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Low-g Demonstrations of Leidenfrost Droplet Impacts with Applications to Non-Contact Fluidics Processing in Space RAWAND RASHEED, MARK WEISLOGEL, Portland State University — Leidenfrost phenomenon has been studied extensively for its role in applications ranging from nuclear reactor cooling, to metals manufacturing, combustion, and other fields. Herein, Leidenfrost phenomenon is exploited as a potential solution to spacecraft water processing challenges by providing a method for non-contact fluid distillation. Leidenfrost investigations have been almost exclusively conducted in terrestrial environments and are in turn largely defined by the ever-presence of gravity. In this work we demonstrate a variety of dynamic Leidenfrost effects for large liquid droplets in the microgravity environment of a 2.1 second drop tower. A scaling model for the impact reveals the ease with which 'non-contact' impacts are achieved at low Weber numbers and low gravity levels. We find the vapor film thicknesses at impact can be millimetric as estimated analytically and confirmed qualitatively via experiments. Dynamic drop impact experiments are extended to a variety of heated substrates including macro-pillar arrays, confined passageways, and others. Leidenfrost droplet evaporation rates and lifetimes are estimated analytically and confirmed qualitatively via experiments for sliding/rolling drops at varying velocities in a terrestrial gravity environment. The empirical and analytical results serve as key design tools for sizing a prototypical non-contact distillation system for terrestrial desalinization or spacecraft water recycling. The potential for contamination-free processing aboard spacecraft is obvious, with further proofs of concept under pursuit.

Rawand Rasheed
Portland State University

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