



### Nucleate Boiling in Microchannels

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An understanding of bubble motion and evolution during nucleate boiling is necessary for the analysis of convective heat transfer rates in microchannels. High-speed photography is used in this study to reveal the complex bubble dynamics during nucleate boiling in copper microchannels of hydraulic diameter  $384\ \mu\text{m}$  ( $275\ \mu\text{m}$  wide and  $636\ \mu\text{m}$  high) and  $25.4\ \text{mm}$  length. De-ionized water flows through the microchannels at a velocity of  $0.68\ \text{m/s}$  ( $\text{Re} = 735$ ) and an inlet temperature of  $86.5^\circ\text{C}$ . The exit pressure is maintained at  $1.05\ \text{bar}$ . A constant heat flux of  $16\ \text{W/cm}^2$  is applied at the bottom of

the microchannel heat sink. A high-speed digital video camera is used to observe the boiling process at 4,000, 8,000 and 15,000 frames per second.

The images shown looking down into the microchannels reveal the transient processes of nucleation, growth, subsequent departure and interaction of bubbles from nucleation sites on the bottom wall of the channel. The measured bubble radius indicates a linear evolution with time. These results are useful in proposing predictive models for boiling heat transfer in microchannel heat sinks.

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