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High-Speed Imaging of Explosive Droplet Boiling at the Superheat Limit[1] F. ROBERT FERRIS, JIM HERMANSON, University of Washington, ARASH ASADOLLAHI, ASGHAR ESMAEELI, Southern Illinois University Carbondale — The explosive boiling processes of droplets of diethyl ether (1-2 mm in diameter) at the superheat limit were examined both experimentally and computationally. Experimentally, droplet explosion was studied using a heated bubble column to bring the test droplet to the superheat limit. The droplet fluid was diethyl ether (superheat limit 147 C at 1 bar) with immiscible glycerol employed as the heated host fluid. Tests were carried out at pressures between 0.5 and 4 bar absolute. The pressure rise associated with the explosive boiling event was captured using a piezoelectric quartz pressure transducer with a 1 MHz DAQ system. High-speed imaging of the interfacial behavior during explosive boiling was performed using a Phantom v12.1 camera at a frame rate of up to one million frames per second with the droplets illuminated by diffuse back-lighting. The imaging reveals features of the Rayleigh-Taylor instability at the vapor-liquid interface resulting from the unstable boiling process. Computationally, Direct Numerical Simulations are performed at Southern Illinois University Carbondale to compliment the experimental tests.

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