Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information for:

Length Scale of Leidenfrost Ratchet Switches Dynamic Droplet Directionality

*Rebecca L. Agapov[1], Jonathan B. Boreyko[1,2], Dayrl P. Briggs[1], Bernadeta R. Srijanto[1,3], Scott T. Retterer[1], C. Patrick Collier[1], and Nickolay V. Lavrik[1]**

[1]Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, TN, 37831 (USA)

[2]Bredesen Center for Interdisciplinary Research, University of Tennessee, Knoxville, TN 37996 (USA)

[3]Department of Materials Science and Engineering, University of Tennessee, Knoxville, TN, 37996 (USA)

*To whom correspondence should be addressed: lavriknv@ornl.gov

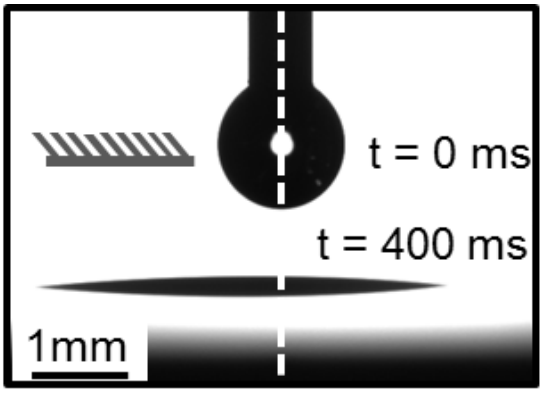

Figure S1. Representative image of asymmetric spreading on the tilted pillar arrays. Spreading of a 1.5 μL droplet of deionized water on TPA-2 (0.2 μm diameter, 1.1 μm tall array of tilted pillars) at the times indicated on the right hand side of the droplet. The tilt of the pillars is to the left, as shown by the schematic in the top left corner.

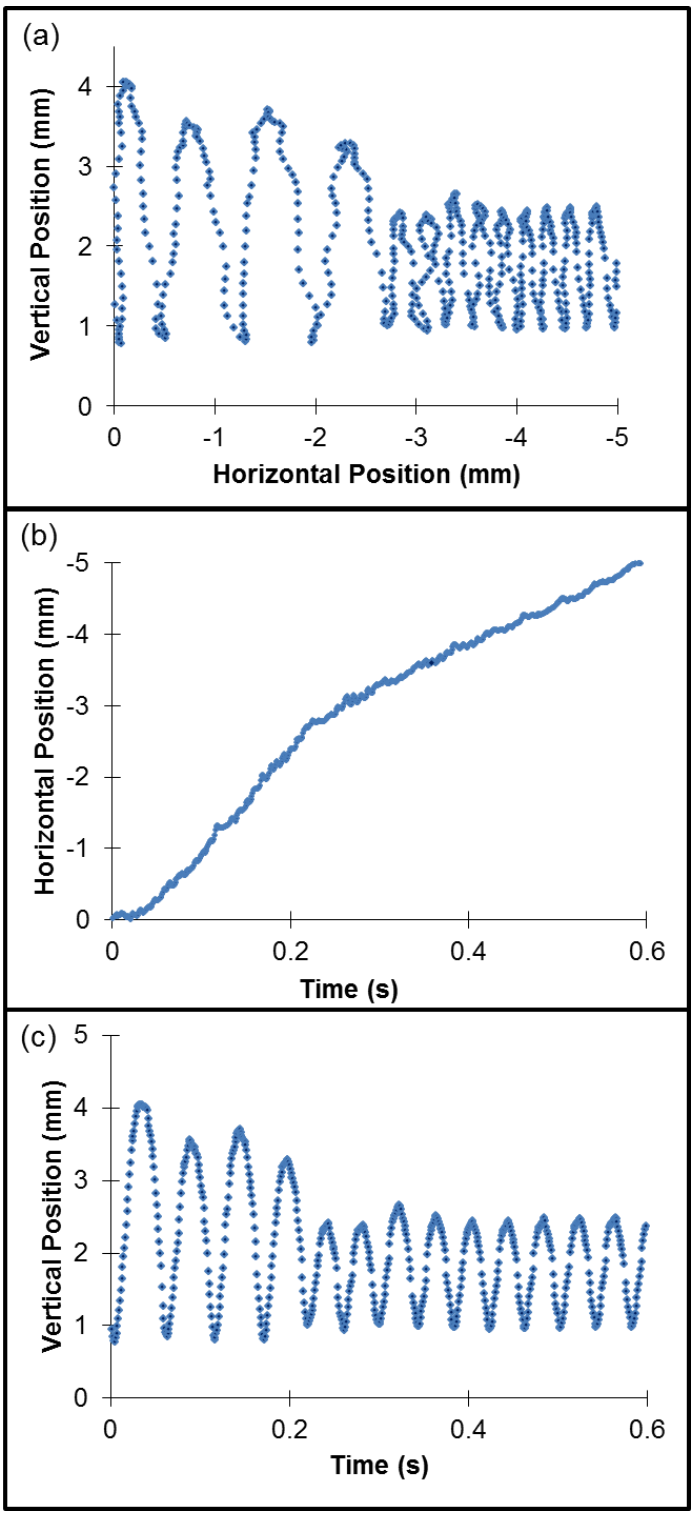

Figure S2. (a) Representative vertical position vs horizontal position map, and the extracted (b) horizontal position vs time and (c) vertical position vs time of a droplet on TPA-1 (0.1 μm diameter x 0.3 μm tall array of tilted pillars). The droplets were released onto the center of the

structured surface (position x = 0 mm). After impact the droplet moved in the same direction as the feature tilt. Each data point corresponds to one frame from a camera recording at 1024 frames per second. The horizontal velocity, calculated as the slope of the horizontal position vs. time plot (b), is initially small. After this initial period, two regions can be observed where the motion is nearly steady state, one region from ~0.01 ms to 0.22 ms and another region from 0.22 ms to 0.6 ms. These two regions correlate well to the transition observed in (a) where the droplet is initially bouncing and losing contact with the surface, but at later times reaches a nearly steady state motion where the droplet deforms but does not lose contact with the surface. In efforts to minimize the differences in velocity observed on shorter time scales due to dissipative forces and droplet interactions with the surface, the average horizontal velocity over the entire 5 mm distance travelled is reported in the text with the emphasis placed on the directionality of the motion.

Video V1. Droplet placed onto a tilted pillar array that contains features that are 100 nm in diameter and 300 nm tall in the transition boiling regime. Droplet directionality is observed with the droplet moving in the direction of the feature tilt, which is to the left in the video. The video has been slowed from 1019 frames per second to 30 frames per second for clarity. The field of view is 14.7 mm x 8.5 mm.

Video V2. Droplet placed onto a tilted pillar array that contains features that are 10 μm diameter and 40 μm tall with the features tilted to the left. The droplet immediately self-propels in the opposite direction of the feature tilt. The video has been slowed from 1019 frames per second to 30 frames per second for clarity. The field of view is 11.4 mm x 8.2 mm.

Video V3. Droplet placed onto a tilted pillar array that contains features that are 1 μm diameter and approximately 2 μm tall with the features tilted to the left. At 375 ºC and *We* of 5, droplets impact the surfaces in the transition boiling regime where interaction with the surface occurs. The droplets either follow the asymmetric wettability mechanism and travel in the same direction as the feature tilt or follow the vapor flow mechanism and travel in the opposite direction of the feature tilt. The video has been slowed from 1019 frames per second to 30 frames per second for clarity. The field of view is 7.7 mm x 8 mm.