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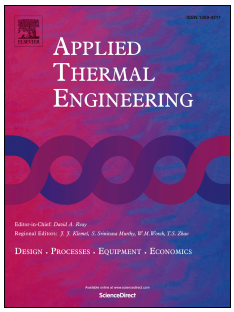

The phase separation in a rectangular microchannel by micro-membrane

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The phase separation in a rectangular microchannel by micro-membrane

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Abstract: A phase separator was formed by populating an enclosed micro-membrane at the microchannel center. When a bubble train in the bare duct interacted with the micro-membrane, a single bubble was separated into two daughter bubbles to flow in the two side regions. The separated bubbles never entered the micro-membrane inside due to the increased surfaced energy. A multiscale numerical scheme using the Volume of Fluid (VOF) method tracked the gas-liquid interface. The results identified that the separator consisted of a phase separating section and a fully phase separation section. Within the separating section, the two side regions contained confined bubble train flow. The liquid plugs were gradually shortened along the flow direction, caused by liquid flowing towards the micro-membrane inside. Liquid circulations were observed within liquid plugs. The gas-liquid could be fully separated. Within the fully phase separation section, gas was flowing in the side regions, with ultra-thin liquid films on solid walls. The separator had the potential to be used as a condenser. The heat transfer enhancement is related to A_r (the bubble project area relative to the bottom surface area) and an averaged liquid film thickness. In contrast to the bare duct section, the fully phase separation section significantly increased A_r and decreased liquid film thicknesses. The heat transfer intensity in the fully separated flow section can be ten times of that in the bare duct section.

Keywords: micro-separator, capillary force, numerical simulation, heat transfer