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C3Or1A-04: Comparative study of heat transfer performance and visualization images of superfluid helium boiling in narrow two-dimensional channel

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In a narrow channel, boiling heat transfer in He II is much different from that in the case of an open bath. Even under saturated pressure condition, rapid temperature rise due to the onset of film boiling is not seen when the bath temperature reaches the lambda temperature, but only temperature oscillation is detected. The behavior of this state looks like the nucleate boiling, though it is known the steady nucleate boiling state is absent in He II in open bath. The high heat transfer coefficient in quasi-nucleation boiling state above the lambda temperature suggests the range where this advantage in heat transfer appears is wider than that based on simple prediction of He II heat transfer. The appearance of meta stable states of superheated He II and superheated He I should be considered in the case of a narrow channel. In this study, the visualization experiment result using a transparent heater and the transient temperature measurement data on a copper heater surface had been compared with each other. Several film boiling modes were observed in a narrow two-dimensional channel. The peak of the heat transfer coefficient appeared around the lambda pressure. In the case of low heat flux, the heat transfer coefficient variation with the pressure shows sudden rise around the lambda point. The heat transfer coefficient under nearly saturated pressure condition below lambda pressure is larger than that above the lambda pressure.

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