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Two-Phase Flow Hydrodynamics in Superhydrophobic Channels

KIMBERLY STEVENS, JULIE CROCKETT, DANIEL MAYNES, BRIAN IVERSON, Brigham Young University — Superhydrophobic surfaces promote drop-wise condensation and droplet removal leading to the potential for increased thermal transport. Accordingly, great interest exists in using superhydrophobic surfaces in flow condensing environments, such as power generation and desalination. Adiabatic air-water mixtures were used to gain insight into the effect of hydrophobicity on two-phase flows and the hydrodynamics present in flow condensation. Pressure drop and onset of various flow regimes in hydrophilic, hydrophobic, and superhydrophobic mini (0.5 x 10 mm) channels were explored. Data for air/water mixtures with superficial Reynolds numbers from 20-200 and 250-1800, respectively, were obtained. Agreement between experimentally obtained pressure drops and correlations in literature for the conventional smooth control surfaces was better than 20 percent. Transitions between flow regimes for the hydrophobic and hydrophilic channels were similar to commonly recognized flow types. However, the superhydrophobic channel demonstrated significantly different flow regime behavior from conventional surfaces including a different shape of the air slugs, as discussed in the presentation.

Kimberly Stevens
Brigham Young University

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