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Leidenfrost Hysteresis with Hydrodynamic Collapse DANA HARVEY, JOSHUA MENDEZ, JUSTIN BURTON, Emory University — The Leidenfrost effect occurs when a heated solid contacts a liquid, and a thin, insulating vapor film forms due to evaporation. The Leidenfrost transition temperature, TL, has a variety of reported values. The effect of hydrophobicity, surface roughness, geometry, and salt concentration are a few variables linked to changes in TL. Here we show how failure occurs when a stable film is cooled well below the temperature at which it was formed. We use an electrical technique with sub-microsecond resolution to measure the thickness of the vapor film under various conditions. Our measurement treats the film as a complex circuit component with measurable impedance. Upon heating, a stable film is formed at an upper critical temperature consistent with recent predictions. Upon cooling, we observe hysteresis. The film can exist near or below the boiling temperature of the liquid, the lower critical temperature, Tc. Failure is characterized by an average thickness and temperature at collapse that does not depend on salt concentration or thermal conductivity for smooth metallic surfaces. Our accompanying numerical simulations suggest that the hydrodynamics of the lubricating vapor film play a dominant role in determining Tc, and depends strongly on the geometry of contact.

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