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Dropwise condensation on soft hydrophobic coatings KONRAD RYKACZEWSKI, AKSHAY PHADNIS, Arizona State Univ, ARIZONA STATE UNIV TEAM — Soft solids such as elastomers can increase droplet nucleation density due to substrate's deformation induced by combined effects of the condensate droplet's surface tension and Laplace pressure. Thus, since nucleation density strongly affects dropwise condensation (DWC) heat transfer, use of soft substrates could potentially enhance efficiency of this industrially important process. Here, we theoretically and experimentally investigate whether such benefits could indeed be attained. Specifically, we experimentally quantified the increase in nucleation density as well as droplet departure diameter as a function of substrate Young's modulus in the range of 75-500 kPa. Next, we combined analytical solutions of the elastomer deformation induced by droplets with finite element modeling of the heat transfer across them. By simulating the effect of Young's modulus of the coating on the heat transfer across the droplet size range relevant to DWC, we demonstrate that thermal resistance added by the condensate due to substrate depression is detrimental. By substituting heat transfer simulation of heat transfer in individual droplets and experimental data on nucleation density and droplet departure into DWC model, we demonstrate that softening of a hydrophobic coating would have detrimental effects on the overall heat transfer during this phase change process.

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