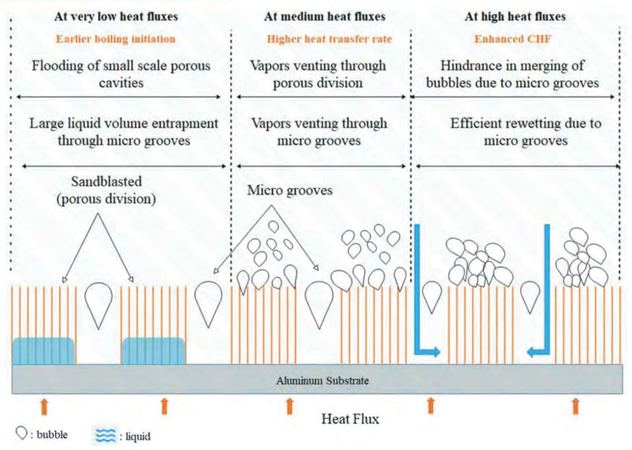

Fig. 3. A schematic of pool boiling of compound surfaces.

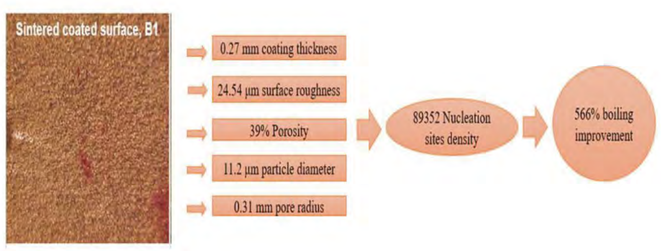

Fig. 4. Schematic representation of the enhanced boiling of high flux sintered coated surface

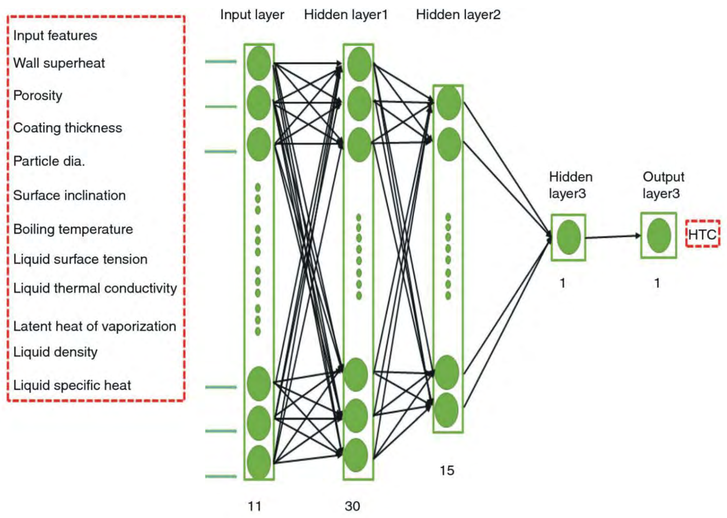

Fig. 5. The proposed DNN structure for HTC prediction

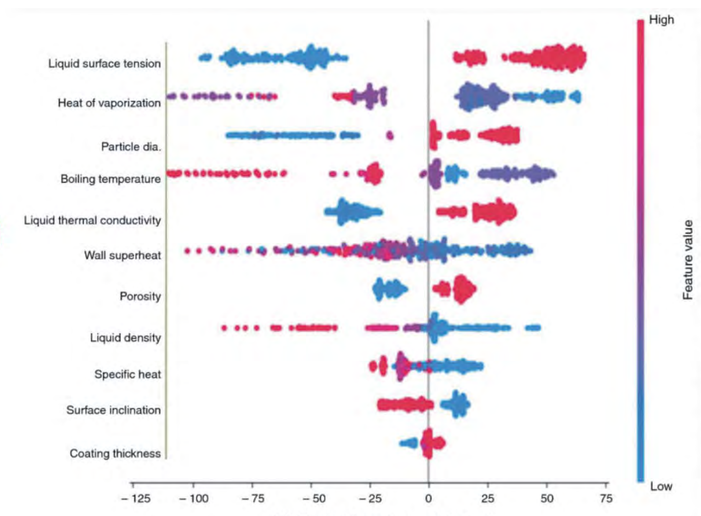

Fig. 6. Impact of input variables on the output of the developed model.

Summary of This Research

Dielectric liquids possess great potential for electronic cooling applications. However, their poor thermophysical properties necessitates the use of engineered surfaces for improved boiling performance. We have tried to improve the boiling performance of dielectric liquids by designing some engineered surfaces both in micro and nanoscale. In addition, we have developed deep learning methods to accurately predict the heat transfer of different working fluids with micro and nanoscale surfaces along with roughened and compound surfaces.

Selected Journal Publications on this Research

- Sajjad, U., Hussain, I., Hamid, K., Bhat, S. A., Ali, H. M., & Wang, C. C. (2021). A deep learning method for estimating the boiling heat transfer coefficient of porous surfaces. Journal of Thermal Analysis and Calorimetry, 1-13.
- Sajjad, U., Sadeghianjahromi, A., & Wang, C. C. (2021). ENHANCING BOILING HEAT TRANSFER FOR ELECTRONICS COOLING BY EMBEDDING AN ARRAY OF MICROGROOVES INTO SANDBLASTED SURFACES. Heat Transfer Research, 52(8).
- Sajjad, U., Kumar, A., & Wang, C. C. (2020). Nucleate pool boiling OF sintered coated porous surfaces with dielectric liquid, HFE-7200. Journal of Enhanced Heat Transfer, 27(8).

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