# Impingement, coalescence and mixing of micro-droplets on a solid surface

Guina Yi[1], Ziqi Cai[2], Zhengming Gao[2], and Jos Derksen[3]

[1]Beijing University of Chemical Technology
[2]Affiliation not available
[3]University of Aberdeen

May 22, 2021

**Abstract**

The coalescence of an impinging droplet colliding with a sessile droplet at an angle($\vartheta$i) is investigated by numerical simulation. The range of $\vartheta$i is 0° - 60° and the surface wettability are set as hydrophilic or hydrophobic, and both of them can affect the droplet mergence behavior. By using a modified mixing function, the dimensionless total mixing time $\tau$m can be calculated. The results show that there is no clear effect of $\vartheta$i on $\tau$m on a hydrophobic surface, while $\tau$m increases as $\vartheta$i increases on the hydrophilic surface. With the Weber number(We) ranging from 5.65 to 22.7 and the Ohnesorge number(Oh) ranging from 0.136 to 0.214, we find $\tau$m hardly changes with We and Oh. By dividing the mergence and mixing process in a convection and a diffusion stage, we find that the diffusion is much larger than the convection time.

**Hosted file**

`DoubleDropletsManuscript20210507_FinalVersion_plaintxt.docx` available at https://authorea.com/users/415190/articles/523091-impingement-coalescence-and-mixing-of-micro-droplets-on-a-solid-surface

Table 1. Parameters settings in MDPD simulations

| description | MDPD units | Physical units |
|---|---|---|
| Radius, $R_c$ | 14 | 18.5 $\mu m$ |
| density, $\rho$ | 6.09 | 1056 $kg/m^3$ |
| Surface tension, $\sigma$ | 7.51 | 56.5 $mN/m$ |
| dynamic viscosity, $\mu$ | 4.872 | 0.0064 $Pas$ |
| | 7.649 | 0.01 Pas |
| static contact angle, $\theta_c$ | 45 °,124 ° | |
| impinging angle $\theta_i$. | 0 °, 30 °, 45 °, 60 ° | |
| Weber number, $We = \frac{2\rho U_0^2 R_c}{\sigma}$ | 5.68, 22.7 | |
| Ohnesorge number, $Oh = \frac{\mu}{\sqrt{2\rho R_c \sigma}}$ | 0.136, 0.214 | |