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A Fundamental Study of the Channel Shape Impact on Microchannel Flow Boiling via Direct Numerical Simulations[1] MIRCO MAGNINI, University of Nottingham, OMAR MATAR, Imperial College London — Microchannel flow boiling is an attractive cooling solution for high-power density electronic devices. The coolant flows in a microevaporator, where many parallel channels are etched on a wafer substrate directly bonded on the surface to be refrigerated. Despite an extensive literature, there is still disagreement about the optimal shape of the channels cross-section which maximises heat transfer. Therefore, we have performed a fundamental study of the impact of the channel shape on the dynamics of elongated bubbles growing in microchannels and the associated heat transfer. We use a customised version of the Volume-Of-Fluid method in OpenFOAM, which includes a non-equilibrium evaporation model. Elongated bubbles are seeded at the upstream of a long microchannel heated with a constant heat flux. Channel aspect-ratios from 1 (square) to 8 (rectangular) are tested. We observe an essential impact of the perimetral distribution of the liquid film surrounding the bubble on the heat transfer patterns. Square channels exhibit higher heat transfer rates at low flow rates, where very thin liquid films are observed; flattened channels yield the best performance at larger flow rates, as they promote the formation of an extended liquid film covering a large fraction of the channel wall.

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