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PIV Measurement of the Flow Field around Film Boiling in He II

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Film boiling phenomena in He II were studied on the basis of the flow field measured with a PIV (Particle Image Velocimetry). Noisy and silent film boiling modes together with a non-boiling state were generated on/around horizontal planar and cylindrical heaters. For PIV tracer particles, H₂-D₂ micro solid particles that were neutrally buoyant in He II were used. The flow field was illuminated by a light sheet of which the light source was a 5W CW-YAG laser, and a high-speed video camera was used as PIV camera. Video images showing the development and crush of vapor bubble or film and the motions of tracer particles dragged by the normal fluid component were PIV-analyzed. The PIV result of the boiling velocity field was composed of AC and DC velocity components of the normal fluid. The AC component follows the dynamic behavior of vapor phase, and the DC results primarily from the thermal counter flow and secondarily is induced by the rising vapor bubbles due to buoyancy. The time-averaged PIV velocity field where the AC component is nearly eliminated provides with the flow field characteristics of film boiling modes of He II, noisy, silent and He I boiling modes as well as of the non-boiling state.

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