Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Characterizing the final moments of the Leidenfrost vapor layer[1]

DANA HARVEY, JOSHUA MENDEZ, JUSTIN BURTON, Emory University —

The vapor layer generated between a very hot surface and an evaporating liquid thins as the surface cools down. Eventually, hydrodynamic fluctuations of the liquid will cause the vapor layer to fail, leading to liquid/solid contact and explosive boiling. Using a new electrical technique we can characterize the failure of the vapor layer on sub-microsecond time scales. The vapor layer is treated as a complex circuit component with measurable impedance. A heated titanium electrode is lowered into a bath of salt water. A 10 MHz carrier signal passes through the vapor layer and the liquid so that the capacitive reactance of the system is low. The amplitude of the carrier wave is monitored in time. Using a model circuit for the vapor layer, physical properties of the layer can be determined. Within the first millisecond, a touchdown event occurs where the liquid rapidly wets the solid surface, characterized by a precipitous drop in the resistive part of the impedance. Then, the heat transfer to the liquid causes vaporization and boiling spreads from the point of contact. We expect this technique will also shed light on the sensitive role that salt plays in the Leidenfrost effect, as well as surface properties such as roughness.

[1]NSF DMR-1455086

Dana Harvey
Emory University

Date submitted: 30 Jul 2019 Electronic form version 1.4