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A mathematically-consistent formulation for evaporation of menisci in microchannels[1] REZA MONAZAMI, HOSSEIN HAJ-HARIRI, University of Virginia — The problem of evaporation from an extended meniscus enclosed in a rectangular microchannel is investigated. A numerical model is developed to study the effect of channel width, wall superheat, as well as the working fluid. The system of differential equations describing fluid flow, heat transfer and thermodynamics can be reduced to a 4th-order ODE for the thickness of the film from its non-evaporating portion to the base of the meniscus. Prior investigations have used ad-hoc boundary conditions–such as doubling of the thickness–in order to kick start evaporation at some arbitrary point of the non-evaporating film. Such approaches result in severe underprediction of evaporative fluxes. In this talk we present a self-consistent mathematical formulation for the boundary conditions, thereby removing all arbitrariness from the solution process. The results for several channel widths and superheats as well different working fluids indicate that evaporative heat fluxes as high as 10MW/m^2 can be achieved. The results are validated using experiments.

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Hossein Haj-Hariri
University of Virginia

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