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Investigation on Pool Boiling Heat Transfer of Magnetic Fluids On Hydrophilic/Hydrophobic Surface

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Extended Abstract

When a fluidic device gets smaller, the heat transfer would become a more important issue. The heat removal technology with pool boiling heat transfer of fluids with particles could be one of the candidates. Fluids with magnetic nanoparticles (magnetic fluids) could be designed to exhibit improved or tunable properties against magnetic field. Magnetic fluids on a modified wall surface in a magnetic field may lead to significant pool boiling heat transfer enhancement [1-3]. In this study, the pool boiling heat transfer problem for magnetic fluids on hydrophilic and hydrophobic wall surfaces under an external applied magnetic field has been shown, and the surface wettability effect has been investigated. To conduct the analysis, magnetite nanoparticles has been synthesized via chemical co-precipitation technique, and oleic acid has been used as a surfactant, capped on the surface of nanoparticles via sol-gel technique. Moreover, a hydrophilic surface of copper hydroxide ($Cu(OH)_2$) has been provided by etching technique on a copper substrate, and a hydrophobic surface has been provided by soaking the copper hydroxide substrate in myristic acid which was dissolved in ethanol. An external magnetic field gradient will then be set, so that we can investigate the influence of a magnetic force on the pool boiling heat transfer performance of the magnetic nanofluid on hydrophilic and hydrophobic surfaces.

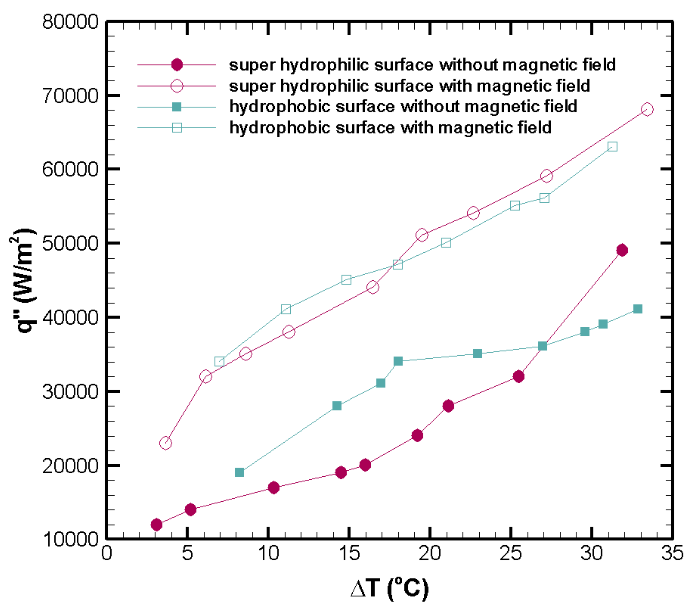

Fig1. Magnetic force effect on excess temperature on hydrophilic/hydrophobic surface for different heat fluxes

The results show from Fig. 1 that the magnetic force generated by a magnetic field gradient could facilitate the bubbles to leave the surface and thus reduce the excess temperature for a fixed heat flux. The largest reduction is about 80% for hydrophilic case and 60% for hydrophobic case. For smaller heat fluxes, hydrophobic surfaces provide a better choice for lower excess temperatures; however, for greater heat fluxes, hydrophilic surfaces provide a relatively better choice. Such a surface effect is relatively insignificant when the magnetic force is applied.

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