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Thermocapillary flow contribution to dropwise condensation heat transfer AKSHAY PHADNIS, KONRAD RYKACZEWSKI, Arizona State Univ — With recent developments of durable hydrophobic materials potentially enabling industrial applications of dropwise condensation, accurate modeling of heat transfer during this phase change process is becoming increasingly important. Classical steady state models of dropwise condensation are based on the integration of heat transfer through individual droplets over the entire drop size distribution. These models consider only the conduction heat transfer inside the droplets. However, simple scaling arguments suggest that thermocapillary flows might exist in such droplets. In this work, we used Finite Element heat transfer model to quantify the effect of Marangoni flow on dropwise condensation heat transfer of liquids with a wide range of surface tensions ranging from water to pentane. We confirmed that the Marangoni flow is present for a wide range of droplet sizes, but only has quantifiable effects on heat transfer in drops larger than 10 m. By integrating the single drop heat transfer simulation results with drop size distribution for the cases considered, we demonstrated that Marangoni flow contributes a 10—30% increase in the overall heat transfer coefficient over conduction only model.

Konrad Rykaczewski
Arizona State Univ

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