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Directional droplet transport at high temperature mediated by structural topography JING LI, City University of Hong Kong, Hong Kong, YOUMIN HOU, The Hong Kong University of Science and Technology, Hong Kong, MANOJ CHAUDHURY, Lehigh University, Bethlehem, SHUHUAI YAO, The Hong Kong University of Science and Technology, Hong Kong, ZUANKAI WANG, City University of Hong Kong, Hong Kong — Controlling droplet dynamics on textured surfaces is of significant importance for a broad range of applications. Despite extensive advances, our ability to control droplet dynamics at high temperature remains limited, in part due to the emergence of complex wetting states complicated by the phase change process at the triple-phase interfaces. When the temperature of the surface is above a critical temperature, a continuous vapor layer separates the droplet from the hot surface, greatly reducing the heat transfer between the droplet and hot surface. In this work, we show that two concurrent wetting states (Leidenfrost and contact boiling) can be manifested in a single droplet by simply manipulating the structural topography. As a result, droplet vectors automatically towards the boiling region that is associated with a large heat transfer efficiency between the liquid and solid. Coupled with a dynamic Leidenfrost model, we show experimentally and analytically that the droplet directional motion depends on the interplay between surface structure and its imposed thermal state. Our basic understanding and ability to control the droplet dynamics at high temperature would find many potential applications in high temperature systems such as spray cooling and fuel injection.

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