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Sliding Bubbles in Confined Rectangular Channels

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ABSTRACT:

This seminar presents experimental and computational work done to characterize the heat transfer enhancement produced by a confined bubbly flow in rectangular minichannels. These channels have a characteristic spacing of 1.0 to 1.5 mm and an aspect ratio of 15:1 or more. The spacing is on the order of the bubble size, but the aspect ratio allows a true bubbly flow regime instead of the Taylor bubble train that tends to dominate the smaller microchannels. Our investigation uses high-speed imaging to observe the bubble field and liquid crystal thermography to measure the test surface temperature. Images of the bubbles taken from within the channel have been acquired using a micro-borescope. We believe these images to be the first of their kind. Recently, these experiments were complemented by numerical simulations of the three-dimensional unsteady laminar flow around a single confined bubble. An enhancement in heat transfer coefficient of a factor of three or more has been demonstrated for these flows, and since the 1960's, there has been evidence that the dominant mechanism is not the bubble nucleation process nor is it the evaporation of a liquid microlayer between the bubble and the heated wall. We find that the dominant mechanism is rather underwhelming by comparison: it is a mixing-driven single-phase convective process behind the bubble.

BIOGRAPHY:

Keith Hollingsworth is Professor and Chair of the Mechanical and Aerospace Engineering Department at the University of Alabama in Huntsville. Prior to 2011, he was a member of the Mechanical Engineering faculty of the University of Houston where he was the Director of the Heat Transfer and Phase Change Laboratory. Professor Hollingsworth's research interests include boiling and two-phase flows, turbulent convective heat transfer, liquid crystal imaging of complex temperature fields, and biomedical heat transfer. He has been the advisor or co-advisor on over 40 theses and dissertations and is a Fellow of the American Society of Mechanical Engineers and an Associate Fellow of the American Institute of Aeronautics and Astronautics