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Dynamic behavior of single droplet impacting on heptane pool with different depths

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ABSTRACT

The paper presents dynamic behavior of single droplet impinging on the heptane pool with various impact Weber number and liquid depths. Liquid depth and Weber number have significant effects on the droplet impact behaviors. Three typical impact regimes, including penetration-secondary penetration/floating, crater-jet/crater-jet-secondary jet and bubble, can be observed in the impact process. The penetration occurs only for low Weber number. Especially, penetration-second penetration appears in a shallow pool for the dimensionless heptane depth of no more than 3.6, while penetration-floating does for the dimensionless heptane depth of no less than 5.4. With an increase in Weber number from 175 to 440, crater-jet appears in shallow pool while crater-jet-secondary jet appears in deep pool, and bubble begins to form as Weber number exceeds 564. Moreover, in order to quantitatively analyze the kinetic behavior, some key parameters were discussed in detail, such as maximum crater depth, width, and jet height, bubble life time, loss rate of impact velocity, etc.

Keywords: drop impact, Weber number, penetration, secondary jet, bubble life time

Nomenclature

d	heptane depth	δ	dimensionless heptane depth
D	diameter	ρ	droplet density
E	energy	σ	droplet surface tension
g	gravitational acceleration	Subscripts	
H	height	depth	maximum crater depth
M	quality	width	maximum crater width
v	theoretical value of impact velocity	jet	liquid column
v_0	measured value of impact velocity	total	total energy
We	impact Weber number	d	droplet
Greek symbols		x	horizontal
α	loss rate of impact velocity	y	vertical
β	ratio of jet energy and total energy		

1. Introduction

Droplet collisions on solid or liquid surfaces have been focused in a number of practical applications [1-15], such as spray cooling [16-20], electronic packaging [21],

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