Pool boiling heat transfer performance of water on thin film coated micro/nano textured surfaces

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DOCTOR OF PHILOSOPHY

By

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Novelty of the thesis

The following section delineates the principal distinctions between current and prior research on composite surfaces, which may be regarded as the novelty of this thesis.

- The present work focused on development of binary oxide composites and its effects on boiling heat transfer performances. Whereas in most of the other's work, the composite surface was prepared with metals like Cu and other elements such as metal, metal oxide, and graphene. For example, Gupta et al. [88] have prepared a composite of Cu and TiO_2, Shil et al. [89] have used graphene nanoparticles with Cu and Al_2O_3. In another study Gupta et al. [136] have used Cu and Al_2O_3 to fabricate porous composite on copper substrate.
- Most of the researchers have developed either hydrophilic [88, 137], or superhydrophilic [89] nanocomposite coating. As per the authors' knowledge, hydrophobic nanocomposite coating and its effects on pool boiling performances, very few have discussed.
- Shi et al. [112], prepared superhydrophobic and superhydrophilic surface using copper foam and experimentally showed that in low heat flux regime ($q'' < 200$ kW/m^2), superhydrophobic surface works well while medium to high heat flux ($q'' > 200$ kW/m^2) superhydrophilic was superior. In the present study a hydrophobic surface prepared on coper substrate which has good water repellent properties and also provide comparatively better heat transfer performance in medium heat flux regime ($q'' < 400$ kW/m^2).
- In literature [88, 89, 136], significance of optimum layer of coating thickness has not been discussed, which may be because of HTC was continuously increased with increased coating layer due to copper. While in the present work, effect of excess coating layer thickness has been discussed and an

optimum value of it found nearly to 10µm, upon which BHTC seems improving, and beyond that, it starts decreasing.

Future work recommendations

- Single bubble tacking and focusing has not performed, so someone can perform this study separately on hydrophobic surface, and can explain the heat transfer, bubble ebullition cycle, bubble departure diameter and frequency can be a different study separately.
- The size of particles also affects the structure formation hence different combinations of particle size can be considered for further investigation separately.
- Generally low concentrations (0.01-0.1 % wt.) prefer for better control over the coating thickness layer, however, someone can investigate the different concentration effects on surface textures and boiling heat transfer performance.
- Compatibility of all three types of composite material has not checked, so someone can try on different substrates to check the compactivity, which is a another type of study can be carryout.

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