CROWN-TO-SPLASH TRANSITION OF IMPINGING HIGH-FREQUENCY ETHANOL DROPLET TRAIN ON HEATED SURFACE

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Impingement of droplets onto a solid surface is ubiquitous in nature. Many efforts have been made to understand the intricate hydraulic, at some point multi-phase, liquid-solid interfacial phenomenon from different perspectives including droplet or droplet train impingement with or without boiling [1,2]. The various impingement patterns such as spreading, splashing, rebound, deposition, crown formation and propagation, levitation, jetting, and so on have been observed. Two distinct transitions of hydrodynamic patterns during the impingement of high-speed and high-frequency continuous ethanol droplet train on a heated titanium surface has been experimentally observed with three boiling regimes, namely, aggregation and crown periphery instability, splashing and stable crown, and stable splashing angle show in Figure 1. The transitions are further proved by the variation of the steady-state but temperature-dependent wetting area. The crown strongly depends on the surface temperature. It is quantitatively characterized by its periphery diameter and height. In the stable splashing angle regime, a sharp shift of the splashing angle from decreasing to increasing is found at the surface temperature of 319 ◦C. It is found that the transition of the normalized splashing angle occurs at a value of a dimensionless factor incorporating the physical properties of the liquid, the hydrodynamic parameters of the droplet and the normalized superheat of the solid surface. The correlation can be employed to suggest the emergence of the Leidenfrost phenomenon for the droplet train impingement systems.

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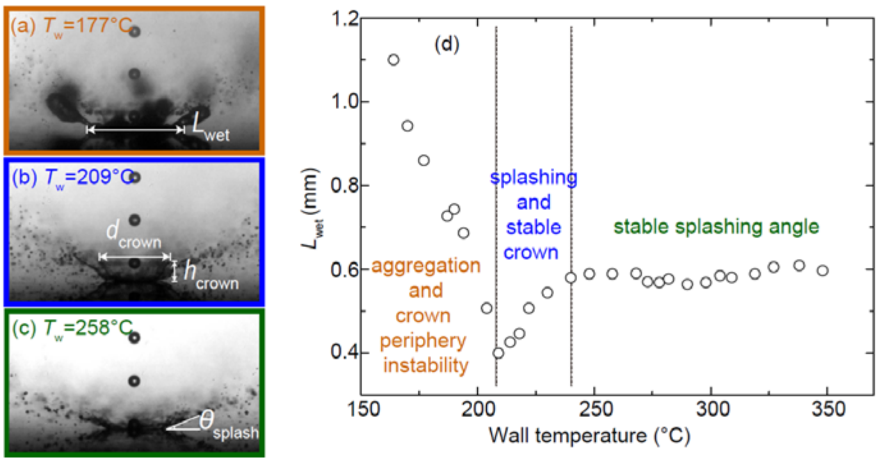

Figure 1 The typical steady-state hydrodynamic patterns for the regime of (a) the wetting length, (b) the stable crown and (c) the splashing angle. (d) shows the wetting length vs the surface temperature.

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