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Liquid Jet Impingement Cooling on Superheated Superhydrophobic Surfaces[1] JACOB BUTTERFIELD, BRIAN IVERSON, DANIEL MAYNES, JULIE CROCKETT, Brigham Young University — Superhydrophobic (SH) surfaces form air cavities between nano- or micro-structures, resulting in self-cleaning properties. This is a potential solution for fouling in cooling applications, but the air cavities also impede heat transfer. Here, water jet impingement heat transfer on surfaces of varying microstructures and wettability is experimentally explored. Silicon wafers with micro-scale posts etched in a square pattern and Teflon-coated are heated to 280C using an epoxied electrical resistance heater. An axisymmetric water jet then impinged normal to and rapidly cooled the surface. High-speed optical and thermal cameras recorded boiling behavior on the surface as well as the transient temperature field beneath the wafer. Spatial and temporal surface boiling was correlated to the temperature changes, and overall local heat transfer coefficients were calculated. The heat diffusion equation was solved and modified to predictively model the heat flux as a function of surface superheat and wettability, jet Reynolds number, and radial distance from the jet. Cavities in the SH surface microstructure allow vapor to escape laterally across the wafer rather than rise directly to the water surface as bubbles, leading to significant heat transfer reduction and delayed cooling times.

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