**1. Introduction**

Evaporation of sessile droplets is an ubiquitous natural phenomenon, which holds an important role in a variety of applications, including inkjet printing[1], DNA mapping[2], spray cooling[3], and microparticle detection[4]. Meanwhile, sessile droplet evaporation is a complex phenomenon controlled by several interdependent factors, such as the droplet contact angle and contact radius[5], contact line motion[6-8], substrate structure[9-14], temperature[15-20] and the surrounding environment[21-23]. Since the seminal work of Picknett and Bexon in 1977[24], sessile droplet evaporation on smooth surface has been systematically analyzed, in which droplet evaporation was distinguished into three evaporation modes: (1) the constant contact radius (CCR) mode: the droplet contact line is pinned with constant contact radius while contact angle keeps decreasing. (2) the constant contact angle (CCA) mode: once the contact angle approaches the receding contact angle, the contact line keeps receding droplet with unchanged contact angle; (3) the mixed mode: both the contact radius and contact angle decrease near the end of evaporation. In several recent studies about the droplet evaporation on structured superhydrophobic surfaces, a special stick-slip mode[25] was observed, in which droplet contact line is moved by the pinning and depinning force alternately.

Several theoretical models have been proposed to predict the evaporation rate of sessile droplet. Also in the classical work of Picknett and Bexon[24], the sessile droplet evaporation in room temperature was firstly assumed to be driven by the vapor diffusion by ignoring the heat transfer and convective flow inside/outside the droplet. And the analytic evaporation rate could be obtained based on an analogy between the concentration field and the electrostatic field[26]. In the past two decades, this diffusion-driven model was extensively studied, which has been applied on modeling the evaporation of sessile droplet with the arbitrary contact angle in CCR mode or with slipping contact line in CCA mode. Comparing with the experimental data, the excellent accuracy of predicted evaporation rate confirm the validity of diffusion-driven model of sessile droplet evaporation not only on hydrophilic surfaces [27, 29] but also on hydrophobic surfaces[20] [30].

However, when the model was employed on sessile droplet evaporation the superhydrophobic surfaces with microstructure[31], especially on heated superhydrophobic surfaces, an overestimation of evaporation rate was observed by Garimalla and Aldhaleai[32] [33]. This deviation of the predicted evaporation rate should be the results of the evaporative cooling giving rise to a temperature reduction on the liquid-vapor interface, which is contradict with the pivotal assumption in classical diffusion-driven model that the temperature of the droplet surface is constant and same as the substrate temperature[]. For instance, the maximum temperature mismatch ~ 25 °C between the droplet surface and the substrates was theoretically predicted when the substrate was heated at 60 °C. Furthermore, the availability of diffusion-driven model might become worse when the different wetting states of droplet on micro-structured surfaces, i.e., Cassie state and Wenzel state are considered. For a sessile droplet evaporates in Cassie state, the existence of the air/vapor cavities between the droplet base and the microstructure would lead to two different components of droplet evaporation, *i.e.*, from the liquid-vapor interface at (1) droplet cap and (2) the droplet base. However, the effect of this extra evaporative interface from the droplet base on sessile droplet evaporation on superhydrophobic surfaces was generally ignored in the majority previous works []. Indeed, in recent works of Wang and Kim [16, 49, 50], the non-negligible evaporation flux through vapor-liquid interface over the cavity has been experimentally confirmed on heated superhydrophobic surfaces, whereas these works are mainly focusing on the wetting or dynamics of evaporating droplet. Therefore, a systematic study about droplet evaporation on heated superhydrophobic surfaces by considering the comprehensive effect of multiple and discontinuous liquid-vapor interfaces at droplet base and droplet vapor is desired.

In this paper, the evaporation of water droplet on hot micro-structured superhydrophobic substrates is experimentally and theoretically investigate. The water droplets with volume of are placed on the superhydrophobic substrate heated at 40 °C , 60, and 80 °C, respectively. The droplet is evaporated in Cassie state during the majority of evaporation time and transited into the Wenzel state at the very end of the evaporation. Based on a comprehensive thermal resistance analysis, a thermal circuit model has been developed to predict the droplet cap surface temperature and to calculate the evaporation rate from the droplet cap surface and the droplet base surface. An evaporation ratio 𝜑 defined as the ratio of evaporation rate from the droplet base surface and the total evaporation rate is analyzed in CCR mode and CCA modes respectively. And we found

Then the substrate is further heated from 80 °C to 120 °C until when a small rise of the substrate temperature will lead to the boiling of the droplet. Deviation between the experimental measured droplet surface temperature and the predicted surface temperature is observed for droplet evaporation at such high temperature substrates because of the internal fluid motion of the water droplet. An effective thermal conductivity is employed as a correction factor for the thermal circuit model to consider the effect of convection heat transfer in the water droplet. The average temperature of the droplet base surface is calculated to explain the delay of the onset of boiling of water droplet on the thin substrate with base temperature higher than 100 °C. This experimental and theoretical study of water droplet evaporation on hot micro-structured superhydrophobic substrates could improve diffusion driven model for droplet evaporation on hot microstructured superhydrophobic surfaces and provide us a potential way to control the sessile droplet evaporation on non-wetting surfaces.

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