Investigation of Flow Boiling Heat Transfer to Binary Mixtures in Micro-Channels

Weilin Qu, Department of Mechanical Engineering, University of Hawaii at Manoa

The objective of the project is to conduct a fundamental study of the various transport phenomena (flow boiling heat transfer, two-phase pressure drop, flow pattern, and flow instabilities) associated with flow boiling of methanol-water binary mixtures in multiple parallel micro-channels with characteristic size ranging from 10 to 1000 microns. Flow boiling of binary mixtures in micro-scale geometries has received little research attention so far and could be quite different from flow boiling of pure liquids in identical geometries due to the effect of mixture composition (mixture effect).

During the past project period, an experimental system has been designed and constructed. Using the experimental system, a primary experimental study has been performed on methanol-water mixture flow boiling heat transfer, two-phase pressure drop, and two-phase flow instabilities in micro-channels having a 240-micron by 640-micron cross-section.

- For a given dissipative heat flux, micro-channel temperature decreased with increasing methanol molar fraction.
- For a given dissipative heat flux, pressure drop increased with increasing methanol molar fraction
- The methanol-water binary mixtures offered better two-phase flow stability than the pure water